“Strategic Planning and Mitigation of Risks in the Construction of Real Estate in Peru”

Master thesis

International Master of Science in Construction and Real Estate Management

Joint Study Program of Metropolia UAS and HTW Berlin

Submitted on 03.09.2018 from

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University of Applied Sciences

International Master of Science in Construction and Real Estate Management
Joint Study Programme of Metropolia Helsinki and HTW Berlin

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Specifications for the Master Examination
according to § 9 and 10 Examination Regulations for the Master Study Programme
Construction and Real Estate Management

1. Master Thesis, Examination Commission

(1) Topic of the Master Thesis
Proposal of strategic planning and mitigation of risks in the construction of real estate in Germany

(2) Examination Commission
Chairperson Prof. Dr. Dieter Bunte
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(3) Thesis Period
Date of Issue 13. DEZ. 2017 20 weeks
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Berlin, 13. DEZ. 2017
Signature of the Chairperson of the Examination Board

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INTERNATIONAL MASTER OF SCIENCE IN CONSTRUCTION AND REAL ESTATE MANAGEMENT

CONCEPTUAL FORMULATION FOR MASTER THESIS

TITLE:

"PROPOSAL OF STRATEGIC PLANNING AND MITIGATION OF RISKS IN THE CONSTRUCTION OF REAL ESTATE IN GERMANY"

WRITING BY:

MARGARITA DEL CARMEN SOTELO CABRERA

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BACKGROUND

The current construction market, is generating in companies to be more competitive between them, especially if they want the award of the tender, which means, they must offer their best cost budget and schedule for the project being bid.

Nevertheless, bidding department of companies in their desire to reduce and optimize the project estimation in cost and time, they like to use ratios of productivity very high, assumptions of ideals conditions for quantity materials waste, use of standard ratios to quantify materials when the project does not have engineering detailed and typical construction process which in some occasions are not possible to follow due the constrains of the land and others. In addition to this, the errors by omission of information coming from the client, human errors because the lack of time to review in carefully way the project in study will increment the cost budget and schedule time which the tender have offered during the contest.

Consequently, problems will appear in construction part if the project is awarded to the company because the offer does not show the real cost and time for execute the project. Therefore, construction company area, before starting work execution, should review carefully the awarded offer and detect the possible risks which have being transferred by the offer. It is very important for companies make matches between different specialties drawings in order to find clashes and additional works which were not included during the offer, omission, but there are part from the contract project scope. Risks will impact according to the type of contract that the offer is. For example, risks will impact strongly for lump sum contracts than unit prices contracts concern about final profitableness expected.

Secondly, construction area supported by management area must work in the project management plan for construction in extent version, which must contain how to manage issues as cost, time, resources, risks and procurement of the project. Hence, have an accurate management plan to follow and detect main risks before start planning the construction part in detail, are some methods which help to reduce negative impacts above the profit of the project.

On the other hand, it is worthless to have excellent strategic and management plan but not efficient procedures for monitoring and controlling the project. This issue must be included in the project

management plan for each topic such as cost, time, resources and etc. Should be clear, what type of tools or performance indexes will be used to control the project.

RESEARCH QUESTIONS AND OBJECTIVES

Objectives:

- Analysis of risks transferred by the bidding process into construction process. Cost impacts.
- Strategic planning to improve the productivity in construction process and resources optimization as an answered plan to mitigate risks transferred by the offer.
- Analysis of risks in construction stage in order to minimize negative impacts and optimize which can increase the profitability of the project.
- Contract Administration. Cause-effect of risks according to the type of project contract.

Research Questions:

- What is the purpose of having a strategic plan and why it is important in the field of construction?
- How do the risks transferred by the offer affect the profitability of the project according to the type of contract?
- Which types of risks affect the final profitability in a project?
- How these risks could affect the cash-flow tendency in a project?
- What is the basic Strategic Plan that a project must have to avoid or minimize negative impacts in its final profitability?
- Which kind BIM tools can be used for proper strategic planning and risk mitigation for those which impact in cost and time in a real estate project?
- What types of current software, tools and performance indicators could be suggested for monitoring and controlling purpose in order to improve the productivity on the construction process in a project?

METHODOLOGY

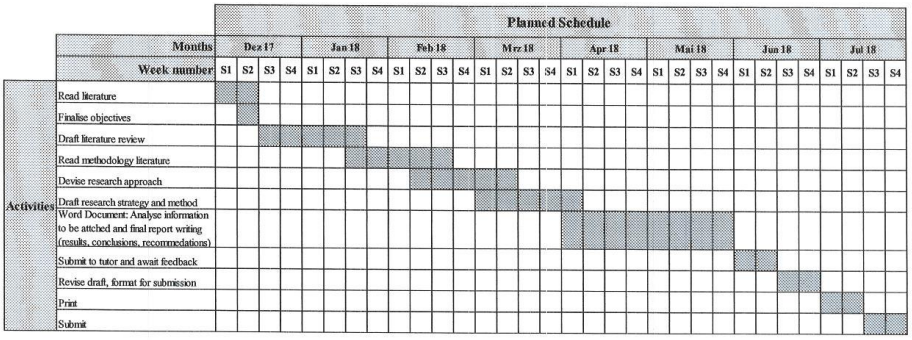
Design Step:

1. Research and draft literature review of strategic planning management, risk management and BIM methodology.
2. Research, analyze and suggest a handle software to make compatibilization of the different specialties drawing plans of the project, during the bidding process.
3. First Part of Risks Management (Risks coming from the offer): Identify, analysis and answered plan for risks which are being transferred by the offer.
4. Literature of contract administration management: study conditions, regulations, standards of type of contract in Germany. Analysis of risks impacts according to the type of contracts in which the project is ruled. Additional and deductive works procedure.
5. Elaborate a basic strategic plan management for construction process. For develop this step, it will be used as support; concepts, technique and tools which are related to Management Philosophy as BIM concepts, guide lines of PMBOK and Lean Construction in order to improve the productivity such as part of the risks response plan.
6. Second Part of Risks Management (Risks which could be happen during the construction stage which can affect directly to the productivity, time and cost of the project).
7. Elaborate a basic plan for Monitoring and Controlling (Risks, Progress, Productivity, Cost, and Time). Suggest a Software, indicator of performance, tools which can be used for this purpose in a project.

Data Collecting Step

1. Research historical data from companies which have been working in construction sector for years. It is possible in this step, use internet tools, books, and existing case studies or make interviews in companies to collect the information.
2. Collecting data information from government (historical reports) which it is allowed to use and data coming from own work experience before in real estate construction projects.

TI ME SCALE



RESOURCES

Although I will use my own resources, I have access to computer hardware, software and internet. Besides, probably the government allows to use historical data for educational and research purposes. In the meantime, my previous employer is agreed to share the information.

REFERENCES

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5. Information Data from Sucre Multifamily Building Project – Miraflores – Lima Perú

Supervisor's Signature
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For the
Chairperson of the Examination Board

of the **Programme** CaREM
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08. AUG. 2018
Received by faculty

REQUEST TO CHANGE THE TITLE OF THE FINAL THESIS

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I wish to request for the following change to the title of my thesis.

Previous title:
Proposal of Strategic Planning And Mitigation of Risks in the Construction of Real Estate in Germany

New title to be confirmed:
Strategic Planning And Mitigation of Risks in the Construction of Real Estate in Peru

Please note that changing the title of the final thesis does not constitute a rejection of the topic as defined by § 21, no. 2 of HTW's Examination Framework Regulations!

Agreement of the 1st examiner: Bunte

Agreement of the 2nd examiner: _____

Agreement of the examination board: i.V. Bunte

Berlin, 08.08.2018

Signature of the candidate

Abstract

This master thesis work is done as a research project at the Construction & Real Estate Management Master Program of the HTW Berlin in collaboration with Metropolia UAS.

This research study how is the Risk Management in Real Estate Companies in Peru, identifying the main factors which are affecting the good performance in a project. The purpose is to determine what are the main risks and the consequence of their impacts.

This master thesis is structured into four principal segments; the first segment is a literature review conducted on the Risk Management relevant information, PMP and Lean Construction philosophy. The second segment is the analysis of an existing case-study and developing two cases studies from two projects of two different companies, and two interviews regarding these topics to get valuable information from risk management in construction companies. The third segment belongs to Results, Mitigation Risks Strategies and Basic Strategic Plan for small-medium sized companies. The last segment of this study are the Results & Mitigation Risks Strategies, and Conclusion & Suggestions.

Implementing a basic Management System in companies and projects can reduce hazards, achieve cost savings and have better time productivity. Furthermore, projects can have a positive result in their final profit or obtain a surplus following the methodology of Lean Construction and Project Management philosophy.

This study of these two real estate projects in Peru indicates that a basic management system which includes risk management could enhance the efficiency of the project and reduce the possible negative risks impacts at the final profit.

Keywords: Profit, Risk Management, Lean Construction-Last Planer, PMP Philosophy, Strategic Planning, tools Implementation of the management system.

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List of Abbreviations

MEF	Ministry of Economy and Finance
MEP	Mechanic, electricity and plumbing
GDP	Gross domestic product
IGV	Impuesto General a las Ventas (General Sales Taxes)
INEI	Instituto Nacional de Estadística e Informática
WBS	Work Breakdown Structure
RCI	Reporte de Cantidades Instaladas (Report of Installed Quantities)
EV	Earned Value
AC	Actual Value
PV	Planned Value
PPC	Porcentaje de plan cumplido (Percentage of the plan accomplished)

1.0 INTRODUCCION

1.1 BACKGROUND

The current construction market is generating in companies to be more competition between them, especially if they want the award of the tender, which means, they must offer their best cost budget and schedule for the project being bid.

Nevertheless, bidding department in its desire to reduce the project cost estimation, it like to use ratios of productivity very high, assumptions of ideals conditions for materials waste, standard rates to quantify materials when the project does not have engineering detailed.

Additionally, the errors by the omission of information coming from the client, human mistakes because the lack of time to review it in carefully way the future project, changes or modifications in last moment by the client, will increment the cost budget and the scheduled time offered during the contest. These risks will impact according to the type of contract that the offer is. For example, risks will affect strongly on the final profitableness expected in lump sum contracts than unit prices contracts.

Consequently, these risks will be transferred to the construction phase, affecting the budgeting and schedule of a project. Therefore, the project situation will be worst if it does not have a strategic planning plan well done developed, which help to avoid or minimize risks could be generated in construction phase; for example, material delay.

The strategic planning plan must be a guideline to manage issues as cost, time, resources, risks, procurement to reduce adverse impacts above the profit of the project.

1.2 SCOPE OF RESEARCH

The current research is referred to Real Estate Business, in the studies fields of Risks Management & Strategic Planning during the construction phase of a project and also consider the risks may be transferred from the offer awarded to the construction phase.

The construction field is a primary user of the project risk management concepts and tools, due to risks is not managing the inappropriate way in most companies, thus as consequences, the project has weak performance. Management concepts suggest

that companies must include a study of risk which comprehends threats and opportunities in all their projects. So is necessary to elaborate an accurate risk plan which must be incorporated in the project from the offer till the construction phase and this plan must be understandable and practiced by all stakeholders in all projects.

On the other hand, the project needs proper strategic planning, which must go in parallel with the risk management plan. The strategy is the base of any project to achieve success, without strategy the project has no direction. Futures project managers, cannot always look in the short term; is essential look beyond. Therefore, a strategic plan helps to establish objectives and methodologies to fulfill them.

Finally, Risk Management Plan and Strategic Planning Plan will be based on the theoretical background of Lean Construction Philosophy (orientated in Construction Phase) in combination with Project Management Philosophy (PMBOCK 5TH Edition). Nevertheless, slight BIM tools of literature will be named to identify and analyze risks which are transferred from the offer to the construction phase. Data numbers and information related to the practical part will be based on real cases studies.

1.3 RATIONALE FOR RESEARCH

Studies in Real Estate business in several countries, indicate there are primary factors which affect the excellent performance in a project strongly; these are conforming by:

- Poor procurement law guidelines that drive public bodies to get the cheapest bidder
- Failed attempts at employing digital solutions
- Poor administrative structure/poorly defined responsibilities
- Inadequate planning and preparation
- A poor risk management plan
- Legal Framework for Time and Cost Overruns
- Contractor Claims
- Claiming Time and Cost Reimbursements
- Inadequate Safety Programs on Projects.

From those factors, inadequate planning and inadequate risk management plan represent 60% of the causes of a project does not achieve the success.

The primary stakeholder in a project is the company and recognizing the guidelines of project risk in construction companies is an elemental step in assessing the level to which strategies reflect theory.

As we mention in the scope of research, the use and elaboration of cases studies; as semi-structured interviews and collecting real data from Peruvians construction organizations, will allow focus in a better way, on the determination of the exact problem. Some construction companies do not have a standard definition of a risk, and they believe that risk means a threat when some risks are opportunities for a project. However, another companies manage these opportunities and can link between threats and opportunities, but, this risk answer like to be a more the action of experience than a risk management framework.

On the other hand, extra time and cost overruns are the usual problems in the construction of real estate especially when it comes from small and medium-size companies.

1.4 RESEARCH GOALS AND QUESTIONS

1.4.1 OBJECTIVES

- Analysis of risks transferred by the offer and during the construction process. Cost Impacts.
- Strategic planning and Risks Plan to improve the productivity in the construction process, optimization of resources, minimize adverse impacts and approach risks which can increase the profitability of the project.
- Basic Contract Administration. Cause-effect of risks according to the type of project contract.

1.4.2 RESEARCH QUESTIONS

- Which kinds of risks affect the profitability of a project?
- How could these risks affect the cash-flow tendency and the final profitability of a project?
- What is the necessary Strategic Plan and Risk Answering Plan that a project must have to avoid or minimize adverse impacts on its final profitability?

2.0 METHODOLOGY

This chapter will explain how the thesis will be structured. This thesis is divided into the following chapters:

1. **Introduction:** In this chapter will be described the current problem which is affecting construction companies in the field related to Risk Management. Will be established the possible factors could affect the success or correct developing of the project.

   On the other hand, the scope of the project will establish the boundaries of the thesis. Moreover, will be mentioned the objectives as well as the primary research questions. This answers will be known later in results chapter.

2. **Literature Review:** This step will make a review of previous work and theory fundaments relating the research problem in order to define, explain and justify the main factors that are involved in the problematic and therefore, to develop possible solutions for research question in this study. Topics as Risk Management, Strategic Planning, Lean Construction and light literature of software to analyze the risks transferred from the offer to the construction site.

3. **Method of Research**: This section could be considered the most critical part of the thesis. This chapter will explain how the data will be collected, how will be this data analyzed, processed and ordered into a data bank. Then, an explanation of methodological problems and their solutions.

How will be data analyzed, processed and treatment?

In this study, there is two type of data, the first one which comes from existing case studies and the data which belongs to Real Estate Peruvian companies.

Analysis 1: Will be studied the existing case study, from their background to their current conditions, determining the main factors which originate risks and what the author suggest to treat that risks.

Analysis 2, Real Estate Peruvian companies Data, Identification and Analysis of main risks, which factors are the leading causes and what are the consequences of these impacts on the project. This information will be processed and compared.

Comparison: Is the output of both analysis 1 and 2, the identification of similarities and differences.

Treatment-Solutions: if statistically, these factors are similar in 90%, the technique used by the article's author will be employed to solve the current problems in Peruvian constructions companies.

4. **Results and Evaluation:** This chapter will discuss the consequences of the methodology used on the data proceeded and will determine if the method is chosen to fulfill the goals of this report.
5. **Conclusion:** This step will summarize the results of the real cases studies and also the questions as If the problematic of research has been solved? Have the objectives been fulfilled? What are the lessons learned from the results?

As a matter of illustration, below is attached a general flow diagram of the current research methodology:

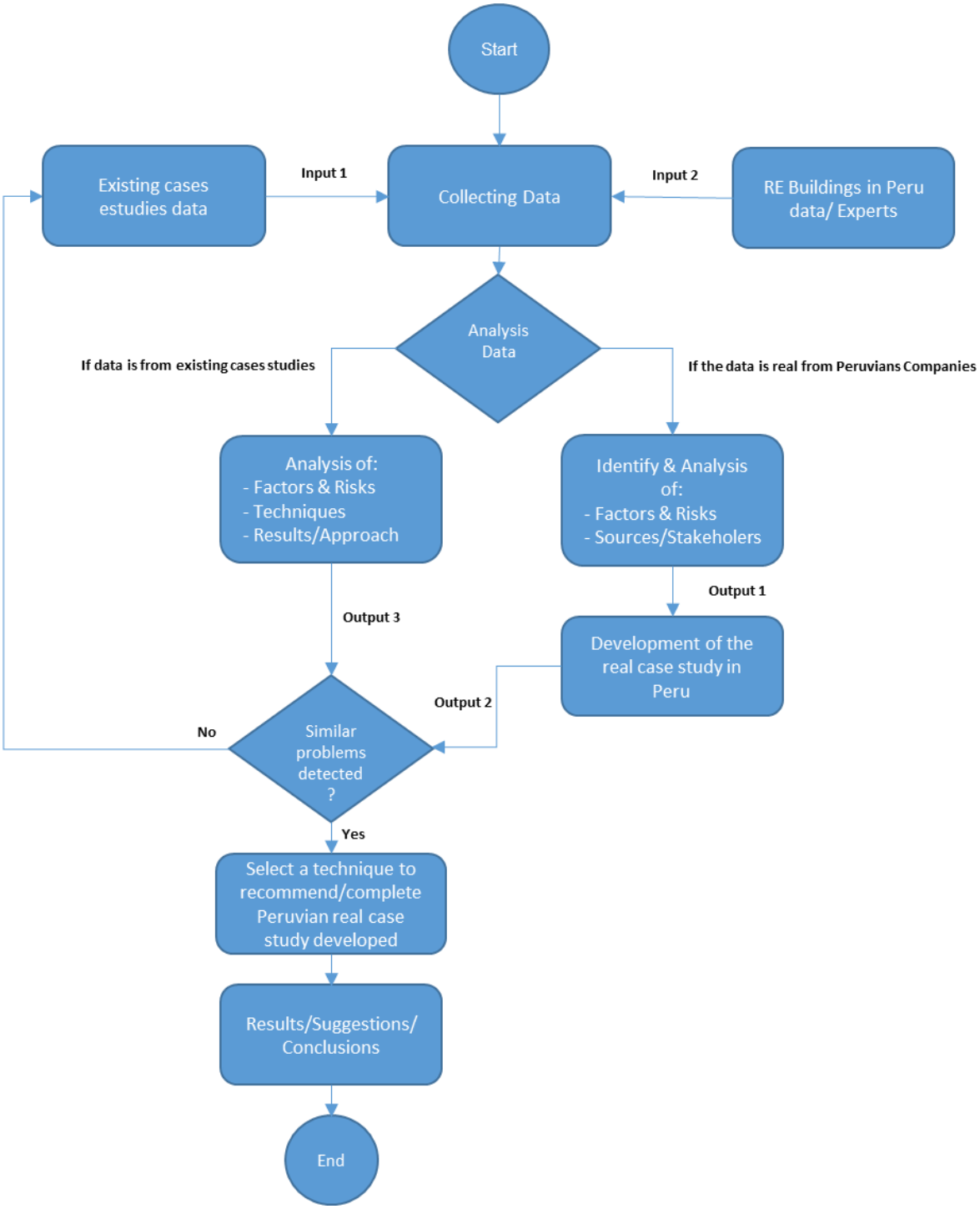


Figure 1: *Flow Diagram of Research Methodology*[1]

[1] (Sotelo, 2018)

3.0 THEORIC LITERATURE BACKGROUND

3.1 RISK MANAGEMENT

The Project Risk Management includes the processes to carry out the risk management planning, as well as the identification, analysis, response planning and control of the risks of a project. The purpose of project risk management consists of increasing the probability and impact of positive events and decreasing the probability and impact of adverse events in the project[2].

3.1.1 What is a Risk?

A standard definition of risk is an uncertain event that if it occurs, can have a positive or negative effect on a project's goals, such as scope, time and cost. The potential for a risk to have a positive or negative effect is an important concept because it is natural to fall into the trap of thinking that risks have inherently adverse effects. If the project team is also open to those risks that create positive opportunities, the project can be a smarter project, streamlined and more profitable: "Accept the inevitable and turn it to your advantage."

Likelihood – the probability of an event is occurring, and consequence – the impact or outcome of an event, are the two components that characterize the magnitude of the risk.

3.1.2 Risk Management Methodology

Risk Management exists a systematic process which is called "Systematic Risk Management Process". This methodology consists of six necessary steps which will help to know how to deal with the risks, generating a positive experience for everyone involved and make the project more profitable.

These six steps according to PMBOK philosophy are:

1. **Plan Risk Management:** Is the process of determining how to accomplish the risk management activities of a project. This process should start in the developing phase of the project, and it must be completed in the project.

The below graphics explain what the necessary input or information which is needed to elaborate the Risk Plan Management is. This information will be analyzed and

[2] (Project Management Institute, Inc. , 2017)

processed by three types of tools, the result of this interaction is called “Risk Management Plan.”

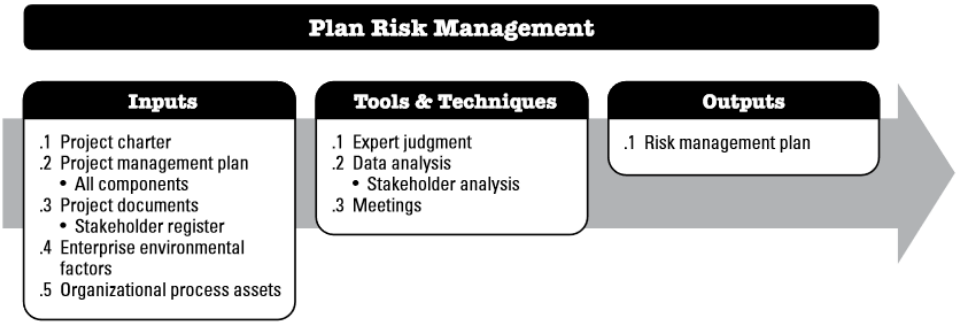


Figure 2: *Plan Risk Management Inputs, Tools & techniques, Output*[3]

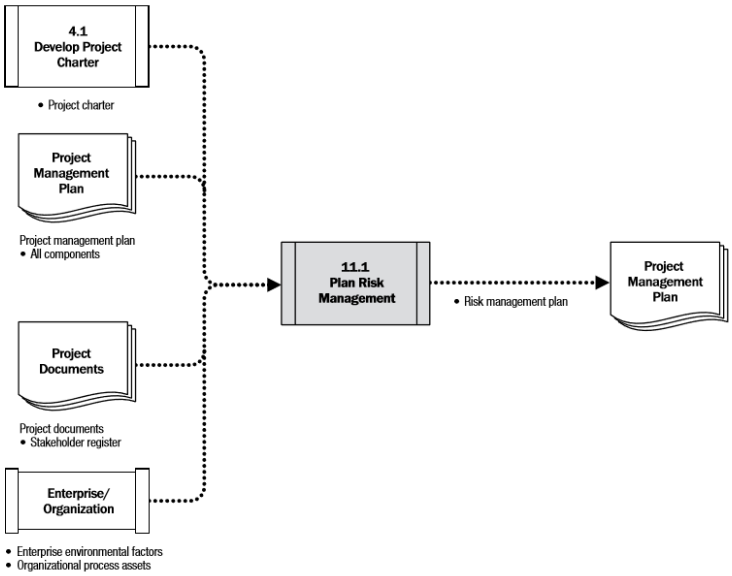


Figure 3: *Plan Risk Management - Data Flow*[4]

“The risk management plan should include these necessary components:

- **Risk strategy:** Describe how risk management will be managed.
- **Methodology:** It establishes what will be the concepts, tools and the necessary information to carry out the management of the risks in the project.
- **Roles and responsibilities:** Assign the functions to each member of the project team about lead, support and risk management for each activity that is stipulated in the risk plan. Explain the specific responsibilities.

[3] (Project Management Institute, Inc. , 2017)
[4] (Project Management Institute, Inc. , 2017)

- **Funding:** Determine and assign the necessary budget to develop the risk management plan. Establish protocols for the application of contingency and management reserves.
- **Timing:** It indicates when and how often the risk management processes will be carried out during the life cycle of the project, and also determines risk management activities that should be included in the project schedule.
- **Risk categories:** Determines the structure of risks breakdown (RBS), which establishes a hierarchy of possible sources of risk.
- **Stakeholder risk appetite:** The risk appetites of key stakeholders on the project are recorded in the risk management plan, as they inform the details of the Plan Risk Management process. In particular, stakeholder risk appetite should be expressed as measurable risk thresholds around each project objective. These thresholds will determine the acceptable level of overall project risk exposure, and they are also used to inform the definitions of probability and impacts to be used when assessing and prioritizing individual project risks.
- **Definitions of risk probability and impacts:** They are specific to the project context and reflect the risk appetite and thresholds of the organization and key stakeholders. The project may generate specific definitions of probability and impact levels, or it may start with general definitions provided by the organization. The number of levels reflects the degree of detail required for the Project Risk Management process"[5].

[5] (Project Management Institute, Inc. , 2017)

RBS LEVEL 0	RBS LEVEL 1	RBS LEVEL 2
0. ALL SOURCES OF PROJECT RISK	1. TECHNICAL RISK	1.1 Scope definition
		1.2 Requirements definition
		1.3 Estimates, assumptions, and constraints
		1.4 Technical processes
		1.5 Technology
		1.6 Technical interfaces
		Etc.
	2. MANAGEMENT RISK	2.1 Project management
		2.2 Program/portfolio management
		2.3 Operations management
		2.4 Organization
		2.5 Resourcing
		2.6 Communication
		Etc.
	3. COMMERCIAL RISK	3.1 Contractual terms and conditions
		3.2 Internal procurement
		3.3 Suppliers and vendors
		3.4 Subcontracts
		3.5 Client/customer stability
		3.6 Partnerships and joint ventures
		Etc.
	4. EXTERNAL RISK	4.1 Legislation
		4.2 Exchange rates
		4.3 Site/facilities
		4.4 Environmental/weather
		4.5 Competition
		4.6 Regulatory
		Etc.

***Figure 4**: Sample of Risk Breakdown Structure (RBS)*[6]

SCALE	PROBABILITY	+/− IMPACT ON PROJECT OBJECTIVES		
		TIME	COST	QUALITY
Very High	>70%	>6 months	>$5M	Very significant impact on overall functionality
High	51-70%	3-6 months	$1M-$5M	Significant impact on overall functionality
Medium	31-50%	1-3 months	$501K-$1M	Some impact in key functional areas
Low	11-30%	1-4 weeks	$100K-$500K	Minor impact on overall functionality
Very Low	1-10%	1 week	<$100K	Minor impact on secondary functions
Nil	<1%	No change	No change	No change in functionality

***Table 1**: Example of Definitions for Probability and Impacts*[7]

The table above is an example of probability and impacts against the three main project objectives. These levels can be used to analyze threats and opportunities by understanding the negative impact as threats (Example: delay, additional cost, and

[6] (Project Management Institute, Inc. , 2017)
[7] (Project Management Institute, Inc. , 2017)

performance shortfall) and positive for opportunities (saving time or cost, and performance enhancement).

- **"Probability and impact matrix:** The opportunities and threats are represented in a standard probability and impact matrix using positive definitions of impact for opportunities and negative impact definitions for threats. Could be used with levels (high, medium, low), or numeric values for probability and impact. Where numeric values are used, these can be multiplied to give a probability-impact score for each risk, which allows the relative priority of individual risks to be evaluated within each priority level.

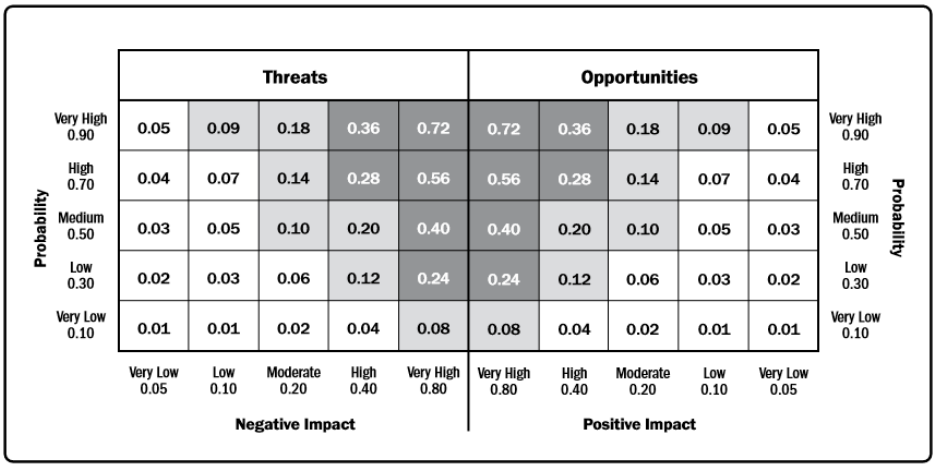


Figure 5: *Example Probability and Impact Matrix with Scoring Scheme*[8]

- **Reporting formats:** determine how the results of the Project Risk Management process will be documented, analyzed and communicated. They describe the information and the context of the risk register and the risk report, as well as any other required outputs from the Project Risk Management processes.
- **Tracking.** Tracking documents where the risks will be recorded and how the risk management processes will be audited"[9].

2. Identify the Risks: Belongs to the identification and sources of the risks, that could affect the project. After the identification of risks, it is elaborated the Project Risk Register.

[8] (Project Management Institute, Inc. , 2017)
[9] (Project Management Institute, Inc. , 2017)

The below graphics explain what the necessary input or information which is needed to identify the risk is. This information will be analyzed and processed by six types of tools, the result of this interaction will be: “Risk register,” “Risk report” and “Project documents updates.”

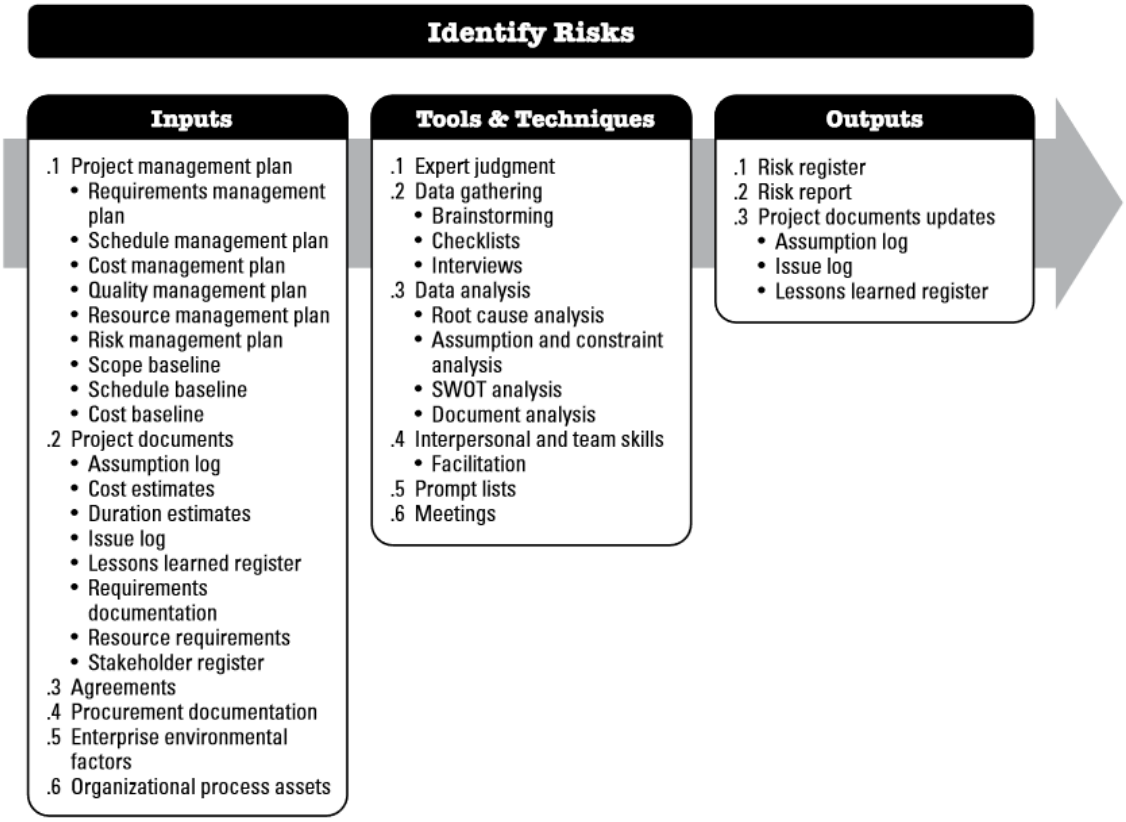


Figure 6: *Identify Risks: Inputs, Tools & Techniques, and Outputs*[10]

[10] (Project Management Institute, Inc. , 2017)

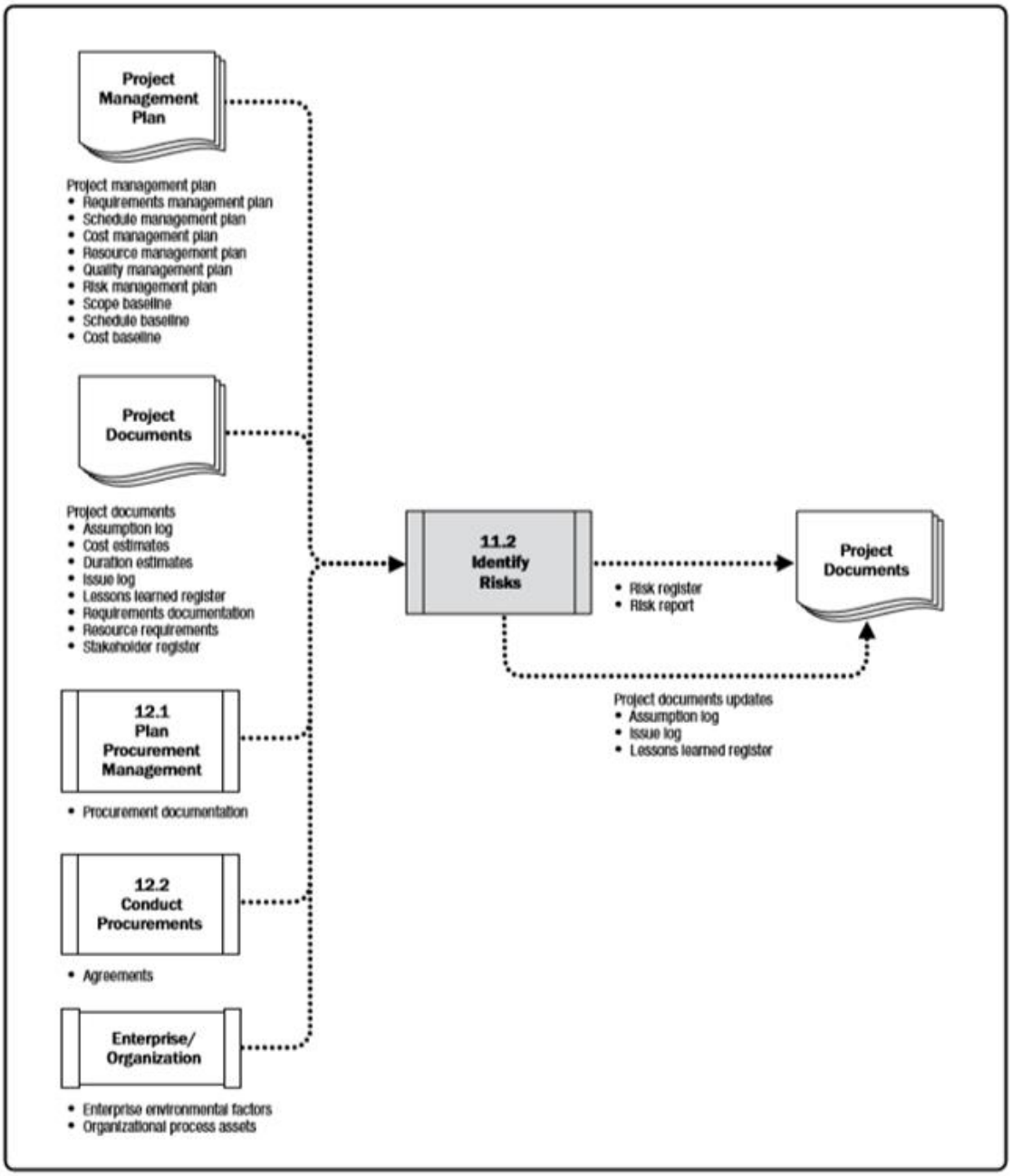


Figure 7: *Identify Risks: Data Flow Diagram*[11]

The process of identification of risks has three elements[12]:

- **Risk Register:** The risk register explains in detail the identified project risks. The outcomes of Perform Qualitative Risk Analysis, Plan Risk Responses, Implement Risk Responses, and Monitor Risks are documented in the risk register as those strategies are driven throughout the project.

[11] (Project Management Institute, Inc. , 2017)
[12] (Project Management Institute, Inc. , 2017)

The risk register must include List of identified risks, potential risk owners and a list of potential risk responses.

- **Risk Report:** The risk report contains information on sources of overall project risk, together with summary information on identified individual project risks.

3. The Qualitative Risk Analysis: This step consists of determining the probability of occurrence and the consequences of its impacts that could affect the goals of the project and objectives. This information must be written into the Project Risk Register.

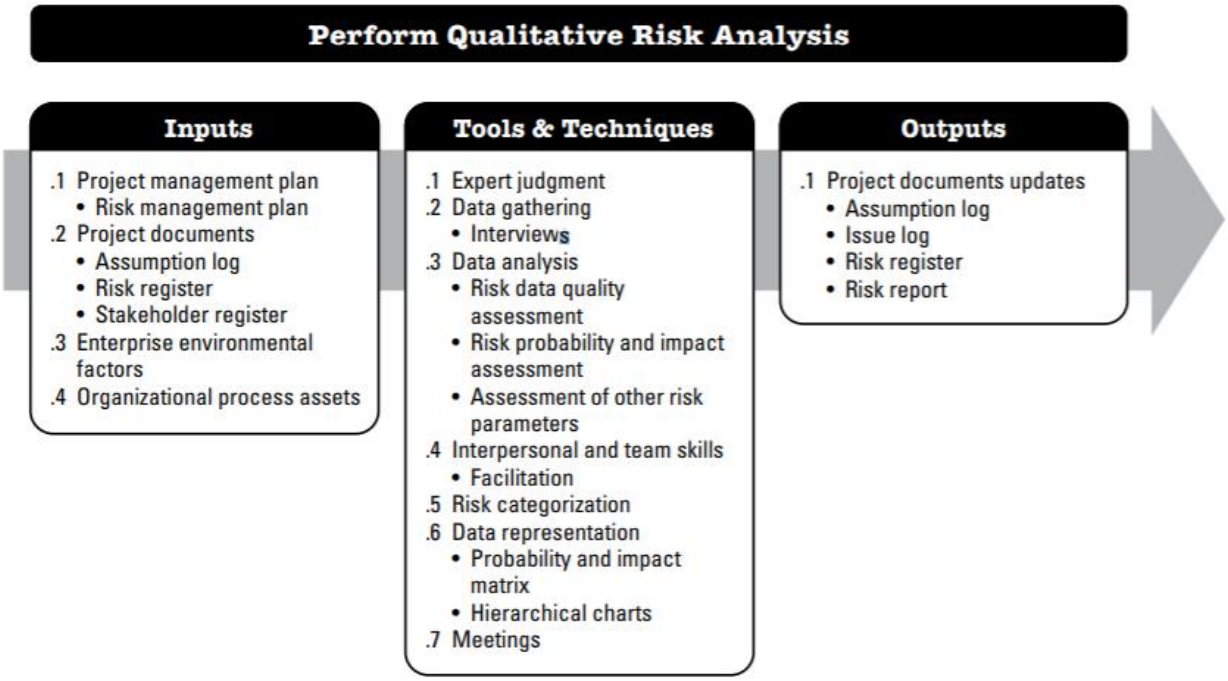


Figure 8: *Perform Qualitative Risk Analysis*[13]

[13] (Project Management Institute, Inc. , 2017)

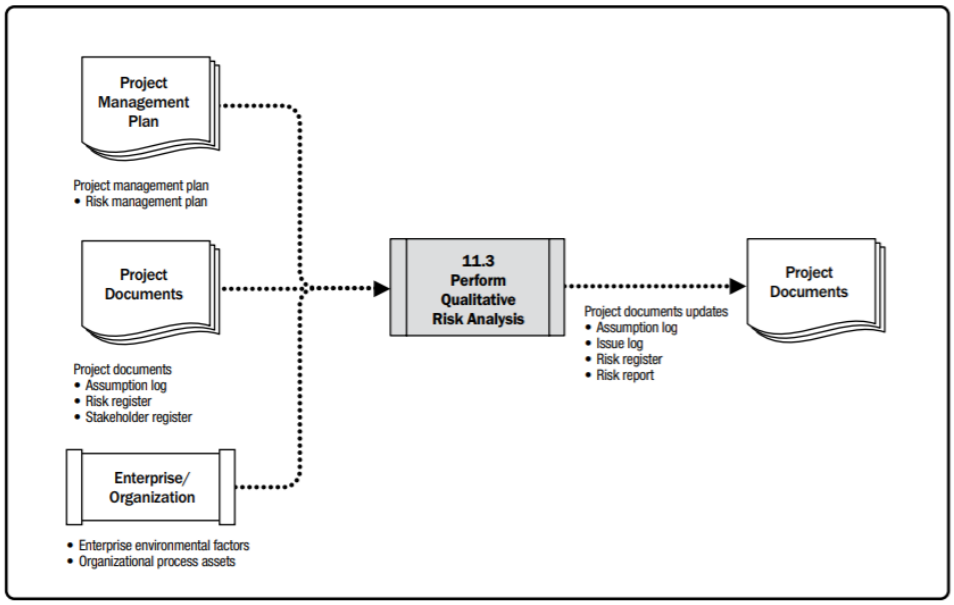


Figure 9: *Perform Qualitative Risk Analysis - Data Flow Diagram*[14]

4. The Quantitative Risk Analysis: It is the process of quantifying the risk impacts numerically in order to make decisions about whether the risk is acceptable or whether it is severe enough to warrant treatment. These risk rankings are also added to the Project Risk Register.

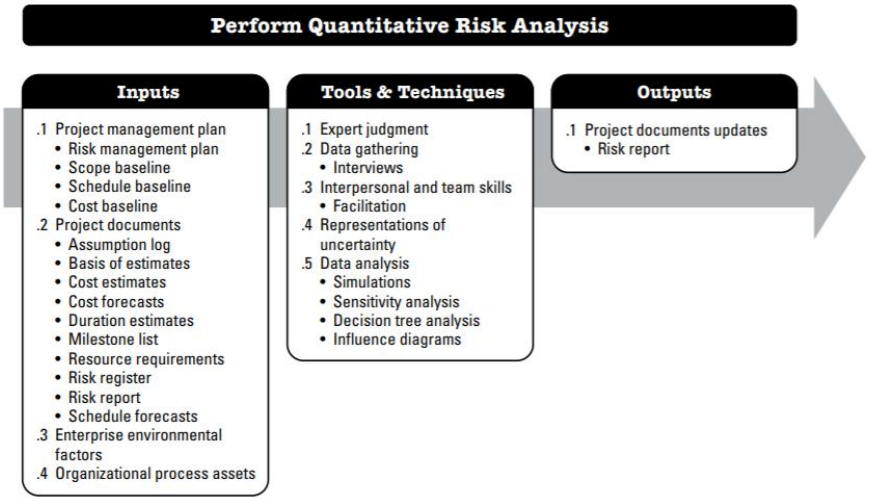


Figure 10: *Perform Quantitative Risk Analysis: Inputs, Tools & Techniques, and Outputs*[15]

[14] (Project Management Institute, Inc. , 2017)
[15] (Project Management Institute, Inc. , 2017)

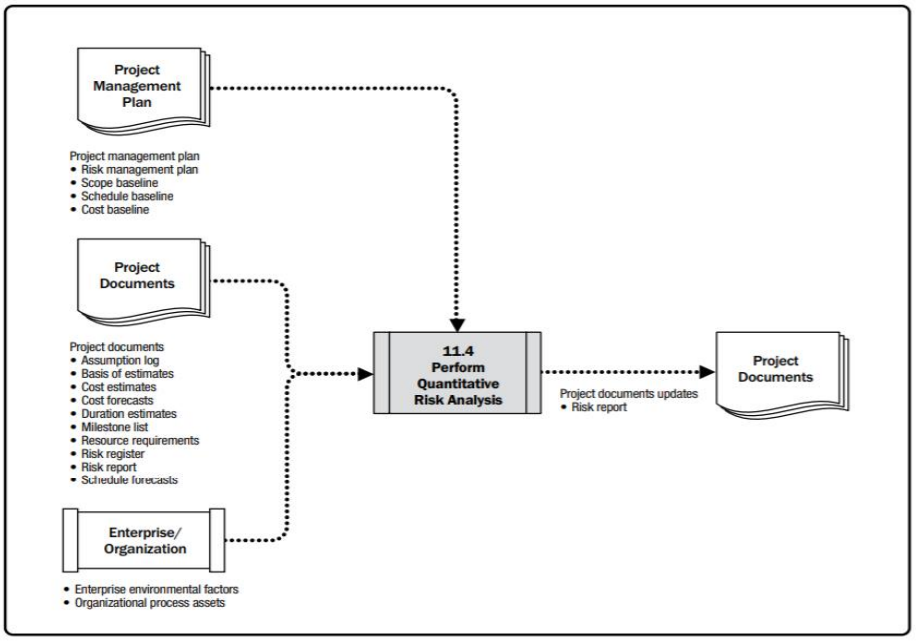


Figure 11: *Perform Quantitative Risk Analysis - Data Flow Diagram*[16]

5. Plan the Response to the Risks: The process of developing options and actions to improve the opportunities and reduce the threats to the objectives of the project. It is created by the risks mitigation strategies, preventive plans, and contingency plans in this step.

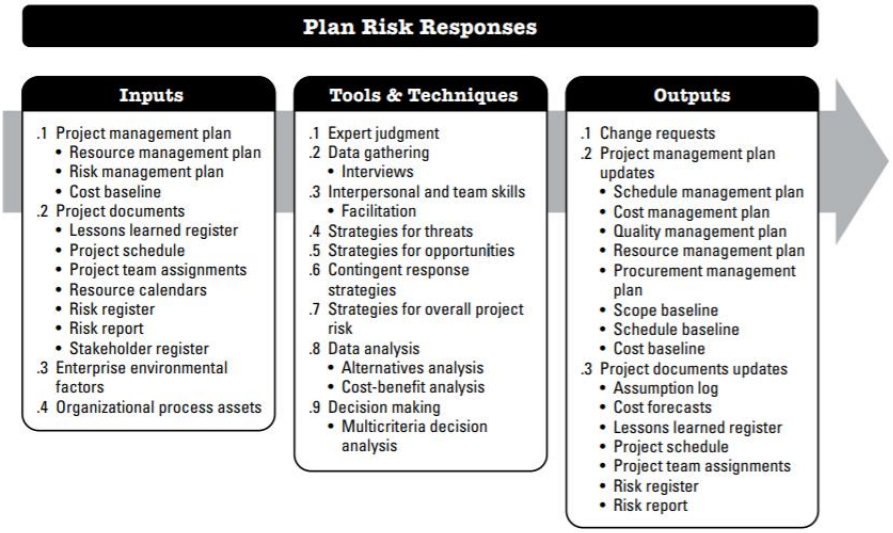


Figure 12: *Plan Risk Responses - Inputs, Tools & Techniques, and Outputs*[17]

[16] (Project Management Institute, Inc. , 2017)
[17] (Project Management Institute, Inc. , 2017)

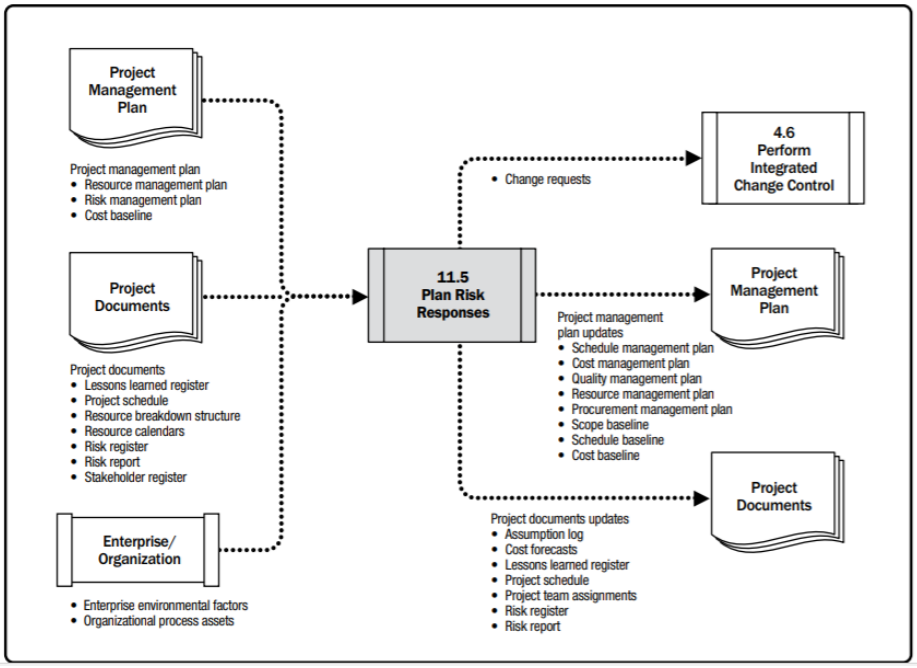


Figure 13: *Plan Risk Responses - Data Flow Diagram*[18]

6. Implement Risk Responses: Implement Risk Responses is the process of implementing agreed-upon risk response plans. The key benefit of this process is that it ensures that agreed-upon risk responses are executed as planned in order to address overall project risk exposure, minimize project threats, and maximize individual project opportunities. This process is performed throughout the project[19].

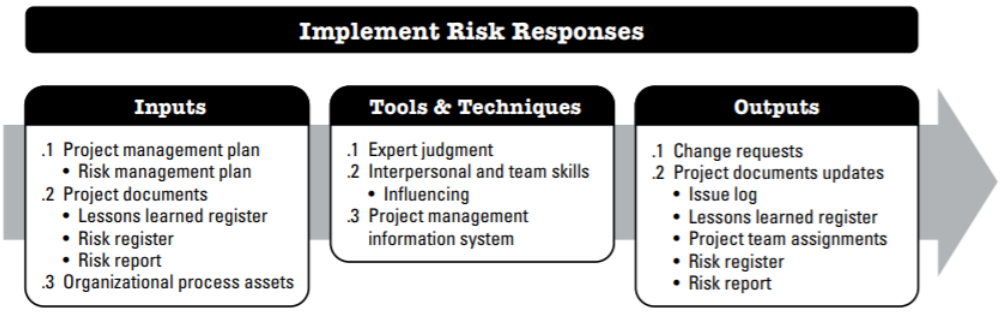


Figure 14: *Implement Risk Responses - Inputs, Tools & Techniques, and Outputs*[20]

[18] (Project Management Institute, Inc. , 2017)
[19] (Project Management Institute, Inc. , 2017)
[20] (Project Management Institute, Inc. , 2017)

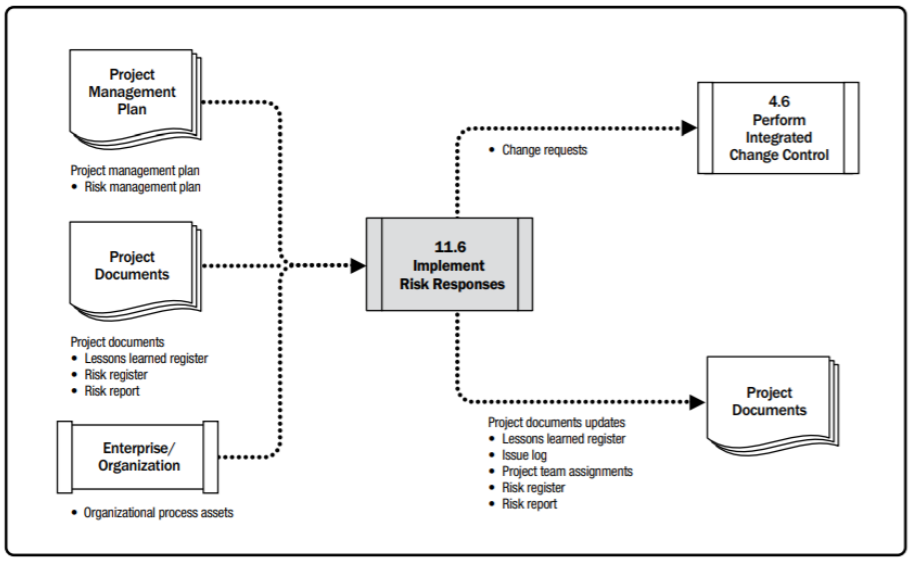


Figure 15: *Implement Risk Responses - Data Flow Diagram*[21]

7. Control Risks: The process of implementing risk response plans, follow up on identified risks, monitor residual risks, identify new risks and evaluate the effectiveness of the risk management process through the project.

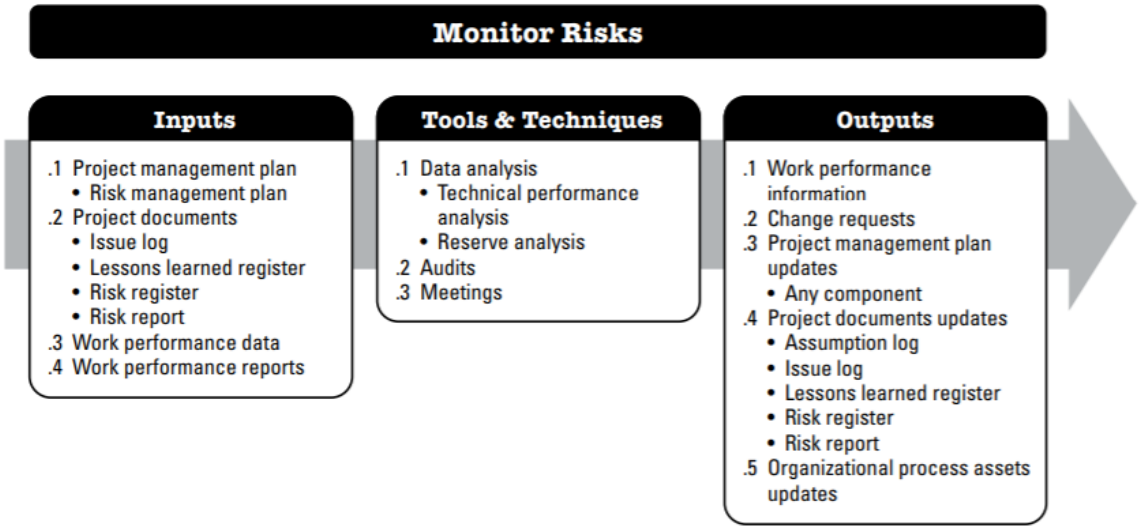


Figure 16: *Monitor Risks - Inputs, Tools & Techniques, and Outputs*[22]

[21] (Project Management Institute, Inc. , 2017)
[22] (Project Management Institute, Inc. , 2017)

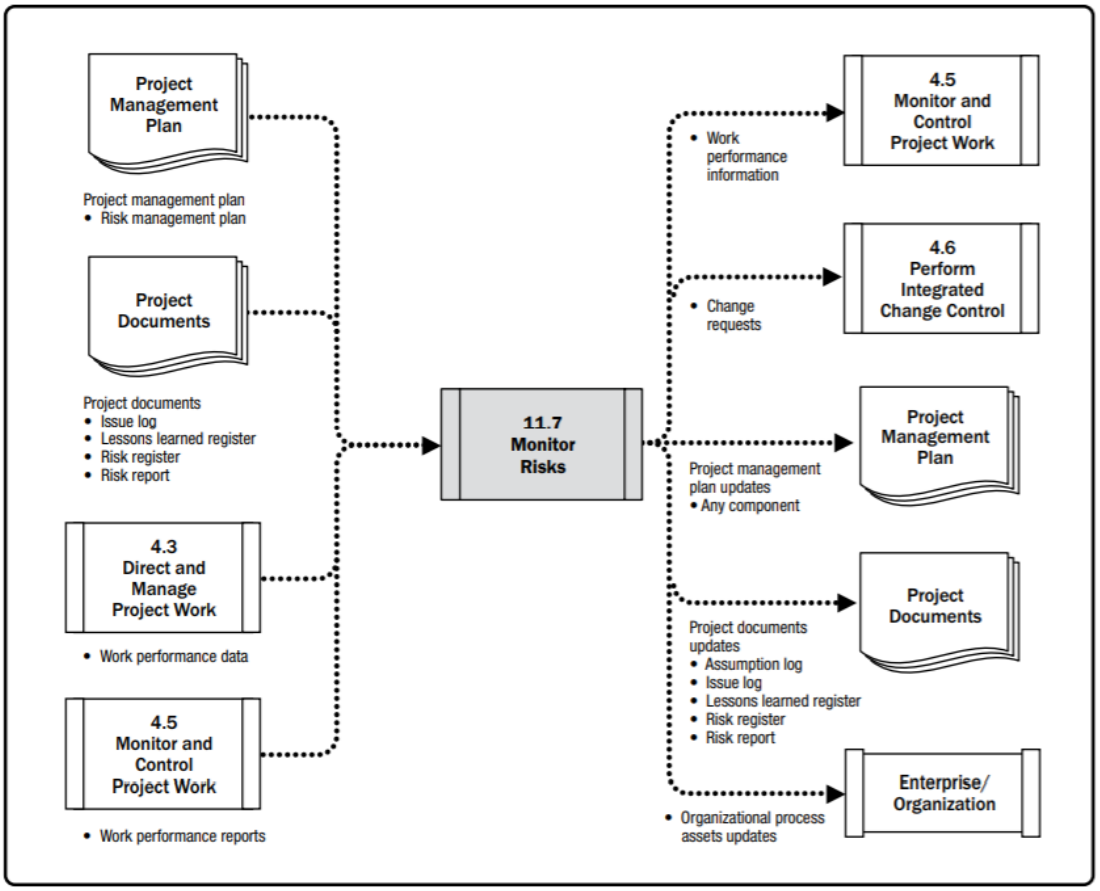


Figure 17: *Monitor Risks - Data Flow Diagram*[23]

In conclusion, all together these seven risk management process steps combine to deliver a simple and effective risk management process. By identifying and managing a complete list of project risks, can be reduced surprises and unpleasant barriers and discover golden opportunities. The risk management process prevents and also indicates how risks can be resolved because those problems have been foreseen. Therefore, the plans to deal with them have already been developed and agreed.

3.1.3 Risk Management in Construction

Now day companies that want to have successful projects as results are incorporating risk studies and their management. The uncertainty of the risk can generate an enormous impact on the project if they are not adequately identified and planned before they occur.

It is a well-known fact that managing risks has two primary objectives: to avoid the downside risks; and to exploit opportunities. The risk avoidance strategy helps to

[23] (Project Management Institute, Inc. , 2017)

secure project objectives, which for many organizations is a giant ahead and may be the single most significant opportunity. However, leaps in project cost and time reduction are results of innovative thinking with a focus on exploring opportunities by challenging the risks. The trend today is to establish ambitious goals, to seek for new technological solutions and concepts and to look for practical ways of organizing and managing projects[24].

The difference between project success and disaster is, of course, more complicated than managing or not managing the risk, but it appears that the number of successful projects would have been far higher if more companies had included risk as an integral part of their project management[25].

3.2 STRATEGIC PLANNING

3.2.1 What is Strategic Planning?

Strategic planning is an organizational management activity that is used to set priorities, focus energy and resources, strengthen operations, ensure that employees and other stakeholders are working toward common goals, establish agreement around intended outcomes/results, and assess and adjust the organization's direction in response to a changing environment. It is a disciplined effort that produces fundamental decisions and actions that shape and guide what an organization is, whom it serves, what it does, and why it does it, with a focus on the future. Effective strategic planning articulates not only where an organization is going and the actions needed to make progress, but also how it will know if it is successful[26].

For United Nations Corporation, the strategy is often about achieving a goal most effectively and efficiently possible; it means aligning a division, section, unit or team to a higher-level strategy[27].

3.2.2 What is a Strategic Plan?

A strategic plan is a document which is used to communicate with the organization the organizations or projects goals, the actions needed to achieve those goals and all of the other critical elements developed during the planning exercise[28].

[24] (Nigel J. Smith, 2014)
[25] (Nigel J. Smith, 2014)
[26] (Balanced Scorecard Institution, 2018)
[27] (United Nations, 2015)
[28] (Balanced Scorecard Institution, 2018)

3.2.3 What is Strategic Management? What is the Strategy Execution?

Strategic management is the comprehensive collection of ongoing activities and processes that organizations use to systematically coordinate and align resources and actions with mission, vision, and strategy throughout an organization. Strategic management activities transform the static plan into a system that provides strategic performance feedback to decision making and enables the plan to evolve and grow as requirements and other circumstances change. Strategy Execution is synonymous with Strategy Management and amounts to the systematic implementation of a strategy[29].

3.2.4 What Are the Steps in Strategic Planning & Management?

There are many different frameworks and methodologies for strategic planning and management. While there are no absolute rules regarding the right framework, most follow a similar pattern and have common attributes[30].

According to the Balanced Scored Institute, these are the necessary steps to follow in the elaboration of the strategic plan:

1) Analysis or assessment, where an understanding of the current internal and external environments is developed.

2) Strategy formulation, where high-level strategy is developed, and a basic organization level strategic plan is documented.

3) Strategy execution, where the high-level plan is translated into more operational planning and action items.

4) Evaluation or sustainment/management phase, where ongoing refinement and evaluation of performance, culture, communications, data reporting, and other strategic management issues occurs[31].

Strategic plans should integrate, drive and connect to the budgeting process, providing the inputs to the 'regular budget' (or 'programmed budget') via the Strategic Framework model. The Strategic Framework, on a biennial basis, captures the objectives, expected accomplishments, and indicators of achievement for each sub-

[29] (Balanced Scorecard Institution, 2018)
[30] (Balanced Scorecard Institution, 2018)
[31] (Balanced Scorecard Institution, 2018)

programme, which would, by definition, be found in a strategic plan. Also, it must be integrated with work-planning efforts. Work-plans (also called operational plans) outlines the specific, shorter-term operational objectives, outputs, projects and processes of an entity[32].

At the individual level, it is useful to adopt strategic planning tools and technique to one's job and position. Thinking and planning 'strategically' at the personal level requires similar inputs, questions, and approach, and develops your capacity to participate in planning efforts for teams and higher-level entities[33].

As a complement to the literature written above, United Nations, in its manual "Strategic Planning - Guide for Managers," describe how to build a strategic plan with the below steps:

1) External Input Gathering: The first step in strategic planning is to gather the information needed to understand and identify the issues, challenges, and trends that will shape and affect a department, office, mission, or programmed strategy[34].

   The result of such input gathering is commonly thought of as external environmental scanning. "External" issues refer to all factors with roots outside the entity; they do not necessarily relate to issues that come from outside the UN. It is also important to gather information about the target clients (i.e., those who are the recipients and beneficiaries of the services delivered). Such inputs help to identify and understand how to group clients, and more importantly, how to characterize their desired outcomes that would result from receiving the services[35].

2) Internal Input Gathering: After looking outward, the next step is to look inward to understand the issues facing an entity that may affect the strategy. The most common and easy-to-use internal analysis method is the SWOT analysis. SWOT stands for Strengths, Weaknesses, Opportunities, and Threats. A SWOT

[32] (United Nations, 2015)
[33] (United Nations, 2015)
[34] (United Nations, 2015)
[35] (United Nations, 2015)

analysis summarizes the perceptions of an internal constituency (i.e., leadership and staff) regarding the internal strengths of an office, its internal weaknesses, the external opportunities for potential pursuit and the external threats to consider[36].

Figure 18: *SWOT Analysis Example[37]*

How to conduct a SWOT analysis?

A simple SWOT analysis can be carried out during a team retreat or strategic planning session with a facilitator leading the discussion and collecting views during the session based on some pre-work. A more comprehensive analysis involves formally surveying a leadership team, staff, business partners, and clients and other stakeholders. The resulting SWOT feedback is then compiled, grouped by common affinities, and prioritized to identify the most critical strategic issues[38].

3) Vision Statement Setting: Once the external and internal inputs are analyzed, management sets the overall direction and goal for the office or team, in this case for the project. Vision statements play the role of a strategic 'north star,' providing focus and alignment. Successful vision statements have three components[39]:

[36] (United Nations, 2015)
[37] (United Nations, 2015)
[38] (United Nations, 2015)
[39] (United Nations, 2015)

Figure 19: *Vision Components*[40]

Applying these components into a project would be interpreted as:

- The vision of the project: Make profit during its life cycle.
- Time Horizon: The contractual schedule of the project.
- Measurability: Goals of the project (cost, time, quality and others more)
- Unique Approach: a strategy to achieve the goals of the project.

4) Creating Objectives and using a Strategy Map: The next step is developing a strategy is defining the objectives or goals of a programmed or services, in this case for a project. Objectives are defined within each of the following five categories. Each objective then answers a fundamental question within the context of that category[41].

- Clients: Investors, Construction Companies in Real Estate Business, Government.
    - Fundamental question: 'To achieve our vision, how should we perform in the eyes of our clients?'
    - How to develop clients orientated objectives: Study their needs and wants.
- Services: Construction Service

[40] (United Nations, 2015)
[41] (United Nations, 2015)

    - Key question: ‘On which services will we place priority, and how will they be focused to provide the best value to our clients’
    - How to develop services orientated objectives: Identify and segment the services that will be provided to the clients. For example, Construction services in Real Estate buildings.
- Internal Processes
    - Fundamental question: ‘To support our services, how and where must we excel in our internal processes?
    - How to develop internal-process orientated objectives: Identify the internal processes that are most important in delivering the services. Example: Quality assurance during the construction phase of the project.
- People and Knowledge
    - Key question: ‘In what must our staffing and knowledge assets be maximized to execute our process?
    - How to develop people and knowledge orientated objectives: The people and knowledge areas most commonly address issues related to the skills and capabilities, knowledge management. Example: Site Construction Engineer with skills and knowledge in management and construction.
- Financial Resources
    - Fundamental question: "In what ways must we maximize our budget acquisition and budget allocation?"
    - How to develop financial resource-oriented objectives: Write each as a short verb-noun direction statement. Example: Shorten the process time for redirecting funds for emergency needs.

Presenting objectives in a strategy map

One way to present objectives is through a strategy map - a visual tool that helps define them and articulates a strategy in an easy-to-read picture (see example below) that fits on a single page - unlike traditional strategies which can be extended, unwieldy documents[42].

[42] (United Nations, 2015)

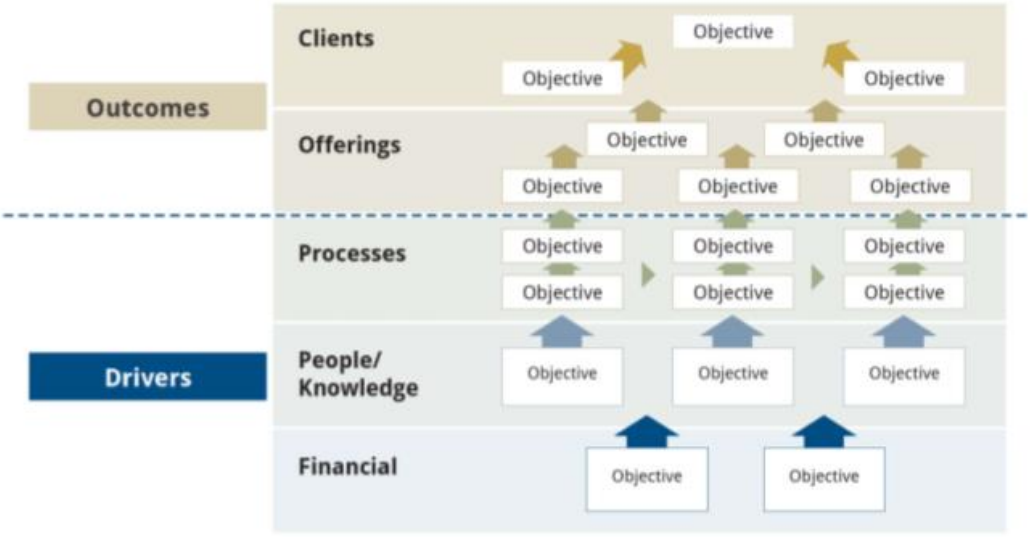


Figure 20: *Strategy Map Example*[43]

5) Strategic Performance Measures: Performance measures play a vital role within a strategic plan in determining how well the organization, office, and project are progressing toward achievement of each objective. They also help to focus management discussion on the right issues related to achievement. For each objective, a set of two-to-four measures should be developed that provide a view of how well the objective is being achieved[44].

[43] (United Nations, 2015)
[44] (United Nations, 2015)

Figure 21: *Choosing effective performance measures*[45]

6) Strategic Initiatives: Strategic initiatives are the activities that contribute to delivering a strategy. It is essential to distinguish the objectives (the verb-noun directional statements in the strategy map) from the initiatives (specific activities that have start dates, end dates, owners, and deliverables). The initiatives must be able to produce a clear and measurable impact on the objectives to which they are aligned. The performance measures, as described above, indicate the success of the initiative(s) by displaying impact and achievement for the objective[46].

   The following diagram generically depicts how initiatives are aligned with an objective and the objectives linked to performance measures. An objective can possess as many initiatives as deemed necessary[47].

[45] (United Nations, 2015)
[46] (United Nations, 2015)
[47] (United Nations, 2015)

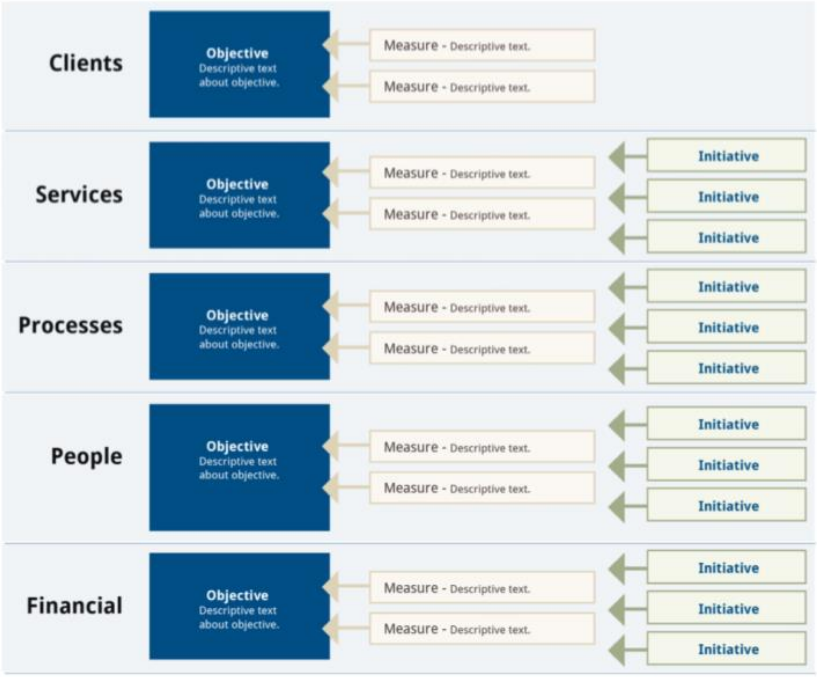


Figure 22: *Strategy Initiatives Diagram*[48]

How to develop Initiatives

Some initiatives may come to mind right away; some may have been part of prior thinking or have already been initiated. Others may require brainstorming. Here are some questions to ask when developing initiatives[49]:

- Will the initiative make a significant impact in achieving an objective?
- Is the objective far from being achieved?
- Is the initiative the most effective and efficient option?
- Does the entity have the skills, knowledge, and experience to complete the initiative?
- Does the entity have the capacity (staff-time, funding) to implement and manage the initiative?
- Is the proposed budget required reasonable?

The management team then reviews the proposed initiatives during a meeting or workshop. Each should be discussed to understand their appropriateness and to apply an overall prioritization. A scoring scheme could be developed to help with

[48] (United Nations, 2015)
[49] (United Nations, 2015)

prioritization; an example is below. Once complete, the proposed budgets should be reviewed, and a final selection of initiatives that balance both effectiveness and cost should be made[50].

Scoring Criteria												
Candidate Strategic Initiatives	Degree of Obj. Align.		Impact on Measure. Gap		Time to Impact		Risk		Capability		Cost	Score
Initiative 'A'	5	X	5	X	5	X	5	X	5	X	5	30
Initiative 'B'	3	X	5	X	3	X	5	X	3	X	5	24
Initiative 'C'	3	X	1	X	3	X	1	X	3	X	5	16

Figure 23: *Initiative Prioritization Approach*[51]

7) Identifying Strategic Risks: Managing risk is a crucial part of effective strategic planning. The flows from the top of the organization, where Enterprise Risk Planning is one of the critical tools of senior leadership. Risk management can be defined as the identification and mitigation of risks, which would hamper the execution of a strategy. Strategic risks are[52]:

   - Possible/known risks from the external environment:
     - What might happen in the external world in the context of politics, economics, social issues, technology, the environment/climate, legalities, security/safety, religion, and regulations?

   - Possible/known risks in the internal environment:
     - What might happen in the internal organizational environment in the context of funding, human capital, processes, projects, service quality, and service timeliness?

   - Risks affecting the composition of the strategy:
     - Which risks need to be part of selecting strategic objectives?

   - Risks affecting strategic initiatives:

[50] (United Nations, 2015)
[51] (United Nations, 2015)
[52] (United Nations, 2015)

- Which risks could prevent the successful execution of the strategy?[53]

Risks	Risk Prioritization			
	Likelihood	Severity	Overall	Mitigated
Summary	**2.5**	**4.3**	**10.6**	
Offering Services to our Clients	1.0	4.3	4.3	
(a) The needs of our clients may change due to local politics.	1	5	5	
(b) We are unsure of what will really make our clients happy.	1	5	5	
(c) Ensuring service quality will be difficult within the security environment.	1	3	3	
Improving and managing our internal Processes	3.0	3.7	11.0	
(a) Our lack of process management expertise will challenge our efficiencies.	5	5	25	✗
(b) We could experience process instability without automation systems.	1	1	1	
(c) The possibility of moving facilities could disrupt all processes.	3	5	15	✗
Developing and Leveraging our People	3.0	4.0	12.0	
(a) Staff objective to working conditions and leave.	3	3	9	
(b) Lack of expertise in the operating environment will limit our abilities.	3	5	15	✓

Figure 24: *Strategy Risks Prioritization*[54]

8) Managing a Strategy: Leaders must ensure that the strategy is effectively used as a management tool in order to gain the value from strategic planning. Strategy review meetings can help drive organizational focus, ensure individual accountability and drive desired results.[55]

   How to create a strategy review meeting approach?

   - Select the frequency and cadence of strategy review meetings. For construction projects could be 1 per week.
   - Determine how to structure the review meetings and set the duration. For construction projects could be 2 hours approximately.

   The issues to be treated should be:

   - Objectives that recently achieved significant milestones.
   - Objectives that are timely due to external timelines (e.g., budgeting cycle)

[53] (United Nations, 2015)
[54] (United Nations, 2015)
[55] (United Nations, 2015)

It is necessary to prepare the needed information to ensure consistency in the meeting, a focus on the strategy, and a view toward driving action. Update the following before each strategic review meeting:

- The overall status of the strategic objective
- Latest data for the related performance measures (displayed in a trend chart)
- Status of ongoing strategic initiatives, including timelines, milestones, expenditures, and expected quality of the deliverables must be actualized.
- Recommendations for the senior management/leadership to consider or to make a decision[56].

3.2.5 Strategic Planning in Construction Professional Service Firms in Europe

The multifaceted nature of strategic planning results in varying characteristics of the process becoming evident between firms. The degree of formality with which the process is undertaken is influenced by the organizational strategic type and approach taken to the process resulting in distinctions along dimensions of process characteristics becoming apparent[57].

The degree of formality in strategic planning is correlated to company size. In construction, a survey of UK construction firms concluded that large firms are more likely to have a formal process resulting in a documented output. Furthermore, it was discovered that construction contractor firms that are subsidiaries of international firms are more likely to engage in formal strategic planning. While these conclusions undoubtedly contribute to the discussion, they do not purport to report on professional practices within the sector. Furthermore, prominent authors in the field, raise concern regarding excessive formalization of the process in place of recognizing that strategy is a learning process[58].

Strategic Planning Tools:

Numerous tools have been developed to aid the strategic planning process. However, there remains skepticism regarding the extent to which strategic planning tools are used in practice[59].

[56] (United Nations, 2015)
[57] (Dublin Institute of Technology, ARROW@DIT, 2012)
[58] (Dublin Institute of Technology, ARROW@DIT, 2012)
[59] (Dublin Institute of Technology, ARROW@DIT, 2012)

Construction companies do not favor the use of strategic planning tools. Possible reasons for this include a shortfall in skills necessary for the use of such tools and a lack of recognition of the potential benefits. The lack of tool usage within construction firms presents a constraint on the development of strategic decision making and perhaps even a wasted opportunity. Tools such as scenario planning provide a useful mechanism for determining alternative courses of action within an uncertain environment and have potential use within quantity survey practices, both at strategic as well as project level[60].

3.3 LEAN CONSTRUCTION PHILOSOPHY APPLIED IN CONSTRUCTION SITE

3.3.1 What is Lean Construction?

Lean Construction is a philosophy which applies concepts of lean manufacturing. The ideology consists of know how to manage and improve the construction process to make profitable the project and satisfy the customer needs. Because it is a philosophy, Lean Construction can be implemented through several approaches. The following tools are used in the Construction Industry[61]:

- Last Planner: Collaboratively plan, track and improve.
- Value Stream Mapping: Identify and remove waste.
- 5S: Organize the project workspace.

This report will talk about the Last Planner, a tool which were used to develop both cases studies in Peru.

3.3.2 What is the Last Planner System?

Its full name is the Last Planner® System of Production Control. Production control is necessary on projects to support working toward planned accomplishments, doing what can be done to move along a planned path, and when that becomes impossible, determine alternative paths that accomplish desired goals. The term Last Planner® is a registered trademark of the Lean Construction Institute, which is why the "®" symbol should appear when first used in a document. The system is organized into five major parts[62].

[60] (Dublin Institute of Technology, ARROW@DIT, 2012)
[61] (Constructive Excellence, 2015)
[62] (Richert Tom, 2017)

Part one belongs to the Master planning, and it is elaborated at the beginning of the project. The master planning identifies the main milestones that measure the step at which the project will progress if it is to be successful. Usually, milestones are completion dates, with duration cero, for main phases or activities which is essential in the project.

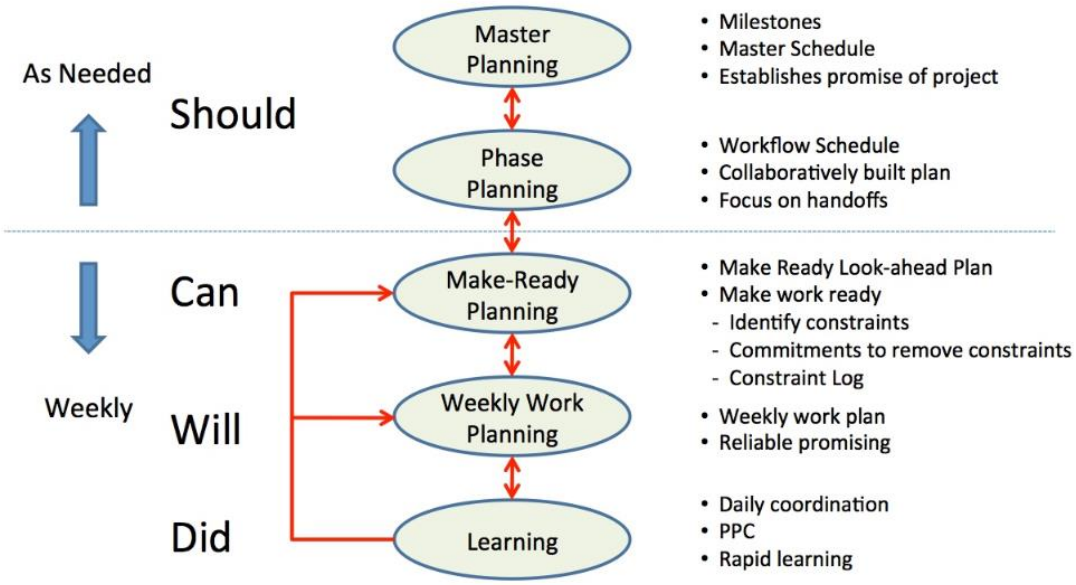


Figure 25: *Last Planner System*[63]

The term “last planner” refers to the people on the team responsible for making the final assignment of work to specific performers and ensuring they have the materials, equipment, and information available to complete their assignments. During the design phase, last planners are typically architectural and engineering project managers. During the construction phase, last planners are typically foremen and superintendents for the trade contractor crews[64].

Part two refers to the phased planning, and it is realized two or three months before the beginning of each phase. It is used a pull planning approach; wherein last planners are very clear about the sequence of requests and commitments they are making with each other. The approach follows a central lean practice of developing flow by starting with the final condition required to complete a phase, and building the sequence of work through a series of customer requests and performer promises to define precisely

[63] (Richert Tom, 2017)
[64] (Richert Tom, 2017)

how work will be released from one operation to another. These phase planning sessions are substantial opportunities for the team to determine how to pace the work so that it progresses at a steady rate with limited variation[65].

The third part of the Last Planner System ensures the execution of the work. This step makes it ready planning through which last planners look ahead to evaluate whether there are constraints to upcoming tasks identified during phase planning. On the other hand, restrictions are conditions that affect a planned task from being completed and include concerns such as labor and material availability, equipment access, construction document conflicts, and permits[66].

The fourth part of the Last Planner System focuses on what each last planner will do to fulfill the promises made during the phased planning. The accomplished through the preparation of a project Weekly Work Plan, wherein each last planner identifies the tasks their teams will complete each day of the following week. Reliability is paramount in developing these shared plans[67].

The fifth part of the Last Planner System focuses on learning from what the team did. It could be through the daily coordination meeting. On which the last planners confirm whether their teams accomplished the planned work that day and if not agreed upon adjustments required to stay on plan for the week. However, the other learning opportunity is through the analysis of a few key metrics. For example, Percent Plan Complete, a measurement of the percentage of weekly planned tasks that were completed as planned, Tasks Made Ready (a measurement of the percent of tasks identified during phase planning that were ready to begin as planned), Task Anticipated (a measurement of the number of tasks in a weekly plan that were identified in the look-ahead plan)[68].

Finally, Management practices need to be aligned with the lean respect for people principle and project leaders need to see themselves as coaches and facilitators of the planning and learning by last planners on the project. Furthermore, the use of the Last Planner System is a discipline, requires continued daily practice till becoming expert[69].

[65] (Richert Tom, 2017)
[66] (Richert Tom, 2017)
[67] (Richert Tom, 2017)
[68] (Richert Tom, 2017)
[69] (Richert Tom, 2017)

3.4 BIM TOOLS TO DETECT RISKS IN THE TRANSFERENCE FROM THE OFFER AND DURING THE CONSTRUCTION PHASE

BIM is the process spanning the generation and management of the physical and functional information of a project. The output of the process is what we refer to as BIMs or building information models which are ultimately digital files that describe every aspect of the project and support decision-making throughout a project cycle. BIM and the subsets of BIM systems and similar technologies feature more than just 3D (width, height, and depth) but may include further dimensions such as 4D (time), 5D (cost), and even 6D (as-built operation)[70].

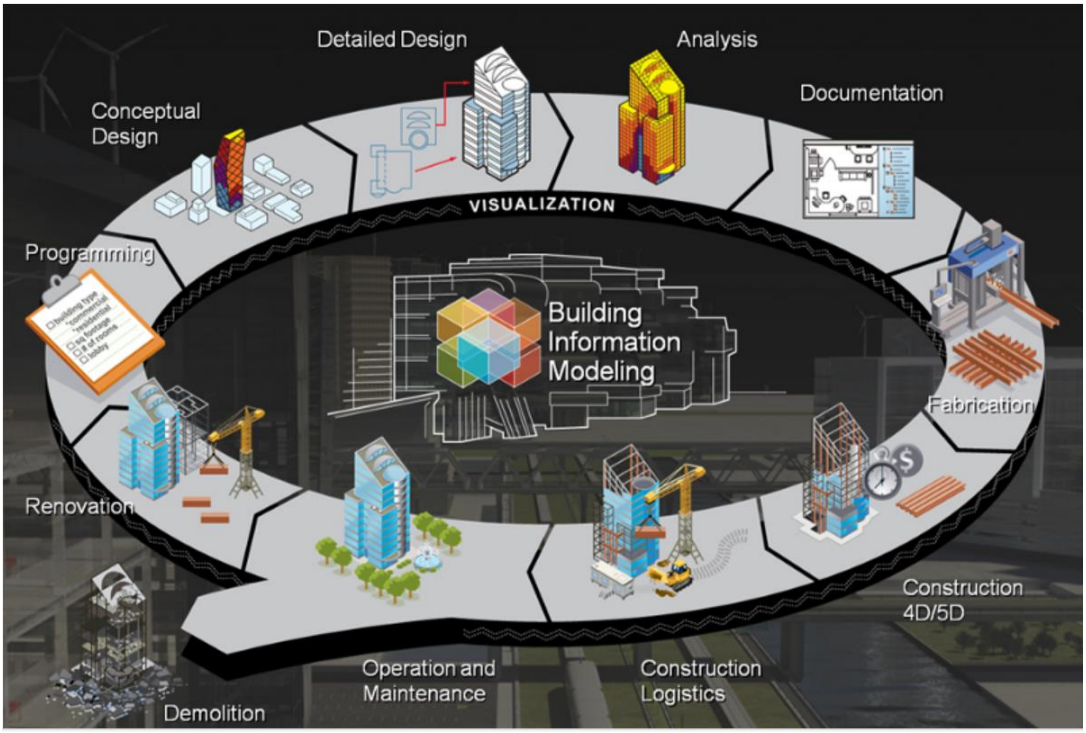


Figure 26: *BIM in Construction*[71]

[70] (National BIM Standard, 2017)
[71] (Thomas Goubau, 2018)

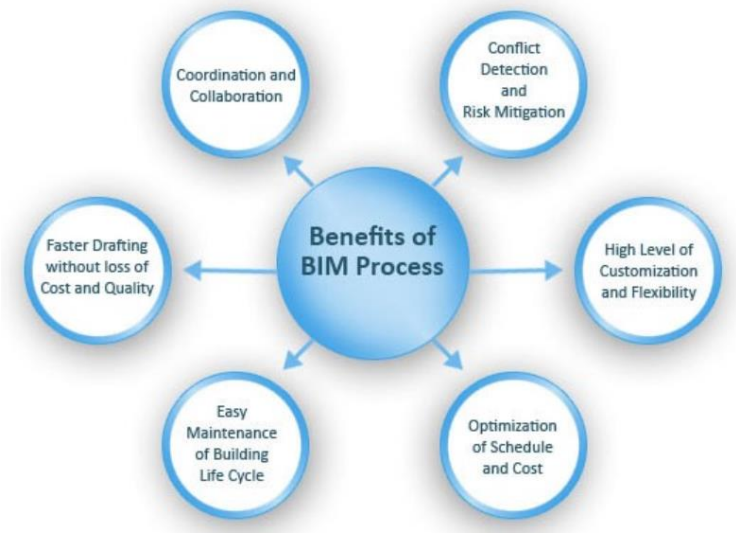


Figure 27: *BIM Benefits*[72]

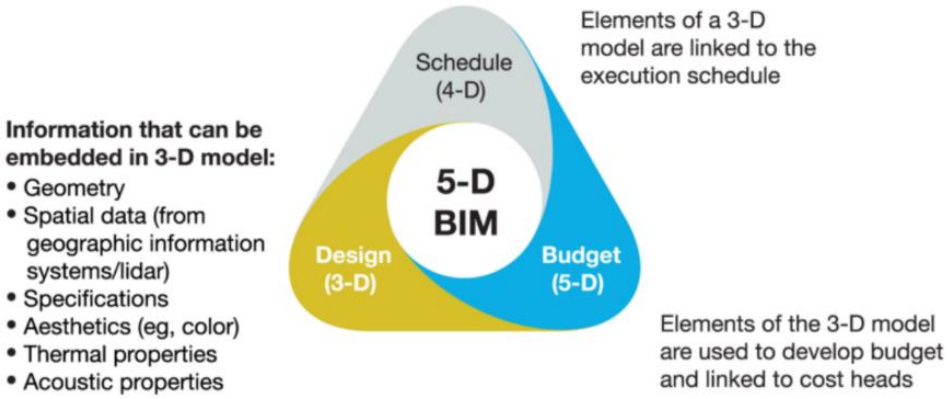


Figure 28: *BIM - 5D Functionality (Include Cost and Schedule)*[73]

Utilizing building information modeling solutions in the construction sector resulted in higher quality work, higher speed, and productivity, and lower costs for building professionals regarding design, construction, and operation of buildings[74].

Higher Quality: BIM allows for flexibility in the exploration and changes to the project design or documentation process at any time without any hassle to the design team. This results in minimized coordination time and manual checking that enables the design team to have more time solving real architectural problems. Common modeling tools provide close control over technical and detailed decisions regarding design

[72] (Thomas Goubau, 2018)
[73] (Thomas Goubau, 2018)
[74] (Thomas Goubau, 2018)

execution. The digital record of building renovations improves planning and management[75].

Higher Speed: BIM enables for design and documentation to be done concurrently instead of serially. Schedules, diagrams, drawings, estimating, value engineering, planning, and other forms of work communication are created dynamically while work is progressing. BIM allows for adaptation of the original model to changes like site conditions[76].

Lower Cost: Using BIM allows for more work to be done by a smaller team. It Means lower costs and minor miscommunications. Less time and money are spent in process and administration because of higher document quality and better construction planning[77].

4.0 ANALYSIS OF AN EXISTING CASE STUDY

This chapter examines a case with similar factors that also influence the construction of real estate projects in Peru. This case study is the basis of sixteen Egyptian construction companies.

4.1 Identification and assessment of risk factors affecting construction projects

Cost saving and time performance are usually essential to all parties who are involved in a construction project, that is the owner, contractor, a subcontractor. The delivery time of a project is a crucial factor for the owner regarding cost as much as it is for the contractor. An unexpected increase in cost and delays in construction projects are caused by the owner, contractor, environments. The effect of cost overrun and schedule overrun do not only influence the construction industry but the overall economy as well[78].

The critical success indicators of construction management system(s) include completing the project with cost and time, within the planned budget and duration, and within the required quality, safety, and environmental limits. Time contingency is used to guarantee the completion time of either an activity or a project. Due to the unique

[75] (Thomas Goubau, 2018)
[76] (Thomas Goubau, 2018)
[77] (Thomas Goubau, 2018)
[78] (Thomas Goubau, 2018)

nature of construction projects, cost overrun and schedule overrun uncertainty are essential for specific budget and scheduling, which should be flexible enough to accommodate changes without negatively affecting the overall cost and duration. It is also essential to allocate a contingency value to both cost and time[79].

The easiest and safest way to build a time contingency is to extend the project end date to a point where there is a comfortable amount of positive float, which may not be cost effective or acceptable to the client. However, it might not also be acceptable to proceed in a project with a zero float plan. Furthermore, it can also be defined as the budget that is set aside to cope with uncertainties during construction or the amount of money/time needed above the estimate to reduce the risk of overruns of project objectives to an acceptable level within the organization. Treasury identified two significant categories of contingency for construction projects[80]:

1. Design Contingency: It addresses the changes during the design process for factors such as incomplete scope definition and inaccuracy of estimating methods as well as data[81].

2. Construction Contingency: It addresses the changes during a construction process. Under a traditional procurement arrangement, the contract typically contains a variation clause(s) to allow for changes and provide a mechanism for determining and valuing variations[82].

Factors affecting cost overrun and schedule overrun

Based on the literature and the opinion of practitioners/Expert through fifty nine questionnaires, several crucial factors that affect cost and time contingency are identified and studied. They are divided into four primary criteria: (A) Site conditions, (B) Resources, (C) Project parties and (D) Project features related factors[83].

[79] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)
[80] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)
[81] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)
[82] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)
[83] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)

It is quite clear that the identified criteria and factors effectively contribute to the uncertainty in construction project cost and schedule, which in turn, impact the assessment of cost and schedule overruns. These factors are considered in predicting project budget and time contingencies[84].

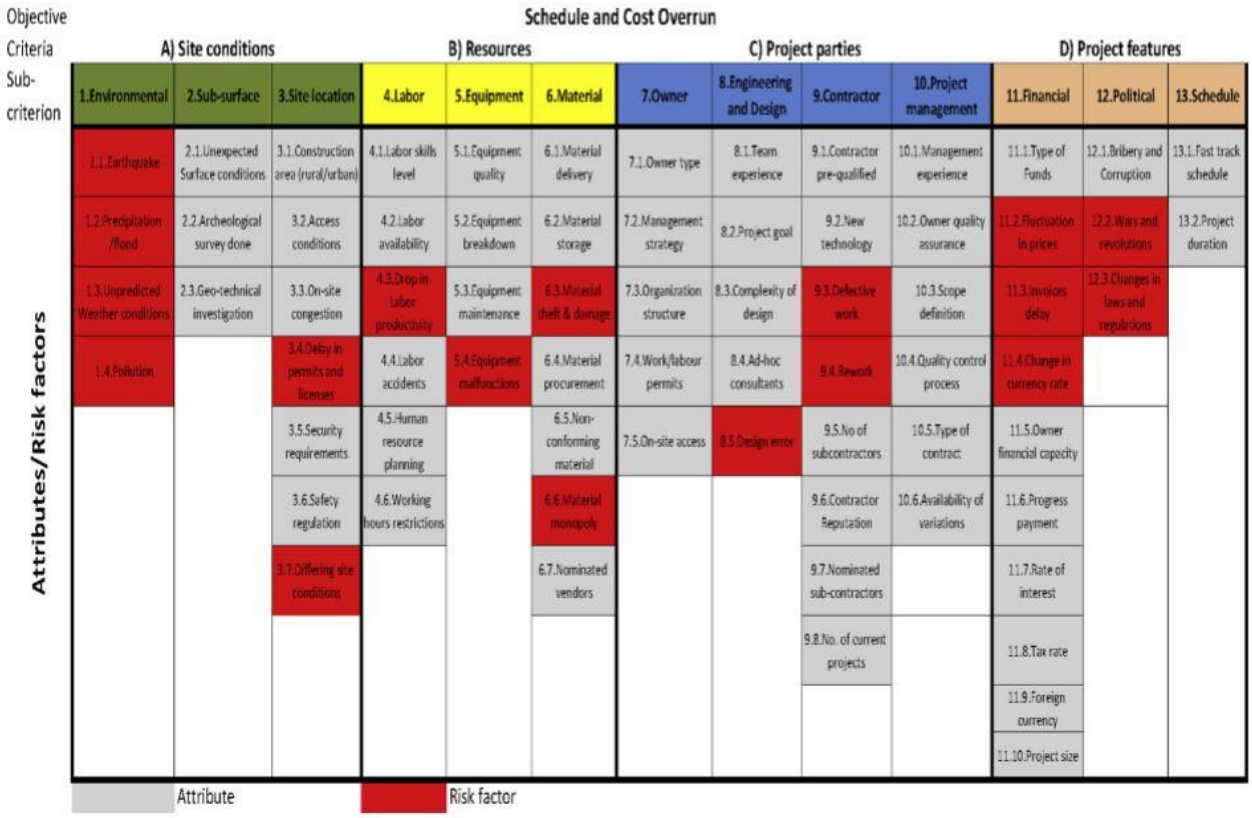


Figure 29: *Summary of attributes*[85]

[84] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)
[85] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)

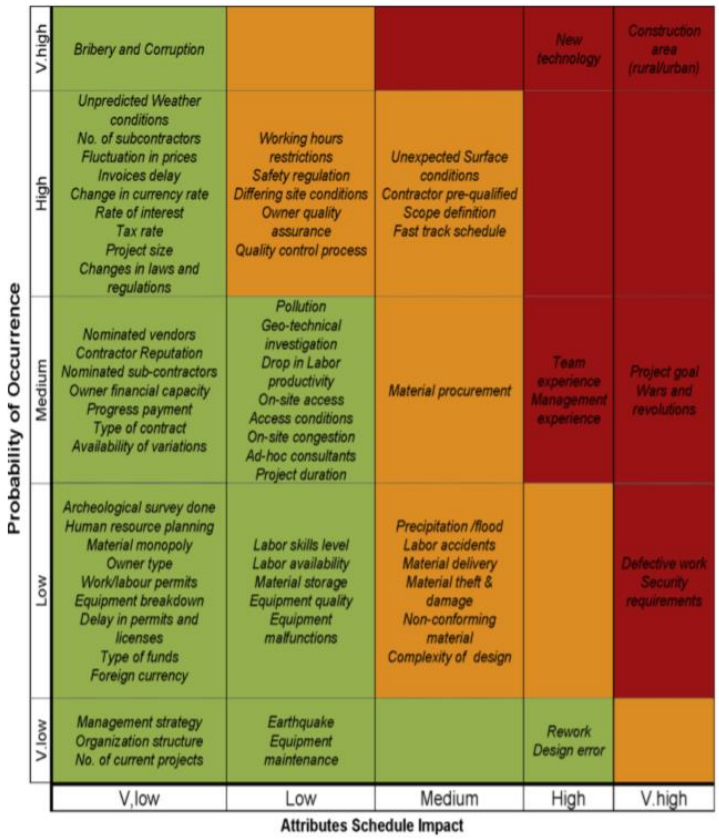


Figure 30: *Heatmap concerning attributes COST impact*[86]

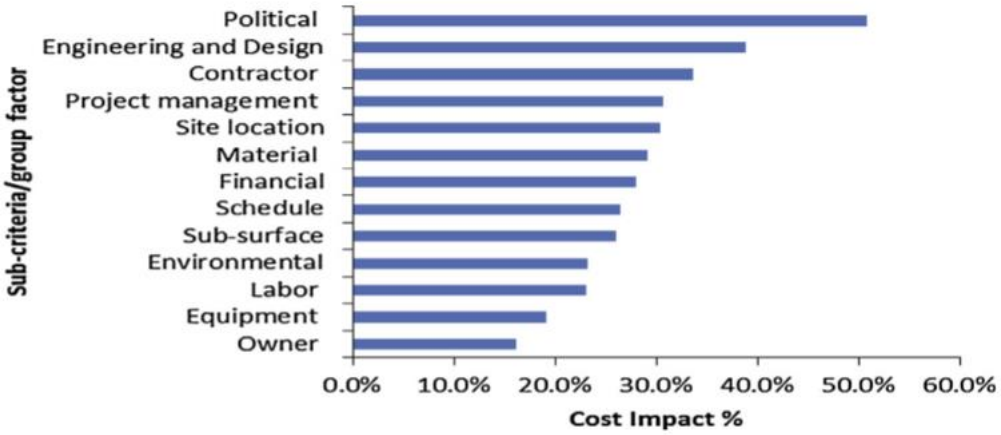


Figure 31: *Tornado chart for sub-criterions schedule impact*[87]

[86] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)
[87] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)

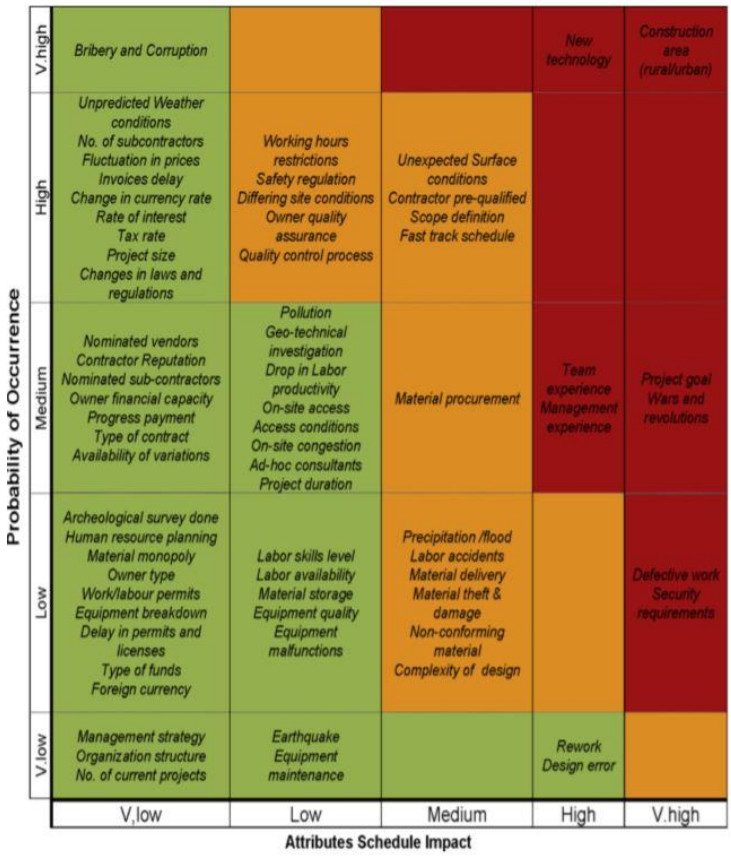


Figure 32: *Heatmap concerning attributes SCHEDULE impact*[88]

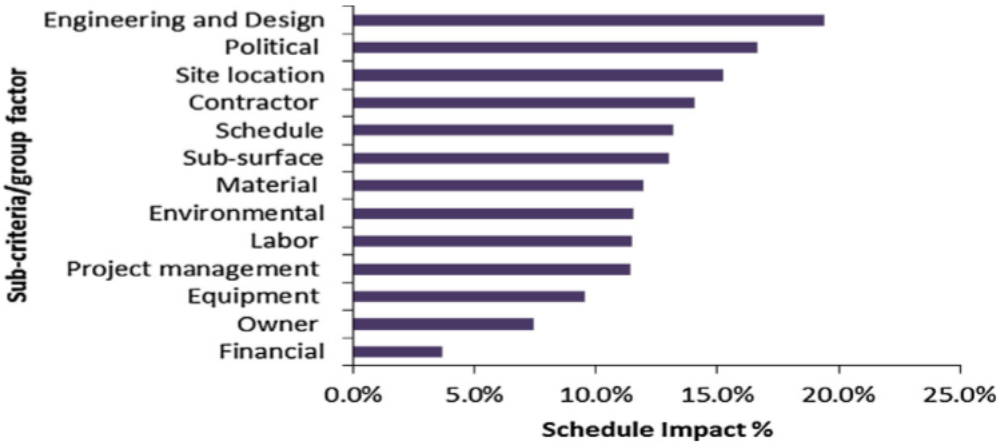


Figure 33: *Tornado chart for sub-criterions schedule impact*[89]

[88] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)
[89] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)

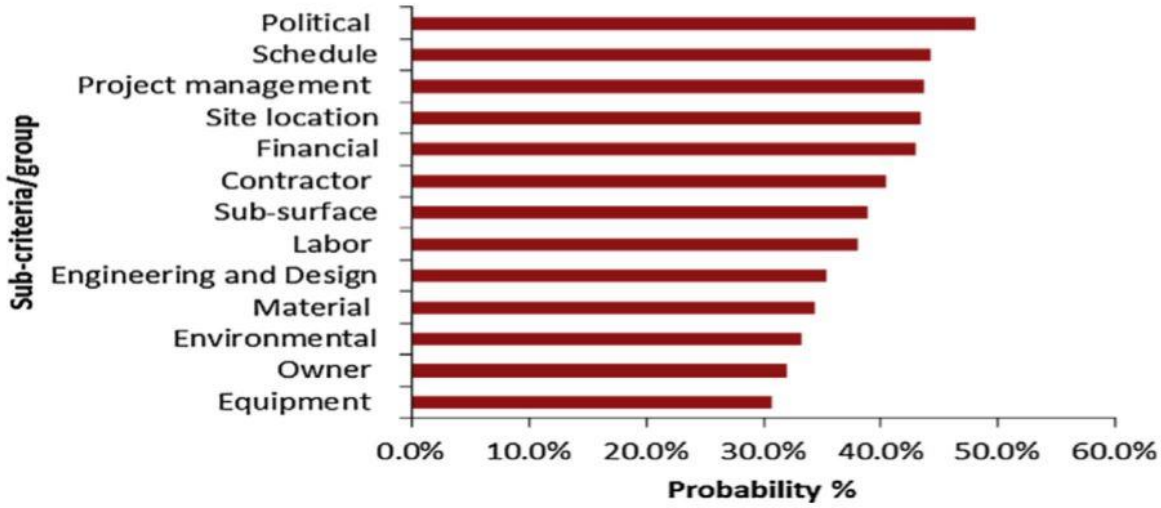


Figure 34: *Attributes probability of occurrence tornado chart (for sub-criterions)*[90]

5.0 DEVELOPING A CASE STUDY FROM PERUVIANS REAL ESTATE COMPANIES

The construction industry is one of the most dynamic and considered motors in the Peruvian economy due to involving others industries which provide materials/supplies (cement, steel, asphalt) to it. Sector construction performance depends on the public and private inversion dynamism. Furthermore, Peru leads the growth of the construction sector in Latin America.

According to MEF projections, construction will be the most dynamic sector and will experience an increase of more than 10% over the next three years. The increased percentage is due to the expansion of public investment and private construction projects as shopping centers, department stores, housing, hydroelectric and thermoelectric power plants, irrigation projects, expansion and modernization of industrial plants and mining centers, construction of roads and airports, among others[91].

The increase of the population and its incomes, as well as the expansion of housing credit, has increased the families demand for housing construction. On the other hand, the improvement in tax revenues has made the State, an essential dynamic agent of the sector.

[90] (Mohamed Sayed Bassiony Ahmed Abd El-Karim, 2015)
[91] (Ministerio de Vivienda, Construccion y Saneamiento, 2018)

In the last 15 years, the construction sector and total GDP grew by an average of 7.7% and 5.3%, respectively. In Peru, construction is one of the sectors with higher levels of productivity for work (after mining and manufacturing). However, 95.8% of workers in the sector are men, 74.5% have reached, at most, full high school and only 8.3% have been trained in a course such as productive technical training. These low levels of education are a public policy challenge if we want to improve the productivity and competitiveness of the construction sector. It requires a comprehensive strategic plan at the national level, which guarantees a formal development, so the construction sector could continue being one of the engines of the economy[92].

5.1 RISK MANAGEMENT IN PERUVIAN REAL ESTATE PROJECTS

It is gratified to observe that Risk Management in Peru is getting mature. This field is becoming in one mandatory area in project management due to the early identification of risks which allows to response and implement answers before these risks convert to in a real problem, affecting the schedule (delays), cost increment or lack of quality in the project.

However, it is noticed that companies declare and control risks in different ways, and in several cases, the way how to deal with them is the less appropriate method. The lack of standards to follow and the differences way to treat these risks could generate wrong or misunderstanding results and no accurate methodology to solve them. Furthermore, this information could be read by the same stakeholders of the project or company but not for others externals agents.

As a matter of studies, this report will use the data from three existing multifamily housing projects.

5.1.1 Residential Building “Sucre” (Real Estate Project)

In this project the general contractor is not the client, the communication between them is through the supervision.

[92] (Ministerio de Vivienda, Construccion y Saneamiento, 2018)

1. Background

➢ The scope of the Project:

Building Information	Description
Building Name:	“Sucre” Residential Building
Type of building:	Real Estate - Housing
Address:	Street Mariscal Sucre N° 235-239. Miraflores, Peru
Construction Year:	2015
N° Floors:	Seven levels, three underground, and a Rooftop level
N° Apartments:	12 unit
N° Parking Lots Exclusive:	41 units
N° Parking Lots for Guests:	Four units
Construction area:	5892.69 m2
Free area	28.04%

Table 2: *Building Information "Sucre"*[93]

The project belongs to a multifamily residential housing group. A brief technical description of it: The structure is made up of masonry portal systems (load bearing walls), concrete walls, columns, and beams. It has mix slabs (brick + concrete + steel) and in few areas slabs of concrete. The foundation is conforming by retaining concrete walls with anchors, individual footings, strip footings and foundation beams.

The building has the essential services and systems required by the building construction code as Fire system, MEP System, and Gas system. However, there is also another interconnected system that gives it added value; these systems are a Domotic security system, energy saving system, extra service lifts, generator set, acoustic isolation windows, air-condition system.

The finishes are first class for the main rooms, with lower costs for service-rooms and parking.

- ❖ Wooden floors for bedrooms, living room and dining room.
- ❖ Porcelain floors for kitchens, bathrooms and services rooms.
- ❖ Marble boards in primary and secondary bathrooms and kitchens.
- ❖ Porcelain tile in bathrooms and kitchens, other environments only painting.
- ❖ Melamine furniture in barrels and closets.

[93] (Sotelo, 2015)

- **Schedule of the Project:**

N° Month	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
Item	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	Jun-16
Architecture											
Structures											
Plumbing Installations											
Electrical Installations											
Mechanical Installations											

Table 3: *Summary Contractual Schedule "Sucre"*[94]

Milestones

Start of the project: **01/07/2015**

End of the project: **30/06/2016**

Contractual time of project: 11 months and one month set up observations and deliver it to the client.

- **The budget of the Project:**

PRESUPUESTO DE OBRA (Project Budget)

Obra (Project):	Edificio Residencial Sucre 235
Lugar (Location):	Miraflores
Area techada (Construction area):	5894.72m2
Fecha (date):	25/07/2018
Moneda (currency):	Nuevos Soles
Tiempo de Ejecución (Schedule):	11 Meses (months)

RESUMEN (Sumary)

Especialidad (Speciality)	Soles	US$
Arquitectura (Architecture)	3,866,853.12	1,171,773.67
Estructuras (Structure)	3,650,830.37	1,106,312.23
Instalaciones Sanitarias (Plumbing)	501,505.53	151,971.37
Instalaciones Electricas (Electricity)	863,338.27	261,617.66
Instalaciones Electromécanicas (Mechanics)	477,262.99	144,625.15
Total Costo Directo S/IGV (Total direct cost without taxes)		**2,836,300.08**
Gastos Generales (Indirect cost)		265,128.15
Utilidad (profit) - 5%		141,815.00
Total costo S/IGV (total project cost without taxes)		**3,243,243.24**
Costo Afecto al IGV (Affected cost by taxes)		3,243,243.24
Costo/m2 (cost/m2) - sin IGV		550.19
IGV (Taxes) - 18%		583,783.78
Total Con IGV (Total cost with taxes) - 18%		**3,827,027.02**

Table 4: *Contractual Budge of "Sucre"*[95]

[94] (Sotelo, 2015)
[95] (Sotelo, 2015)

The project was under the loop sum modality. However, was a risky contract for the contractor because an exclusion letter which was signed in hand to hand with the contract. The total amount was agreed on **$3, 827,027.02** Americans dollars (including taxes). From the table:

- Total direct cost (construction cost): $2,836,300.08 Americans dollars.
- Total indirect cost (staff, overhand cost, and financial costs): $265,128.15 Americans dollars.
- Is considered 5% for profit concept and 18% for taxes according to Peruvians rules (IGV)

2. Identification of Risks

There are several sources of risks at a different stage of the project. For this thesis report will focus on two stage of the project: Transition between the offer and construction phases and during the own construction process. Will be analyzed risks which impact in cost and time affecting the excellent performance of the project.

A) Risks coming from the offer:

In Peru, it is really common the transference of risks from the offer to construction stage because the poor compatibility process of the different drawings specialties, human errors, no detail engineering, assumptions of high productivity ratios and ideal conditions for measure the waste of materials, and for the short period of time for developing the whole tendering process.

According to the type of the project, no detection of risks could influence the final profit, and itself develop. For this project, **it was under loop sum without readjustments**, which had many disadvantages for the contractor. Some of these main clauses are:

- The agreed compensation will not be subject to adjustment only if they correspond to additional, complementary or deductive work according to the provisions of the scope of the project.
- Exceptionally, only the increase in the law by the concept of labor will be considered, according to the indexes updated by the INEI, government institution of the Peruvian state.

The offer was analyzed by the project manager and the construction team, the followings risks were identified:

- The estimated quantities in many activities were under the real quantity.
- The price of concrete was lower according to the market.
- Mistakes & Omission in the quotation of the domotic security system, insulated windows, wood floors, the board of marble and other architectural finishes because of no precise definition of scope, lack information or human errors from bidding area. The price of these items was minimum in comparison to what the client asked.
- Inaccurate calculation of financial expenses, general administrative costs, and on-site overhead costs.
- The omission of specialized equipment for particular activities. Ex: crane
- Architectural and general administrative items were determined as “critical.”
- No engineering and architectural detail.
- Loop sum contract without readjustment in prices or quantities.
- Offer without exclusions agreement for particular materials or equipment.
- The exchange rate of currencies from “dollar” to “Nuevos soles” for a particular procurement as lifts and architectural finishes.

B) Risks coming from construction phase:

- Lack of qualified subcontractors.
- Subcontractors without financial liquidity as a consequence the payment of their labors were affected.
- Lack of organization and documentary formalities process from subcontractors generating delays in their payment.
- Delays in technical answers and approval of activities starting by supervisors.
- Additional works asked by the supervision without payment.
- Low productivity ratios of labors in critical activities.
- Changes/Additional works in the last moment by the client affecting the procurement chart plan, cost and time of the project.
- Planning mistakes in procedures and procurement.
- Working with subcontractors recommended by the supervisors.

- ❖ Delay delivery of materials to the project.
- ❖ Lack of knowledge of labors in the execution of activities.
- ❖ Lack of knowledge in management and uses of tools for control costs, time and physical advances of the project by the contractor company. The company was resistant to be adopted into new methodologies to make more profitable the project as was suggested by the project manager and his team.

All these risks were registered in Risk Register and Risk Report.

3. The Qualitative Risk Analysis

The project management team established the following table to determine the risks of the probability of occurrence and the consequences of its impacts that could affect the goals of the project. The estimated occurrence probability and as well as the scales determination for cost and time are related to the magnitude of the project.

SCALE	PROBABILITY	"+/- IMPACT ON PROJECT OBJECTIVES"		
		TIME	COST	QUALITY
Very high	> 70%	> 2 months	>$501K	Very significant impact on overall functionality
High	51-70%	1-2 months	$101K-$500K	Significant impact on overall functionality
Medium	31-50%	1 month	$51K-$100K	Some impact in key functional areas
Low	11-30%	1-4 weeks	$10K-$50K	Minor impact on overall functions
Very Low	1-10%	1 week	<$10K	Minor impact on secondary functions
Nill	<1%	No change	No change	No change in functionality

Table 5: *Table of scale and impact on project objectives "Sucre."*[96]

The interval range for cost and time were established according to the contractual budget of the project ($5 million Americans dollars), and the total profit declared ($150K Americans dollars).

According to the project manager, if the amount of cost loss is more than the profit of the project, the project is declared in "economic bankrupt."

A project with less completion time than 12 months, is considered as "critical." Thus, has any delay in more than 1- 2 months could affect the project in strongly way. Therefore, according to Peruvian Contract Management, if the real progress is less than 75% for what was planned in the contractual schedule in that specific period, it is

[96] (Sotelo, 2015)

mandatory to reschedule the contractual schedule, and this process will involve cost (need of additional resources).

On the other hand, the extra works required by the client had its schedule and budget.

Following table 5, the identified risks have been qualified in the matrix above:

Red: High – Very high risks Yellow: Medium risks

Green: Null – Low risks

		Qualitative Analysis			
Source	**Risk Description**	**Prob**	**Impact**	**Risk**	**Objective**
Bidding department	No real estimation of quantities in BOQ.	1.00	0.75	0.75	Cost of the project
Bidding department	No real prices for incidents materials as concrete, steel and other architectural finishes.	1.00	0.75	0.75	Cost of the project
Bidding department	No consider the price of especal equipment inside the price of the activity. Ex. Crane	0.65	0.65	0.42	Cost of the project
Bidding department	Omission of scope and no consideration of materials specifications.	1.00	0.85	0.85	Cost & Time of the project
Bidding department	No real calculation for general administrative costs, site-overhead costs and finance costs.	0.85	0.85	0.72	Cost of the project
Client	Not complete delivery of engineering and architecture	1.00	0.45	0.45	Cost & Time of the project
Type of contract	Loop sum without readjustment in prices or quantities.	1.00	0.50	0.50	Cost of the project
External Market	Exchange rate of currencies from “dollar” to “nuevos soles” for special procurement.	0.50	0.50	0.25	Cost of the project

Table 6: *Table of Qualitative Analysis - Risks coming from the Offer “Sucre.”*[97]

From the table above, the risks with the most significant impact correspond to errors in the metering of the quantities, omission in the scope and general administrative costs. Because the contract is lump sum mode without price adjustments, any error in the prices in quantities is assumed by the contractor. Other risks that must be followed and controlled moderately are the use of specialized equipment for individual items and the engineering as well as detailed architecture. In this project, the use of crane was omitted inside the analysis unit price, and the lack of detail in engineering and architecture drawings plans delayed orders in the procurement. These delay effects in a substantial way the schedule and the general administrative cost.

From the table below, which concern to risks originated during the construction, the primary sources of risks are coming from the “subcontractors.” Several of these subcontractors were no formal and had economic problems (liquidity) affecting most of the time the labors payment, as a consequence at the beginning of the week the number of labors was not enough to develop the activities that were planned before

[97] (Sotelo, 2015)

by the project manager and the constructor site engineer. In addition to this, low ratios of productivity and lack of skilled labors in architecture finishes, remaking some of the works because the quality in the final product was not well.

		Qualitative Analysis			
Source	**Risk Description**	**Prob**	**Impact**	**Risk**	**Objective**
Client	Additional works asked by the supervision without payment.	0.75	0.65	0.49	Cost of the project
Client	Delays in technical answers and to approve the start of an activity.	0.85	0.75	0.64	Cost & Time of the project
Municipality	Stop of work because the project do not follow the standard, permision or any claim from a neighbor.	0.25	0.85	0.21	Cost & Time of the project
Labors	Low ratios of productivity.	0.85	0.75	0.64	Time of the project
Labors	Lack of knowledge in execution of activities.	0.60	0.60	0.36	Cost & Time of the project
Planners	Planning mistakes in procedures and procurement.	0.50	0.85	0.43	Cost & Time of the project
Providers	Delays in deliver materials to the project.	0.75	0.75	0.56	Time of the project
Subcontractors	Work with subcontractors recommended by the supervisors	0.65	0.75	0.49	Cost & Time of the project
Subcontractors	Lack of qualified subcontractors: No economic liquidity, poor organization and documentary formalities.	0.85	0.85	0.72	Cost of the project
Contractor	Lack of knowledge in management and uses of tools for control costs, time and physical advances of the project. The company is against to adopt new techniques suggested by PM.	0.85	0.85	0.72	Cost & Time of the project

Table 7: *Table of Qualitative Analysis - Risks during the Construction phase "Sucre."*[98]

On the other hand, the delays in the technical answer by the supervisor or the client took more time than the normal established, affecting the procurement schedule and increasing the cost of labors due to standby hours for the stop of works (no authorization to continue and no material).

Finally, another important source was the same constructor company, the resistant to be adapted into a new system in management, the lack of planning and control at the beginning of the project made those risks could not handle in wholly way.

4. The Quantitative Risk Analysis

After realizing the analysis qualitative, the next step is the quantification of those risks. Unfortunately, at the beginning of the project, this stage was not calculated, however, before starting the construction phase, the project management team quantified them to know what was the last utility at the end of the project.

[98] (Sotelo, 2015)

Quantification of Risks from the offer:

Item/Description	Original Amount	
	Soles	Dollars
Contrato (Contract)	S/111,019.61	$ 33,642.31
Omision del Alcance (by omission of scope)	S/306,143.90	$ 92,770.88
Omision en el Presupuesto (omission in the budget)	S/10,453.24	$ 3,167.65
Total	**S/427,616.75**	**$ 129,580.83**

Table 8: *Quantification of Risks from the Offer "Sucre"*[99]

The table above shows the risks coming from the offer, and for better understanding, these risks were classified into three main item: Contract, Omission by scope, Omission in the budget.

It could be noticed the original amount of risks represents 4.00% of the project budget, an amount which already is too high and compromises the profitability of the project. From this amount, only 3.30% was approved by the client, and the constructor assumed the difference.

The table below indicates the amount of the risks which were covered and not covered by the client.

Item/Description	Cost Approved		Cost Denied	
	Soles	Dollars	Soles	Dollars
Contrato (Contract)	S/111,019.61	$ 33,642.31	S/0.00	$ -
Omision del Alcance (by omission of scope)	S/231,650.93	$ 70,197.25	S/74,492.98	$ 22,573.63
Omision en el Presupuesto (omission in the budget)	S/10,453.24	$ 3,167.65	S/0.00	$ -
Total	**S/353,123.78**	**$ 107,007.20**	**S/74,492.98**	**$ 22,573.63**

Table 9: *From the offer-Cost Approved and Cost Denied by the client "Sucre."*[100]

Where the risks coming from the omission of the scope, have the highest impact on cost and time.

[99] (Sotelo, 2015)
[100] (Sotelo, 2015)

Quantification of Risks during construction:

Item/Description	Original Amount	
	Soles	Dollars
Adicionales por el cliente (Additional client)	S/557,931.93	$ 169,070.28
Construccion (Construction process)	S/17,008.31	$ 5,154.03
Demora por el cliente (Delay by the client)	S/56,237.96	$ 17,041.81
Demora en Procura (Delay in the procurement)	S/4,803.75	$ 1,455.68
Total	**S/635,981.96**	**$ 192,721.81**

Table 10: *Quantification of Risks during the Construction Phase "Sucre"*[101]

The table 10 shows the risks originating during the construction phase. These risks are represented by three items: Construction process, delay by the client, delay in the procurement.

The item "Additional Client," belongs to the extra work which was not included in the original scope of the project. From the table 10, risks represent 0.73% of the project, while the extra work required by the client is 5.21%. This additional work will have a different budget, and schedule wheatear is necessary.

Item/Description	Cost Approved		Cost Denied	
	Soles	Dollars	Soles	Dollars
Adicionales por el cliente (Additional client)	S/549,006.93	$ 166,365.74	S/8,925.00	$ 2,704.55
Construccion (Construction process)	S/12,756.23	$ 3,865.52	S/4,252.08	$ 1,288.51
Demora por el cliente (Delay by the client)	S/8,659.08	$ 2,623.97	S/47,578.88	$ 14,417.84
Demora en Procura (Delay in the procurement)	S/0.00	$ -	S/4,803.75	$ 1,455.68
Total	**S/570,422.25**	**$ 172,855.23**	**S/65,559.71**	**$ 19,866.58**

Table 11: *During Construction: Cost Approved and Cost Denied by the client "Sucre."*[102]

There were additional works which the client did not want to pay, but the contractor has to make them without payment in order to keep the proper relationship with the client.

The problems above impacted in the final profitability of the project, but the owner of the construction company did not understand it, even although that the project manager explained and supported this extra cost as a loss of money for the project.

[101] (Sotelo, 2015)
[102] (Sotelo, 2015)

5.1.2 Residential Building “Ficus” (Real Estate Project)

In this project the client is the general contractor, the communication between them is through the project manager.

1. Background

- **The scope of the Project:**

Building Information	Description
Building Name:	“Ficus” Residential Building
Type of building:	Real Estate - Housing
Address:	Street Faustino Sánchez Carrión N° 342-346, Magdalena del Mar, Peru
Construction Year:	2016
N° Floors:	Four levels, three underground, and a Rooftop level
N° Apartments:	17 unit
N° Parking Lots Exclusive:	18 units
Construction area:	2489.3 m2
Free area	28.00%

Table 12: *Building Information "Ficus"*[103]

The project has 17 apartments and 18 parking lots; all parking spaces are located in the basements. From the semi-basement to the 4th floor, the apartments are distributed, three for each level and five duplexes on the 4th floor. The building has an elevator that complies with the standard, referring to the dimensions and technical specifications and an open staircase from the first basement to the roof level of the project. The elevator will be without a machine room, and the water supply will be constant pressure type.

The foundation is made by reinforced concrete, which is composed of the strip and own footing. The structure is based on columns and walls of Reinforced Concrete, Mansory portal system. It has mix slabs, between lightweight slab (Firth System) and concrete slabs.

The building has the necessary services required by the building construction code as Fire system, MEP System, and Gas system. However, there is also another

[103] (Sotelo, 2016)

interconnected system that gives it added value; these systems are a CCTV security system, intercom system between the main door, each apartment and reception.

The finishes are the following:

- ❖ Porcelain floors for kitchens, bathrooms and services rooms.
- ❖ Granite boards in bathrooms and kitchens.
- ❖ Porcelain or ceramic tile in bathrooms and kitchens, other environments only painting.
- ❖ Melamine furniture in kitchens and closets.

➢ **Schedule of the Project:**

Milestones

Start of the project: **22/06/2016**

End of the project: **30/04/2017**

Contractual time of project: 10.5 months and one month set up observations and deliver it to the client.

Month	Jun		Jul.				Aug.					Sep.			Oct.				Nov.				Dec.					Jan.				Feb.				Mar.				Apr.				
Item	22/06-26/06	27/06-03/06	04/07-10/07	01/07-17/07	18/07-24/07	25/07-31/07	01/08-07/08	08/08-14/08	15/08-21/08	22/08-28/08	29/08 -04/09	05/09-11/09	12/09-18/09	19/09-25/09	26/09-02/10	03/10-09/10	10/10-16/10	17/10-23/10	24/10-30/10	31/10-06/11	07/11-13/11	14/11-20/11	21/11-27/11	28/11-04/12	05/12-11/12	12/12-18/12	19/12-25/12	26/12-01/01	02/01-08/01	09/01-15/01	16/01-22/01	23/01-29/01	30/01-05/02	06/02-12/02	13/02-19/02	20/02-26/02	27/02-05/03	06/03-12/03	13/03-19/03	20/03-26/03	27/03-02/04	03/04-09/04	10/04-16/04	17/04-23/04	24/04-30/04
Structure																																											
Architecture																																											
Plumbing Installation																																											
Electricity Installation																																											
Mechanic Installation																																											

Table 13: *Contractual Schedule "Ficus"*[104]

[104] (Sotelo, 2016)

- **The budget of the Project:**

CONTRACTUAL BUDGET OF THE PROJECT

Project: Residential Ficus
Location: Street Faustino Sanchez Carrion 342-346
District: Magdalena del Mar
Date: May 2016

Item	Description	Unit	Quantity	Partial Price (S/.)	Partial Price ($)
01	Provisional Works	Glb.	1.00	99,900.00	30,272.73
02	Structure	Glb.	1.00	1,153,417.80	349,520.55
03	Architecture	Glb.	1.00	1,212,653.51	367,470.76
04	Plumbing Installation	Glb.	1.00	227,537.18	68,950.66
05	Electricity Installation	Glb.	1.00	242,100.54	73,363.80
06	Mechanics Installation	Glb.	1.00	102,300.00	31,000.00
	Total Direct Cost			**3,037,909.02**	**920,578.49**

Plot Area **502.00 m2** **t/c:** **3.30**
Construction Area **2,489.30 m2**

Ratio S/./m2	**1,220.39**
Ratio $/m2	**369.81**

Table 14: *Contractual Budget "Ficus"*[105]

The project was under price unit modality without profit, because the general contractor is the owner, the construction company designs and builds the apartments. However, the goal of the manager has ended the construction of the project with a surplus of 5% of the total budget. The total amount of direct cost **$ 920,578.49** Americans dollars (without taxes).

2. Identification of Risks

In the "Ficus" project, due to the general contractor is the same owner/client, the risk coming from the offer does not apply, because the project did not have a bidding process. Instead of it, the project had a contractual budget which was approved by the owner. The owner took as reference ratios of construction ($/m2) from others project that the company executed before (project with similar characteristics and architecture finishes) to measure the suggested budget for "Ficus" project.

A) Risks coming from construction phase:

- Lack of laborers and the land surveyor technician.
- Lack of qualified subcontractors.

[105] (Sotelo, 2016)

- ❖ Subcontractors without financial liquidity as a consequence the payment of their labors were affected.
- ❖ Lack of organization and documentary formalities process from subcontractors generating delays in their payment.
- ❖ Low productivity ratios of labors in critical activities.
- ❖ The laborers had difficulties to be adapted to changes or new techniques.
- ❖ Delays in approve changes, or additional budget works by the last user affecting the procurement chart plan, cost and time of the project.
- ❖ Lack of space for material stock: bricks, steel and prefabricated beams for slabs.
- ❖ Detailed engineering and architecture drawings approved for planning the procurement chart.
- ❖ Delay delivery of materials to the project.
- ❖ Lack of flexibility to ahead activities due to lack of cash flow. Cash flow was designed to solve only the planned activities but not others extra activities in the same month.

3. The Qualitative Risk Analysis

The following table was established as a standard to determine the probability of occurrence from the risks and the consequences of its impacts that could affect the goals of the project. The estimated probability of occurrence is related to the magnitude of the project.

SCALE	PROBABILITY	"+/- IMPACT ON PROJECT OBJECTIVES"		
		TIME	COST	QUALITY
Very high	> 70%	> 2 months	>$101K	Very significant impact on overall functionality
High	51-70%	1-2 months	$46K-$100K	Significant impact on overall functionality
Medium	31-50%	1 month	$25K-45$K	Some impact in key functional areas
Low	11-30%	1-4 weeks	$5K-$25K	Minor impact on overall functions
Very Low	1-10%	1 week	<$5K	Minor impact on secondary functions
Nill	<1%	No change	No change	No change in functionality

Table 15: *Scale and Impact on the project objectives "Ficus."*[106]

The interval range for cost and time were established according to the total amount of the project ($1 million Americans dollars), and the total surplus declared ($45K Americans dollars).

[106] (Sotelo, 2016)

According to the project manager, if the direct cost is more than the planned value (without including the additional works required by the owner or the last users), the project is declared in "economic deficit."

A real estate project with less completion time than 12 months, is considered as "critical." Thus, if the project would have any delay in more than 1- 2 months could affect itself in strongly way. However, for this project, there is no need to apply penalties if the real progress (actual value) is less than 75% for what was planned in the contractual schedule in that specific period. The owner is the General Contractor.

On the other hand, the extra works required by the client had its schedule and budget.

Following table 5, the identified risks have been qualified in the matrix above:

Legend of colors:

Red: High – Very high risks

Green: Null – Low risks

Yellow: Medium risks

		Qualitative Analysis			
Source	**Risk Description**	**Prob**	**Impact**	**Risk**	**Objective**
Design Department	Delays in technical answers.	0.85	0.70	0.60	Cost & Time of the project
Design Department	Not complete delivery of engineering and architecture	1.00	0.45	0.45	Cost & Time of the project
Final Users	Delays in approve the budget for changes or additional works requested	1.00	0.85	0.85	Cost of the project
Finance Deparment	Lack of cash flow to bring forward activities not programmed in the month.	1.00	0.85	0.85	Cost & Time of the project
External Market	Exchange rate of currencies from "dollar" to "nuevos soles" for special procurement.	0.50	0.50	0.25	Cost of the project
Labors	Low ratios of productivity.	0.85	0.75	0.64	Time of the project
Labors	Lack of knowledge in execution of activities. Difficulty adapting to new changes.	0.60	0.60	0.36	Cost & Time of the project
Providers	Delays in deliver materials to the project.	0.75	0.45	0.34	Time of the project
Layout of the project	Lack of space for storage materials as bricks, cement, steel and prefabricated beams.	0.35	0.75	0.26	Cost & Time of the project
Subcontractors	Insufficient capacity of laborers	0.65	0.85	0.55	Cost & Time of the project
Subcontractors	Lack of qualified subcontractors: No economic liquidity, poor organization and documentary formalities.	0.85	0.85	0.72	Cost of the project

Table 16: *Table of Qualitative Analysis - Risks during the construction phase "Ficus."*[107]

In table 21, the primary sources of risks are coming from the subcontractors and two internal departments of the company. Several of these subcontractors had economic problems (liquidity) affecting the labors payment, as a consequence the laborers used

[107] (Sotelo, 2016)

to abandon the work. In addition to this problem of laborers desertion, the necessity to capacitate again the new laborers hired demand additional costs and time for the contractor.

Others factors as low ratios of productivity and lack of skilled labors in architecture finishes also impact in the cost due to reworked activities on which the quality in the final product was not accurate.

On the other hand, the delays in the technical answer by design department and approve of budget changes by the final user took more time than the normal established, affecting the procurement schedule and increasing the cost of labors due to standby hours for the stop of works (no authorization to continue and no material).

Finally, another important source was the cash flow of the company. Monthly the cash flow was designed to support only planned activities; however, if during the month there

would be possible to bring forward others activities, the project management was not allowed to do it because of the lack of liquidity for these new items.

4. The Quantitative Risk Analysis

Quantification of Risks during construction:

Item/Description	Original Amount	
	Soles	Dollars
Adicionales por el cliente (Additional client)	S/28,283.25	$ 8,570.68
Construccion & Subcontractors	S/91,137.27	$ 27,617.35
Total	**S/119,420.52**	**$ 36,188.04**

Table 17: *Quantification of Risks during the Construction Phase "Ficus"*[108]

The table above shows the risks originating during the construction phase. These risks are generating by three factors: Construction process, delay by the client and users and subcontractors' problems.

[108] (Sotelo, 2016)

The item “Additional Client,” belongs to the extra work which was not included in the original scope of the project.

Item/Description	Cost Approved by the User		Cost Assumed by the Owner	
	Soles	Dollars	Soles	Dollars
Adicionales por el cliente (Additional client)	S/28,283.25	$ 8,570.68		
Construccion & Subcontractors			S/91,137.27	$ 27,617.35
Total	**S/28,283.25**	**$ 8,570.68**	**S/91,137.27**	**$ 27,617.35**

Table 18: *During Construction - Cost Approved by the User and Cost Assumed by the Owner “Ficus”*[109]

From the table 23, risks represent 3.0% of the project, while the extra work required by the client is 0.93%. This additional work will have a different budget, and schedule wheatear is necessary.

These risks impacted on the project's surplus of 5%, however, the project manager optimized the real cost of resources and approached the positive risks. The last surplus at the end of the project was 2%.

5.2 INTERVIEW WITH PROJECT MANAGERS OF REAL ESTATE COMPANIES IN PERU

5.2.1 Interview with the Project Manager of Residential Building “Sucre”:

1. Which are the main risks could affect the viability in real estate project? Please only consider from the bidding process until the construction phase.

The interviewee indicates[110]**:** *There are different risks from the conception of the project itself, it could be mistaken in the economic model input or its design. Furthermore, making errors in the cost forecasting of the project as well as not selling most of the apartments during the development phase, could be detrimental due to the high banking interests and the lack of cash flow for the execution of the project.*

Regarding the possible potential buyers of the project, often the developer does not work with “target group” thus, it is unknown if the project will fulfill the client satisfaction. In addition to this, the client could be affected with hidden defects that the final product could have due to the non-accurate effective process of the project, and this is important for the client, because of the high amount of the investment that will be done.

[109] (Sotelo, 2016)
[110] (Moreano, 2018)

In Peru, the responsibility after the selling of an apartment or property is extended up to 10 years, so the construction process of the project should be carefully done and controlled to avoid or mitigate post sales repairs which generate cost losses to the contractor.

On the other hand, the competition of market in the country is usually unfair, where most of the construction companies offer products which have a good look in architecturally way but do not respect the design standards and they do not achieve the required quality. In somehow, this kind of projects has lower costs than a typical project which had followed all requirements of the design and Peruvian standards of construction. These projects do not guarantee proper behavior during an earthquake or another disaster. Unfortunately, this is not tangible and difficult to quantify.

Finally, some customers choose the project by only examining the price and the final product looks. Many clients or final users do not become aware that they can request all the necessary information related to the property execution before they received the apartment, in order to understand if the final products meet the requirements of the design.

2. Which factors do you think are the primary sources for those risks?

The interviewee indicates[111]: *The real estate market requires high risks to obtain more profit, these risks are related to the total investment needed. Some real estate companies increase their profit through the construction of residential buildings and not only be responsible for selling them. In this case, the risks are high due to some final users do not take risks to buy a project which is still in drawings, even if it is cheaper than one apartment already built. For this reason, most of the construction companies are suffering from accurate liquidity to execute the project.*

Reliability of the company is crucial for the final users. There are several cases of unethical entrepreneurs who, once they have collected the total amount, abandon the work and declare themselves in a broken bank, scamming those users who invested all their savings in that project.

[111] (Moreano, 2018)

There is no banking support to companies when they are just beginners; this generates a great effort from these entrepreneurs who need financial support to do not fail their potential clients.

On the other hand, the excessive increase in land prices and the municipality are restrictions in a project. The municipality, a stakeholder with high influence, does not contribute to increase the economic growth of the country when it interrupts or stop the development of one project.

Nevertheless, there is an excellent diversity and ideas for the urban development of new areas (non-central areas). However, the no accessibility and lack of public transport to these sectors are restrictions to continue growing up in the construction field in Lima. Further, some mafias which threat the normal development of a project if it is not well managed.

3. Which methodology do you use to treat these risks in a real estate project? What are the advantage and disadvantage of using this suggested methodology?

The interviewee indicates[112]: *According to his experience, the most significant advantage to realize a real estate project with a methodology belongs to the development phase (no construction phase). It is recommended the PMI philosophy and the use of BIM of the point of view from an MBA. In addition to this, Lean construction philosophy, Scrum and supply chain tools.*

These software and tools integrate different specialties to identify incompatibilities, restrictions, and omission of scope in order to alert the panel of experts and mitigate or avoid risks. Thus, model the project in the future through this software, do the project under control, and it allows to have better strategies for execution as well as optimums logistics. Also, help to reduce the cost impact of the project because these possible ambiguities that could be found in the integration of different specialties can be corrected and updated.

Furthermore, the analysis of incompatibilities can predict if the project is viable or not. The contractor could have dissolved the contract, before starting the construction, if the study of the project is not viable. It is preferable to lose a small amount of capital

[112] (Moreano, 2018)

than lose more after the construction of the project. In most cases, the client recognized these risks and the solution benefited both parties.

4. Which IT-System (Primavera P6, MS Project, BIM, ERP SAP, Microsoft Excel) or other software do you use or do can you suggest to treat these risks in a real estate project? Why?

The interviewee indicates[113]: *different tools are used, for small and medium companies. Working with software as Primavera is not feasible because the original license is expensive, however, there are others programs such as MS Project that in combination with S10 and Excel can cover the expectations of the managers and have minimum errors in consolidating the whole data.*

The tools of BIM help significantly to have better development of the project, in mitigating risks coming from the poor compatibility of different specialties. This task of compatibility, before BIM philosophy arrived in Peru, was the responsibility of an expert, who used to work with software and tools in 2D, for example, CAD. However, still, some companies are working with software in 2D due to the high cost which demands to implement a BIM system. In addition to this, the cost is not only due to the implementation of a BIM system, but also must to be considered the cost of new hardware and the staff capacitation. Hiring someone who knows the systems does not ensure that they know the process and vice versa.

In Peru, there is misinformation regarding the tools and software that exist in the world market to carry out real estate projects. When the tendencies of the market suggest using one updated software, most of the entrepreneurs think that this costs of implementation can affect the profit of the company or the project, they do not for seeing the long-term benefits.

5. Do you use KPIs to measure the goals achievement in a project? If that is so, which KPIs do you use? What were the latest results that you obtained at the end of the project? Could you fulfill in entirely way the goals of the project? If your answer is no, please explain the reasons and the risks which affected the success of the project.

[113] (Moreano, 2018)

The interviewee indicates[114]: *He used management indicators (KPIs), and he relays them as a tool of measure of projects goals. He is aware that largest companies use these tools as an instrument to fulfill the goals and control the risks to guarantee the success of the project and further contribution in similar futures projects.*

However, in medium and small-sized companies where he had worked in the latest years, most of them did not take the importance of management indicators, as a consequence, the final profit of the project is affected. There are several reasons that these companies did not want to accept new technologies, tools, software and applied management philosophy in their projects, is the cost and time of implementation the most potent reasons.

Most of these companies consider as a waste of money use management standards or implement this system in their project, why? Because they see the investment only in the present, but not as a benefit in the future. For them, invest at capacitation of staff from different areas, pay engineers with management know-how, install new software belong to a budget which was not provisioned and they believe that this extra budget will affect the final margin of the project. In addition to this, professional without management skills are cheaper than those who know this field, so for them is better to hire cheap stuff of engineers and architectures.

Between the tools that he had used were, cost and revenue indicators, customer satisfaction indexes, digital marketing, brand notoriety, annual growth rate, commercial efficiency by delivered budgets, KPIs to measure if the scope and objectives of the project were achieved, indexes of measure the planning (Actual vs. Plan Value) and others more. The majority of the projects on which were used management philosophy and objectives controlled by KPIs, present profits between 8% and 15%, those projects that did not use them presented losses or profits in the range of 2-3%.

5.2.2 Interview with the Project Manager of Residential Building "Ficus":

1. Which are the main risks could affect the viability in real estate project? Please only consider from the bidding process until the construction phase.

[114] (Moreano, 2018)

The interviewee indicates[115]: *One of the significant risks is the considerable increase of the dollar due to the different currency of the country ("Nuevos Soles"). This risk impacts the Project in the rare occasion, on which equipment or an incident material that cannot be found in the national market and the company has to import it from others countries with different currency where the dollar is the neutral currency for transactions.*

Furthermore risks present in the real estate projects in Peru are Works paralyzation due to the force workgroup "Syndicate", natural disasters, incompatibilities in the design or problems in the site construction. Also could be part of these risks to do not reach the minimum sale of apartments as a result of no liquidity to continue the Project.

2. Which factors do you think are the primary sources for those risks?

The interviewee indicates[116]: *There are, external factors as a demand for buying more dollars and fluctuation which influences the increment of the dollar value. There are Internal factors as problems with the force workgroup "Syndicate," lack of resources, changes of regulations in construction standards, human factors for the incompatibility issue and lack of knowledge in management in some companies.*

3. Which methodology do you use to treat these risks in a real estate project? What are the advantage and disadvantage of using this suggested methodology?

The interviewee indicates[117]: *To mitigate risks coming from the exchange of currency, is recommended to elaborate the budget in the same currency than the incidents materials are. In addition to this, could be possible to consider alternatives to materials during the design phase, especially for materials which are difficult to find in the national market or are very expensive. For example, for materials as architecture finishes.*

4. Which IT-System (Primavera P6, MS Project, BIM, ERP SAP, Microsoft Excel) or other software do you use or do can you suggest to treat these risks in a real estate project? Why?

[115] (Ibarra, 2018)
[116] (Ibarra, 2018)
[117] (Ibarra, 2018)

The interviewee indicates[118]: *For determination of incompatibilities, it is recommended BIM. This software models the project in 3D, and the designer can combine the whole specialties of the project into one file. This analysis helps to identify the risks before starting the construction phase and even although before signing the contract. Architects and engineers can solve problems of incompatibilities; thus they can mitigate risks at the beginning of the project.*

5. Do you use KPIs to measure the goals achievement in a project? If that is so, which KPIs do you use? What were the latest results that you obtained at the end of the project? Could you fulfill in entirely way the goals of the project? If your answer is no, please explain the reasons and the risks which affected the success of the project.

The interviewee indicates[119]: *He uses KPIs to measure the goals of the project and to ensure its success. Without measured indicators, it is not viable to manage and improve project by project. The KPIs or management indicators that he uses in most of the projects are: Percentage of activities accomplished (PPC) per week and in an accumulated way, the percentage of earn value (earn value divided by actual cost). For example: If the PPC is 0.83 at the end of the project, mean the project is in the national market average. However, if the earned value is 0.98, explains that for every 0.98 soles (0.30 dollars) of investment the operative profit will be 0.02 soles (0.006 dollars).*

6.0 RESULTS, MITIGATION RISK STRATEGIES USED AND STRATEGIC PLAN FOR FUTURE PROJECTS

This Chapter explains how the two real cases study of “Sucre” and “Ficus” projects were resolved according to the project management of each construction company. Next, there will be a comparison between both projects and the respective recommendations.

Finally, as the last subchapter, there will be briefly strategic planning which includes internationals standards and suggestions for future projects in Peru.

[118] (Ibarra, 2018)
[119] (Ibarra, 2018)

6.1 PLAN TO RESPONSE THE RISK: How the project manager handled these Risks?

Residential Building "Sucre" Project: For this project, the identified risks represent 4.72% of the total amount of the project. The primary sources from those risks correspond to the omission of the scope and errors in the calculation of the budget.

Initially, the loss of cost due to the risks was more significant than the profit, this being a strong restriction for the construction of the project. So the project manager, in a first instance propose to negotiate with the client about the existence of these risks before starting the execution works. The objectives of the meeting were, how these risks could impact? What could be the consequences? Moreover, what is the better way to handle these risks? There were possibilities to terminate the contract, but both parties reached an agreement, and the client assumed part of these risks to the viability of the project was not affected.

After the negotiation, the client accepts 74% of this loss cost due to risks and the difference the contractor covered 26%.

Original Amount		Cost Approved			Cost Denied		
Soles	Dollars	Soles	Dollars	%	Soles	Dollars	%
S/505,666.78	$ 153,232.36	S/374,539.09	$ 113,496.69	74.07%	S/131,127.68	$ 39,735.66	25.93%

Table 19: *Cost Approved vs. Cost Denied "Sucre"*[120]

Nevertheless, still the profit of the project was affected but now less than before. For mitigation or avoid the impact of these risks, the team management prepares a response plan to risks; this plan was implemented before starting the construction.

This response plan to risks consisted of procedures which explain how to make the project more profitable by improving the productivity of labors, optimizing the construction train process, controlling the waste of materials, controlling in detail costs of the project and to following a strategic procurement plan. Furthermore, how to deal with the different stakeholders (internal and external) and Training strategies for personnel in management.

The project manager decided to implement the lean construction philosophy in the execution of activities, so the whole team (from the labors to the head of the

[120] (Sotelo, 2015)

construction area) were capacitated in the use of tools and to be familiar with the management concepts. Next up to, as an internal control, were elaborated a target budget and schedule. These were internal documents; however, for the client, the contractual documents will be being used.

These internal documents were the new baseline and were used to control the success of the project. This new schedule and budget were based on current prices, ratios of work performance and quantities according to the reality of the project and the market.

If the contractor works hand in hand with this new schedule and budget, it guarantees compliance in the contractual field. Generally, these internal documents are more adjusted and strict but viable in comparison to those stipulated in the contract.

The advantage of working with an internal baseline will help in the identification of floats in activities, which could improve the critical path of the schedule. The positive breach in cost from the activities can cover other items that are in deficit using the compensation method. The table below shows the breach between the contractual budget and the real cost in the project. The budget has grouped by specialties.

The amounts in red within the parentheses represent the losses. According to the attached table, the risks costs plus the additional works required by the client amounts to $322,302.64. The loss cost coming from the differences between real and contractual cost $136,281.06, it is included in $322,302.64 from this amount, the client did not recognize the amount of $42,440.21. The contractor had to cover this amount.

	Actual Cost		Contractual Cost		
Specialties	**Soles (S/.)**	**Dollars ($)**	**Soles (S/.)**	**Dollars ($)**	**Breach ($)**
Privisional work	S/. 649,290.01	$ 196,754.55	S/. 3,650,830.37	$ 1,106,312.23	$ 20,675.50
Structure work	S/. 2,933,311.20	$ 888,882.18			
Architecture work	S/. 3,990,958.05	$ 1,209,381.23	S/. 3,866,853.12	$ 1,171,773.67	$ (37,607.55)
Electricity work	S/. 827,528.74	$ 250,766.28	S/. 863,338.27	$ 261,617.66	$ 10,851.37
Plumbing work	S/. 437,734.32	$ 132,646.76	S/. 501,505.53	$ 151,971.37	$ 19,324.61
Mechanics work	S/. 560,736.90	$ 169,920.27	S/. 477,262.99	$ 144,625.15	$ (25,295.12)
General Administrative Costs & Others	S/. 1,284,881.47	$ 389,358.02	S/. 874,922.90	$ 265,128.15	$(124,229.87)
	S/. 10,684,440.68	**$ 3,237,709.30**	**S/. 10,234,713.18**	**$ 3,101,428.24**	**$(136,281.06)**

Profit of the project	**$ 141,815.00**

Risks Costs and Additional works	**Total**
Orignal Amount Cost (Incl. Additional works)	**$ 322,302.64**
Approved Cost	**$ 279,862.43**
Denied Cost	**$ (42,440.21)**

Table 20: *Breaches between the actual and contractual cost "Sucre."*[121]

[121] (Sotelo, 2015)

The project manager takes the following actions in order to reduce the loss cost of the project:

- Call for tendering and select the three best subcontractors, who were offering a better price, quality and have financial liquidity.
- Create an accurate WBS of the project and establish the train sequence of work, in order to improve the line of learning in workers. Helping to optimize the productivity of labors.
- Negotiate with suppliers, agreement of better prices for wholesale purchase.
- Reducing or keeping the contractual schedule to do not increase the general administrative cost.
- Controlling the incidents materials and particular architecture finishes as cement, concrete, steel, bricks, wood floor, insulated windows, and others.
- Controlling the real vs. plan/target cost and the final operative result.
- Elaborating a procurement plan, from the requirement until the delivery of the material to the site.
- Advance plan of permits for pre-mixed concrete uses and closure of streets due to the delivery of materials.
- According to the market, the possibility to buy materials in “soles” if the value of dollars were increased.
- Implementing the use of the last planner tools: Look ahead of construction, daily plan, restriction analysis, look ahead of procurement, the percentage of activities accomplished, weekly plan.
- Using the operative result of the project per month, forecasting tables, S-Curve of physical and value advance, control of real and invoice cost, cash flow, contract management (additional and deductive works), communication formularies with the client, control of updated drawings plan, control of purchasing orders and stock per month.
- Controlling the performance of workers from each activity, updating the bank information with real ratios and accurate teams of labors for each activity, control of workforce curve, and tables of physical advance.

Primarily, the project manager focused on the exhaustive control of costs, schedule, productivity, and quality in the work to be carried out. The cost result of the project

after implementing this management system it is in table 21. A brief description of the table is:

- Incomes: Is referred to the contractual amount (payment from the client) without the profit, this is called “Contractual Cost.”
- Target Cost: Is the internal budget after updating the information with real prices, quantities, and activities which were omitted in the contractual budget. Specialties grouped this target cost.
- Approved Cost: Is the cost for additional works asked by the client and partial cost for activities omitted in the contractual budget.
- Applied Cost: Is the total cost of the project without the profit.
- Economic Margin: Is the extra amount coming from the difference between the incomes and the total cost (this could be a target or real).
- Profit: Is the contractual amount declare in the budget.
- % Surplus: It is the percentage that corresponds to an additional gain to the already declared profit in the project.

Table 21 also shows the comparison between the income from the client, the target cost, and the real cost.

It can be observed in the table, that the real cost is slightly higher than the target cost but less than the cost of sale (including the additional costs).

It was planned to have a margin of 11%. However, the contractor had to assume works without any payment due to the omission of activities that were indicated in the scope but not in the budget. As an additional strategy, the contractor optimized the cost of production from the additional works, and these savings were used to cover activities in deficit. The final margin was 8.81% from which 5% belongs to the declared profit of the project, and 3.81% is the surplus. The difference between the target margin and the real margin was used to cover the deficit in cost.

Code	Description	Total Plan		Operative Result		
		(S/.)	($)	Real Cost		% Efficiency
	INCOMES (Contractual Budget)					
	Direct Cost	S/9,359,790.28	$2,836,300.08	S/9,359,790.28	$ 2,836,300.08	
	Indirect Cost (Administrative cost)	S/874,922.90	$ 265,128.15	S/874,922.90	$ 265,128.15	
	Contractual Amount	**S/10,234,713.18**	**$3,101,428.24**	**S/10,234,713.18**	**$ 3,101,428.24**	**100.00%**
	Approved Cost	S/923,546.03	$ 279,862.43	S/923,546.03	$ 279,862.43	
	Total Amount	**S/11,158,259.21**	**$3,381,290.67**	**S/11,158,259.21**	**$ 3,381,290.67**	**100.00%**
	TARGET COST					
MO	Manpower	S/950,000.00	$ 287,878.79	S/956,812.73	$ 289,943.25	100.72%
EQ	Equipment	S/90,000.00	$ 27,272.73	S/86,160.25	$ 26,109.17	95.73%
SMAT	Materials	S/1,863,549.64	$ 564,712.01	S/1,878,841.70	$ 569,345.97	100.82%
SC	Subcontractors	S/6,394,717.25	$1,937,793.11	S/6,477,744.53	$ 1,962,952.89	101.30%
GG	Indirect Cost	S/1,172,285.26	$ 355,237.96	S/1,284,881.47	$ 389,358.02	109.60%
	Total Costo	**S/10,470,552.15**	**$3,172,894.59**	**S/10,684,440.68**	**$ 3,237,709.30**	**102.04%**
	Applied Cost	**S/10,470,552.15**	**$3,172,894.59**	**S/10,684,440.68**	**$ 3,237,709.30**	
	Economic Margin	**S/687,707.06**	**$ 208,396.08**	**S/473,818.52**	**$ 143,581.37**	
	Profit	**S/467,989.51**	**$ 141,815.00**	**S/467,989.51**	**$ 141,815.00**	
	% Margin (Surplus + Profit)	**11.04%**	**11.04%**	**8.81%**	**8.81%**	
	% Profit (from direct cost)	**5.00%**	**5.00%**	**5.00%**	**5.00%**	
	% Surplus	**6.04%**	**6.04%**	**3.81%**	**3.81%**	

Factor of Performance (CPI1 = EV/AC)	**1.04**
Factor of Performance (CPI2 = PV/AC)	**0.98**

Table 21: *Operative Result at the end of the project "Sucre."*[122]

On the other hand, for manage the schedule, the project had a target schedule as a general patron to follow and an S-Curve of physical advance to control it. This tool was used to compare the target curve, the contractual curve, the actual curve (real) and the forecasting curve.

The S-curve of physical advance used the total workforce of the project and distributed it by activities and through the time. For this reason, the importance to control the ratios of productivity per each activity, the number of hours employed by the labors in execute an activity and the exact quantity used for complete an item.

The project use formats to collect the numbers of hours for the S-Curve sheet calculation, these sheets were fulfilled by the head of the laborers per each activity. Previously to deliver the information to the cost and planning area, this information was controlled and approved by the site construction engineer. This format was the daily report of installation (RCI), the information collecting was manpower hours and the quantities executed per activities.

The figure 36, shows the S-Curve format which was used in the project. This scheme belongs to the week 17. In it, it is possible to see how the real (actual) curve of physical

[122] (Sotelo, 2015)

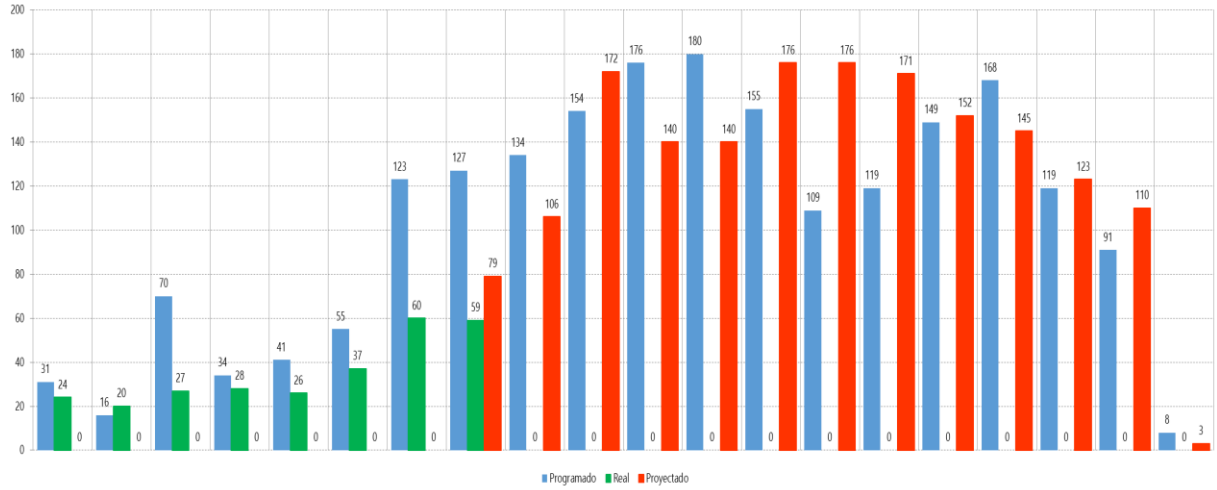
progress intersect, the contractual progress curve, the target progress curve, and the forecasting progress curve. All the curves must have the “S” shape and start at 0% and should end at 100%.

The S-Curve helps to measure the real progress in the project to compare it with the target and contractual curve to know how far or close it is from them. For example, for week 17, it could be observed that the real progress is 18.09%, the plan value is 19.78%, and the contractual progress is 29.51%. After analyzing, it can be concluded that the project is on delay with both schedules target (-1.69%) and contractual (-9.73%).

The project manager must elaborate the working plan for recovering and prevent to reach the 70% of delay from the contractual schedule because if this happens, it is mandatory to reprogram the contractual schedule and the contractor should pay penalties for it. Furthermore, it is possible to know which activities are critical from the study of the S-Curve of Physical advance.

From the figure 36, the yellow curve is the S-Curve target; the dark blue curve is the contractual S-Curve, the red curve is the S-Curve of the forecast, and the light blue curve is the real S-Curve. The table in figure 36, shows the weekly and accumulated workforce hours. These workforce hours could be real, plan, contractual ones.

The S-Curve calculate through the information of workforce hours, the target number of laborers and also can estimate the real laborers who must be in the project at that period. It will indicate if the physical laborers in the project, are employing more hours to execute the activities or if the team of laborers are over-dimensioned.

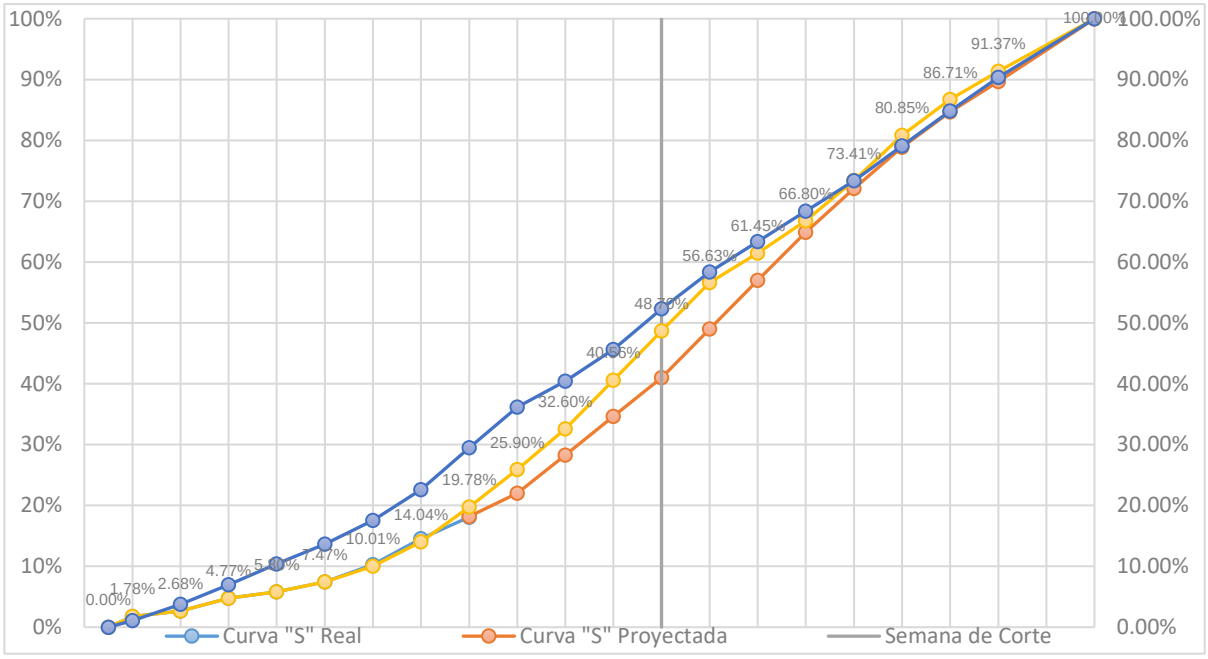


Quantities of labors	Plan	0	31	16	70	34	41	55	123	127	134	154	176
	Real	0	24	20	27	28	26	37	60	59			
	Forecast									79	106	172	140

Figure 35: *Histogram of labors "Sucre."*[123]

The blue bar is the planned number of workers, the green bar is real quantities of laborers coming from the workforce hours reported, and the red bar is the projection of the workers for the following weeks. This green bar must be compared with the list of laborers working in the project.

[123] (Sotelo, 2015)



	10/07/2015	30/07/2015	13/08/2015	27/08/2015	10/09/2015	24/09/2015	08/10/2015	22/10/2015	05/11/2015	19/11/2015	03/12/2015	17/12/2015
Programme	0	3,756	1,895	4,409	2,164	3,535	5,347	8,516	12,101	12,904	14,124	16,807
	0	3,756	5,651	10,060	12,224	15,759	21,105	29,622	41,723	54,627	68,750	85,558
	0.00%	1.78%	0.90%	2.09%	1.03%	1.68%	2.53%	4.04%	5.74%	6.12%	6.70%	7.97%
	0.00%	1.78%	2.68%	4.77%	5.80%	7.47%	10.01%	14.04%	19.78%	25.90%	32.60%	40.56%
Real	0	3,263	2,186	2,954	2,400	2,629	3,893	4,615	5,379			
	0	3,263	5,449	8,403	10,803	13,432	17,324	21,939	27,318			
	0.00%	1.78%	0.90%	2.09%	1.03%	1.68%	2.84%	4.24%	3.54%			
	0.00%	1.78%	2.68%	4.77%	5.80%	7.47%	10.31%	14.55%	18.09%			
Contractual	0	2,128	5,114	6,232	6,597	6,346	7,506	9,759	13,407	12,874	8,280	10,060
	0	2,128	7,242	13,474	20,071	26,417	33,923	43,682	57,089	69,964	78,244	88,304
	0.00%	1.10%	2.64%	3.22%	3.41%	3.28%	3.88%	5.04%	6.93%	6.65%	4.28%	5.20%
	0.00%	1.10%	3.74%	6.96%	10.37%	13.65%	17.53%	22.58%	29.51%	36.16%	40.44%	45.64%
Forecasting									38,271	8,026	13,235	13,388
									38,271	46,297	59,532	72,921
									18.19%	3.81%	6.29%	6.36%
									18.19%	22.00%	28.29%	34.65%

Programme	Total Manpower Hours
	Manpower Hours Accumulated
	% Weekly Physical Progress
	% Physical Progress Accumulated

Contractual	Total Manpower Hours
	Manpower Hours Accumulated
	% Weekly Physical Progress
	% Physical Progress Accumulated

Real	Total Manpower Hours
	Manpower Hours Accumulated
	% Weekly Physical Progress
	% Physical Progress Accumulated

Forecasting	Total Manpower Hours
	Manpower Hours Accumulated
	% Weekly Physical Progress
	% Physical Progress Accumulated

Figure 36: *S-Curve of Physical Advance, Week 17 "Sucre"*[124]

[124] (Sotelo, 2015)

Residential Building "Ficus" Project: For this project, the identified risks represent 3.00% of the total amount of the project. The primary sources from those risks are the lack of formalities in subcontractors, delay of the users in the approval of the budgets to realize the requested changes and the lack of cash flow to bring forward activities which were not planned in the month.

Same than "Sucre" project, the response plan to risks of "Ficus" project, explain how to make the project more profitable by improving the productivity of labors, optimizing the construction train process, controlling the waste of materials, controlling in detail costs of the project and to following a strategic procurement plan. Furthermore, how to deal with the different stakeholders (internal and external). The leaders of each team of laborers were capacitated with the know-how of these tools.

The project also had a target budget and schedule. These internal documents were a requirement by the owner to be more strict in the construction stage of the project and to guarantee the success of it.

In summary, these internal documents were the new baseline and were used to control the project. This new schedule and budget were based on current prices, ratios of work performance and quantities according to the reality of the project and the market.

The table below shows the breach between the original budget and the real cost at the end of the project. For this purpose, the budget has grouped by specialties.

From table 22, the additional works required by the users amounts to $8,570.68. The difference between the actual and the contractual cost is $27,617.36.

The surplus declared at the beginning of the project was $46,028.92. However, the last surplus was less than the planned value.

Specialties	Actual Cost		Contractual Cost		Breach ($)
	Soles (S/.)	Dollars ($)	Soles (S/.)	Dollars ($)	
Privisional work	S/. 99,900.00	$ 30,272.73	S/. 99,900.00	$ 30,272.73	$ -
Structure work	S/. 1,115,931.72	$ 338,161.13	S/. 1,153,417.80	$ 349,520.55	$ 11,359.42
Architecture work	S/. 1,181,852.11	$ 358,137.00	S/. 1,212,653.51	$ 367,470.76	$ 9,333.76
Electricity work	S/. 218,731.49	$ 66,282.27	S/. 227,537.18	$ 68,950.66	$ 2,668.39
Plumbing work	S/. 228,082.91	$ 69,116.03	S/. 242,100.54	$ 73,363.80	$ 4,247.76
Mechanics work	S/. 102,273.50	$ 30,991.97	S/. 102,300.00	$ 31,000.00	$ 8.03
	S/. 2,946,771.74	**$ 892,961.13**	**S/. 3,037,909.02**	**$ 920,578.49**	**$ 27,617.36**

Surplus declared of the project	$ 46,028.92

Risks Costs and Additional works	Total
Additional works requested by users	**$ 8,570.68**

Table 22: *Breaches between the actual and contractual cost "Ficus."*[125]

The project manager optimized the construction process, the excellent use of resources and management in property the procurement plan to achieve the surplus established at the beginning of the project and for these reasons, the following were established:

- Call for tendering and select the four best subcontractors, who were offering a better price, quality and have a financial. All the contracts of subcontractors should have had a clause which stipulates penalties or sanctions in case of non-compliance with its obligations.
- Divided the project in accordance to the WBS of the project and established the train sequence of work, in order to improve the line of learning in workers and increase the productivity of laborers.
- Controlling the incidents materials and particular architecture finishes as cement, concrete, steel, bricks, wood floor, and others.
- Controlling the real cost vs. plan/target cost and the final operative result.
- Elaborating a procurement plan, from the order of purchase until the delivery of the material to the site.
- Advance plan of permits for pre-mixed concrete uses and closure of streets due to the delivery of materials.
- Plan the activities with four weeks' horizons and weekly plan of activities. This plan included the number of laborers per activity.

[125] (Sotelo, 2016)

- An easy understanding sequence to follow in particular activities. For strenuous activities, the site engineer established the sequences of construction for that activity by colors.
- According to the market, the possibility to buy materials in “soles” if the value of dollars were increased.
- Implementing the use of the last planner tools: Look ahead of construction, daily plan, restriction analysis, look ahead of procurement, the percentage of activities accomplished, weekly plan.
- Using the operative result of the project per month, forecasting values, S-Curve of valued advance, control of real and invoice cost, cash flow, contract management (additional and deductive works), communication formularies with the client, control of updated drawings plan, control of purchasing orders and stock per month.
- Controlling the performance of workers from each activity, updating the bank information with real ratios and accurate teams of labors for each activity, control of workforce curve, and tables of physical advance.

In summary, the project manager focused on the exhaustive control of costs, schedule, productivity, and quality in the work to be carried out. The cost result at the end of the project, it is in the table below.

- Incomes: Is referred to the contractual amount (budget from the owner).
- Target Cost: Is the internal budget after updating the information with real prices, quantities, and activities which were omitted in the contractual budget. Specialties grouped this target cost.
- Approved Cost: Is the cost of additional works asked by the users.
- Applied Cost: Is the total cost of the project.
- Economic Margin: Is the extra amount coming from the difference between the incomes and the total cost (this could be a target or real).

Code	Description	Total Plan		Operative Result		
		(S/.)	($)	Real Cost		% Efficiency
	INCOMES (Contractual Budget)					
	Direct Cost	S/3,037,909.02	$ 920,578.49	S/3,037,909.02	$ 920,578.49	
	Contractual Amount	**S/3,037,909.02**	**$ 920,578.49**	**S/3,037,909.02**	**$ 920,578.49**	**100.00%**
	Approved Cost	S/28,283.25	$ 8,570.68	S/28,283.25	$ 8,570.68	
	Total Amount	**S/3,066,192.27**	**$ 929,149.17**	**S/3,066,192.27**	**$ 929,149.17**	**100.00%**
	TARGET COST 1					
MO	Manpower	S/261,849.89	$ 79,348.45	S/267,362.51	$ 81,018.94	
EQ	Equipment	S/24,806.83	$ 7,517.22	S/25,329.08	$ 7,675.48	
SMAT	Materials	S/513,652.91	$ 155,652.40	S/524,466.65	$ 158,929.29	
SC	Subcontractors	S/1,762,585.25	$ 534,116.74	S/1,799,692.30	$ 545,361.30	
GG	Indirect Cost	S/323,118.70	$ 97,914.76	S/329,921.19	$ 99,976.12	
	TARGET COST 2					
AD	Additionals works	S/28,283.25	$ 8,570.68	S/28,283.25	$ 8,570.68	
	Total Costo	**S/2,914,296.82**	**$ 883,120.25**	**S/2,975,054.99**	**$ 901,531.81**	**102.08%**
	Applied Cost	**S/2,914,296.82**	**$ 883,120.25**	**S/2,975,054.99**	**$ 901,531.81**	
	Economic Margin	**S/151,895.45**	**$ 46,028.92**	**S/91,137.29**	**$ 27,617.36**	
	% Margin (Surplus)	**5.00%**	**5.00%**	**3.00%**	**3.00%**	

Factor of Performance (CPI1 = EV/AC)	**1.03**
Factor of Performance (CPI2 = PV/AC)	**0.98**

Table 23: *Operative Result at the end of the project "Ficus."*[126]

It can be observed in the table, that the real cost is slightly higher than the target cost but less than the direct cost established at the beginning.

It was planned to have a surplus of 5%. However, the contractor had difficulties during the executing of the project, and the final surplus was 3%.

In contrast, for manage the schedule, the project had a target schedule, and the S-Curve of valued advance supported it. This tool was used to compare the target curve, the contractual curve, the actual curve (real) and the forecasting curve.

The S-curve of valued advance uses the total budget and distributes it by activities and through the time.

The actual progress value per month is the valuation of the work executed in that month. The project used formats to collect the real quantities installed which were fulfilled by the head of the labors per each activity. Previously to deliver the information to the cost and planning area, this information was controlled and approved by the site construction engineer. This format was the daily report of installation (RCI), the information collecting was workforce hours and the quantities executed per activities.

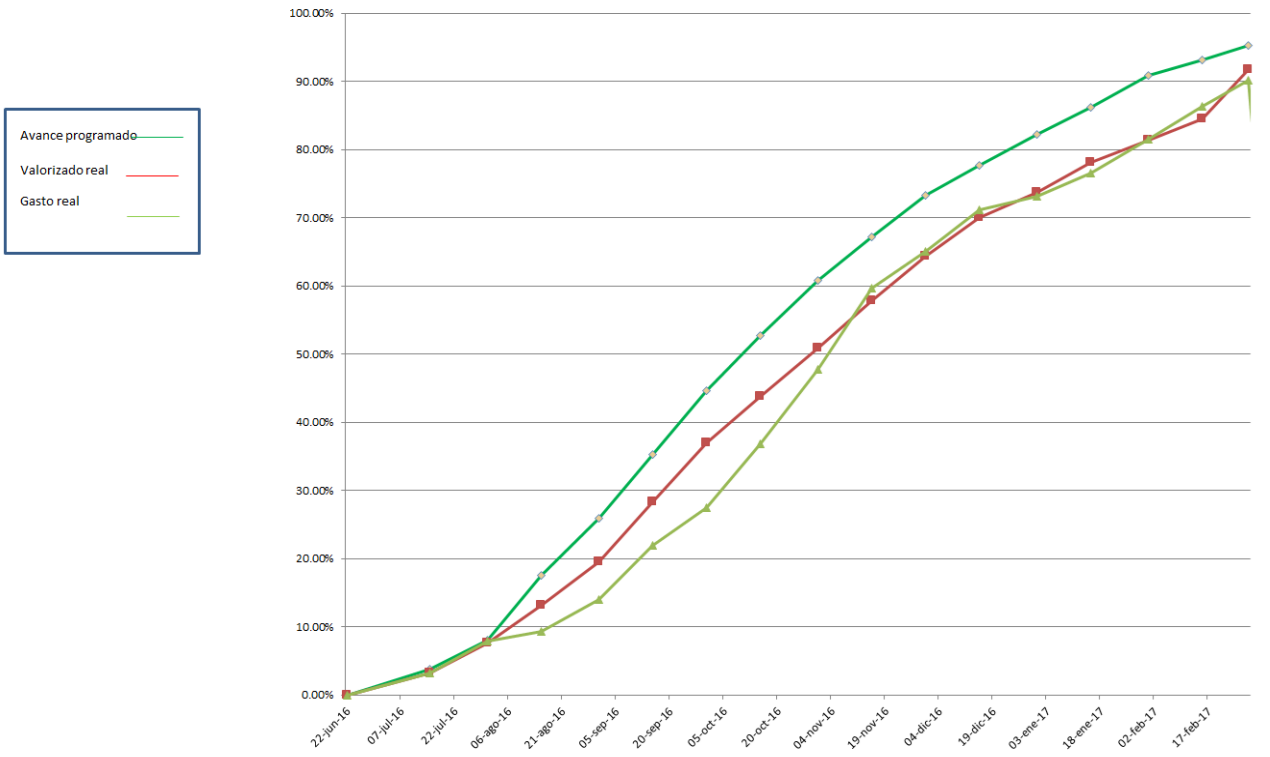
[126] (Sotelo, 2016)

The figure 37, shows the S-Curve format which was used in the project. This scheme belongs to the week 17. In it, it is possible to see how the real (actual) curve of physical progress intersect, the contractual progress curve, the target progress curve.

The S-Curve helps to measure the real-valued progress of the project and compare it with the target and contractual curve in order to know how far or close is this actual value from them. For example, for week 17, it could be observed that the real progress is 90.17%, the target value is 95.30%, and the contractual progress is 91.77%. After analyzing, it can be concluded that the project is on delay with both schedules, target (-5.13%) and contractual (-1.60%).

The project manager must elaborate on the working plan for recovering, in order to avoid being under the contractual schedule. It is possible to know which activities are critical from the study of the S-Curve of valued advance.

From the figure 37, the dark green curve belongs to the target schedule, the green light curve is the real value progress, and the red curve is the contractual schedule.



	22/06/2016	15/07/2016	31/07/2016	15/08/2016	31/08/2016	15/09/2016	30/09/2016	15/10/2016	31/10/2016	15/11/2016	30/11/2016	15/12/2016	31/12/2016	15/01/2017	31/01/2017	15/02/2017	28/02/2017	15/03/2017	31/03/2017	15/04/2017	30/04/2017
CRONOGRAMA DE DESEMBOLSO - PROGRAMADO	0.00%	3.71%	8.04%	17.58%	25.89%	35.23%	44.58%	52.70%	60.75%	67.22%	73.29%	77.66%	82.23%	86.12%	90.88%	93.14%	95.30%	96.62%	98.08%	99.00%	100.00%
VALORIZADO REAL DE OBRA	0.00%	3.27%	7.62%	13.12%	19.58%	28.36%	36.94%	43.83%	50.93%	57.85%	64.36%	70.00%	73.77%	78.15%	81.39%	84.46%	91.77%	91.77%	91.77%	91.77%	91.77%
GASTO REAL - INCLUYE IGV	0.00%	3.27%	7.91%	9.25%	14.06%	22.00%	27.42%	36.88%	47.80%	59.67%	65.08%	71.17%	73.20%	76.59%	81.48%	86.26%	90.17%	0.00%	0.00%	0.00%	0.00%

Figure 37: *S-Curve of Physical Advance, Week 17 "Ficus"*[127]

6.2 CONTROL THE RISKS: How the Project Manager controlled these Risks?

Residential Building "Sucre" Project: The management system implemented in the project contains how these risks will be controlled and monitored.

This management system consists of the development of an accurate method to control the cost, time and quality of the project. The project manager implemented a system based on the PMBOK, Peruvians standards and Lean Construction tools as a guideline. This system was conforming by:

- A management procedure for cost control and planning in the project, composing by the target budget using real analysis price units and the target schedule updated with a real ratio of productivity and correct dimension of the labors team.

[127] (Sotelo, 2016)

- Reports of incurred costs of the project, which consists in record and control of real and invoiced costs, provisions which were used in the month but could not be invoiced, and forecasting costs, cash flow, register of purchase orders and services, stock value of the warehouse and formats for controlling incidents materials, and procurement chart.
- Reports of controlling and monitoring: Critical Project, Femfo Annex, Manpower Report, Adjusted Economic Report.
- S-Curve of physical and actual work progress, measured by the management of performance indicators CPI, SPI, EV, AC, PV, and others.
- Valuation report of subcontractors and suppliers.
- Formats of Lean Construction tools as Progress Look-ahead-schedule, PPC, restriction analysis, weekly plan, PAC, and others.
- Elaboration of gaps analysis reports in costs and workforce of budget items. Realization of reports and notify the project manager and resident engineers, elaboration of recovery plans in production progress and strategic plan to confront shortage in the costs progress and improvement.

KPIs as a measurement and control tool of objectives and risks:

The project manager through implementing a management system wanted to achieve the primary objectives of the project which were the Cost, Time and Quality. Is not only the use of tools formats and reports which guaranteed the success of the project, but it is also necessary to establish KPIs in order to measure whether the project objectives will be met or not.

The KPIs not only will measure the goals of the project also will help to control the risks which are related with the project objectives, because in somehow the business initiatives/strategies to achieve these goals consists in mitigate or avoid risks which can impact the objectives of the project negatively.

The following table shows the objectives and KPIs for Cost and Time.

Objective	KPI	KPI Metric	KPI Target Value	IT-System	Strategies
Complete the project with a surplus	The margin of the project	%	10.00%	SAP ERP - Cost Module	1. Elaborating a target budget with real analysis price unit (updated information).
					2. Applying compensation method between negative items with items that are in positive income.
					3. Manage the extra cost due to an omission in the scope in carefully way. Optimize the resources in this critical activities.
The real cost must be less than the plan cost	Cost performance index (CPI)	Number	CPI > 1	SAP ERP - Cost Module, Macro in excel & Oracle for warehouse	1. Controlling the real cost by phases and activities. Developing a WBS for cost.
					2. Controlling the waste of materials especial in the use of concrete and materials for architectural finishes.
					3. Controlling manpower cost, incidents materials and stock (warehouse).
Have a positive cash flow during the project	Liquidity of the project per month	Soles (S/.)/ month	S/. 1'000,000.00 ($304,000.00)	SAP ERP - Cost Module & Macro in excel	1. The valued progress of the month must be greater than the costs incurred in the month.
					2. Payment of subcontractor and suppliers must be according to the schedule.
					3. Controlling the physical progress of works according to the target schedule.

Table 22: *Cost KPIs & Objectives "Sucre"*[128]

[128] (Sotelo, 2015)

Objective	KPI	KPI Metric	KPI Target Value	IT-System	Strategies
Complete the project in contractual time	Milestone	Month	30/08/16	Primavera P6 Professional R 8.1	1. Elaborating a target schedule with real ratios of productions and quantities. 2. Plan of recovering in case of delays. Use the floats of the activities in case of emergency as risk plan answer. 3. Use Fast Tracking concept to overlap possible activities.
Real physical progress must be equal to or more than the plan progress	Schedule performance index (SPI)	Number	SPI > 1	Primavera P6 Professional R 8.1/MS Project/ S-curve in excel	1. Daily control of the quantities installed. Analysis of real vs. standard productivity ratio. 2. Control the workforce hours per day vs. numbers of laborers. 3. Control of procurement chart, look ahead of activities and revision of the weekly plan.
Control of the projected days to finish the project.	Estimated duration at completion (EAC)	Number	EDAC =< TAC	Primavera P6 Professional R 8.1/MS Project/ S-curve in excel	1. Weekly control of real vs. planned workforce hours. 2. Control of subcontractors that have correctly of numbers of laborers per team. 3. Coordinate with the supervision a plan of tests and conformities so that there is continuity in the execution of the works.

Table 23: *Time KPIs & Objectives "Sucre"*[129]

Management Index:

PV: Planned Value	119,442 hh
AC: Actual Cost	81,957 hh
EV: Earned Value	95,056 hh

SV: Schedule Variance = EV - PV
SV = 95,056 - 119,442 = -24,386 hh

SPI: Schedule Performance index = EV / PV
SPI = 95,056 / 119,442 = 0.7958

CV: Cost Variance = EV - AC
CV = 95,056 - 81,957 = 13,099 hh

CPI: Cost Performance Index = EV / AC
CPI = 95,056 / 81,957 = 1.1598

Figure 38: *Management Index, controlling the Real S-Curve of physical progress in week 17 "Sucre."*[130]

[129] (Sotelo, 2015)
[130] (Sotelo, 2015)

Forecasting

TAC: Time at completion		=	331 días
AD: Actual duration		=	150 días
ED: Earned duration = AD x SPI			
	ED = 150 x 0.7958	=	119 días
EDR: Estimate duration of the rest = Factor x (TAC - ED)			
Factor 1 = 1		=	1.0000
Factor 2 = 1 / SPI		=	1.2565
Factor 3 = 1 / (CPI x SPI)		=	1.0834
	Used Factor	=	Factor 1
	EDR = 1.0000 x (331 - 119)	=	212 días
EDAC: Estimate duration at completion = AD + EDR			
	EDAC = 150 + 212	=	362 días
BAC: Budget at completion		=	206,836 hh
ETC: Estimate to complete = Factor x (BAC - EV)			
Factor 1 = 1		=	1.0000
Factor 2 = 1 / CPI		=	0.8622
Factor 3 = 1 / (CPI x SPI)		=	1.0834
	Factor utilizado	=	Factor 1
	ETC = 1.0000 x (206,836 - 95,056)	=	111,780 hh
EAC: Estimate at completion = AC + ETC			
	EAC = 81,957 + 111,780	=	193,737 hh
VAC: Variance at completion = EAC - BAC			
	VAC = 193,737 - 206,836	=	-13,099 hh
TCPI: To complete performance index = (BAC - EV) / (EAC - AC)			
	TCPI = (206,836 - 95,056) / (193,737 - 81,957)	=	1.0000

Figure 39: *Forecasting, Controlling the Real S-Curve of Physical Progress in week 17 "Sucre."*[131]

Figures 38 and 39 are the analysis and results in week 17 of the project. These indicators were used to measure the schedule and the total workforce hours as a part of the cost objective.

It could be noted in week 17 the project was behind the target schedule SPI = 0.7985 (SPI < 1) and under the planned cost CPI = 1.1598 (CPI > 1) which means there is a necessity to add resources (manpower hours) or the ratio of productivity of laborers were not according to the standard value declared. The project manager must start the recovering plan in order to avoid the risk to be in delay.

Furthermore, according to the forecasting, if the project continues with the same resources or the productivity of laborers do not improve, the project will have a delay of 31 days.

[131] (Sotelo, 2015)

On the other hand, in the bottom part of table 21, there are indicated the KPIs for cost at the end of the project.

	Total Plan		Operative Result		
	(S/.)	($)	Real Cost		% Efficiency
Applied Cost	S/10,470,552.15	$3,172,894.59	S/10,684,440.68	$ 3,237,709.30	
Economic Margin	S/687,707.06	$ 208,396.08	S/473,818.52	$ 143,581.37	
Profit	S/467,989.51	$ 141,815.00	S/467,989.51	$ 141,815.00	
% Margin (Surplus + Profit)	11.04%	11.04%	8.81%	8.81%	
% Profit (from direct cost)	5.00%	5.00%	5.00%	5.00%	
% Surplus	6.04%	6.04%	3.81%	3.81%	
Factor of Performance (CPI1 = EV/AC)	1.04				
Factor of Performance (CPI2 = PV/AC)	0.98				

***Figure 40**: Cost KPIs "Sucre"*[132]

Residential Building "Ficus" Project: The management system which was used in the project contains how these risks will be controlled and monitored. These strategies were to control the cost, time and quality of the project. Same than "Sucre" project, the implemented system is based on the PMBOK, Peruvians standards and Lean Construction tools (Last Planner) as a guideline. This system was conforming by:

- A management procedure for cost control and planning in the project, composing by the target budget using real analysis price units and the target schedule updated with a real ratio of productivity and correct dimension of the laborer's team.
- Reports of incurred costs of the project, which consists of record and control of real and invoiced costs, forecasting costs, and cash flow.
- Reports of controlling and monitoring: Manpower Report and Operative Result of the Project.
- S-Curve of valued progress, measured by the management of performance indicators CPI, SPI, and others.
- Control of subcontractors and suppliers.
- Formats of Lean Construction tools as Progress Look-ahead-schedule, analysis of restriction, weekly plan, and PAC.
- Elaboration of gaps analysis reports in costs and workforce of budget items. Preparation of reports, alert the project manager and resident engineers, the

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realization of recovery plans in production progress and strategic plan to confront shortage in the costs progress and improvement.

KPIs as a measurement and control tool of objectives and risks:

The priority objectives for project stakeholder point of view is to achieve the three peak of the triangle Cost, Time and Quality which guarantee the success of the project.

Similar to the "Sucre" project, tools and formats were used to control and monitoring the objectives and risks. To guarantee the success of the project were established KPIs. This KPIs not only will measure the goals of the project also will help to control the risks which are related with the project objectives, because in somehow the strategies to achieve these goals consists in mitigate or avoid risks which can impact these objectives negatively. For example, in the bottom part of table 23, there are indicated the KPIs for cost at the end of the project.

	Total Plan		Operative Result		
	(S/.)	($)	Real Cost		% Efficiency
Applied Cost	S/2,914,296.82	$ 883,120.25	S/2,975,054.99	$ 901,531.81	
Economic Margin	S/151,895.45	$ 46,028.92	S/91,137.29	$ 27,617.36	
% Margin (Surplus)	5.00%	5.00%	3.00%	3.00%	
Factor of Performance (CPI1 = EV/AC)	1.03				
Factor of Performance (CPI2 = PV/AC)	0.98				

Figure 41: *Cost KPIs "Ficus"*[133]

Furthermore, the objectives and KPIs for Cost and Time of the project are in the tables below.

[133] (Sotelo, 2016)

Objective	KPI	KPI Metric	KPI Target Value	IT-System	Strategies
Complete the project with a surplus	The margin of the project	%	5.00%	SAP ERP - Cost Module & S10	1. Elaborating a target budget with real analysis price unit (updated information)
					2. Optimize the resources in critical activities.
The real cost must be less than the plan cost	Cost performance index (CPI)	Number	CPI > 1	SAP ERP - Cost Module and Oracle for warehouse	1. Controlling the real cost by phases and activities. Developing a WBS for the cost.
					2. Controlling the waste of materials especial in the use of concrete and the materials for architectural finishes.
					3. Controlling workforce cost, incidents materials and stock (warehouse).
Have a positive cash flow during the project	Liquidity of the project per month	Soles (S/.)/ month	S/. 289,324.67 ($87,674.14)	SAP ERP - Cost Module & Excel	1. The valued progress of the month must be greater than the costs planned in the month.
					2. Payment of subcontractor and suppliers must be according to the schedule.

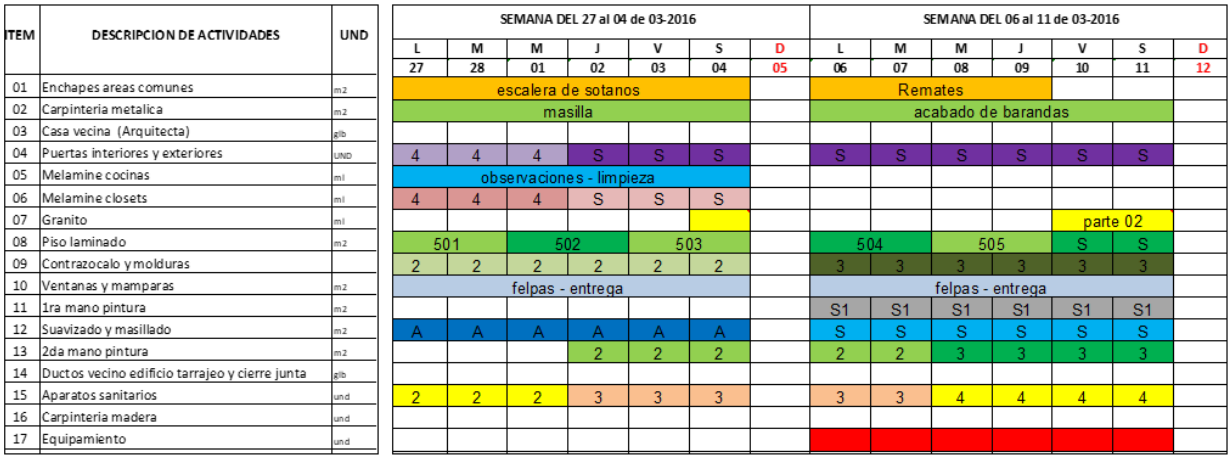
Table 24: *Cost KPIs & Objectives "Ficus"*[134]

Objective	KPI	KPI Metric	KPI Target Value	IT-System	Strategies
Complete the project in contractual time	Milestone	Month	29/04/17	MS Project	1. Elaborating a target schedule with real ratios of productions and quantities.
					2. Plan of recovering in case of delays. Use the floats of the activities in case of emergency as risk plan answer.
					3. Use Fast Tracking concepts to overlap possible activities.
Real physical progress must be the same or more than the plan progress	Schedule Performance Index (SPI)	Number	SPI < 1	MS Project & S-curve in excel	1. Daily control of the quantities installed. Analysis of real vs. standard productivity ratio.
					2. Control the workforce hours per day vs. numbers of laborers. Control of subcontractor works.
					3. Control of procurement chart, look ahead of activities and revision of the weekly plan.
Control of the projected days to finish the project.	Estimated duration at completion	Days	25 days less	MS Project & S-curve in excel	1. Control of subcontractors that have correctly of numbers of laborers per team and resources.
					2. Coordinate with the last users to approve in proper time the new budget for modifications.

Table 25: *Time KPIs & Objectives "Ficus"*[135]

[134] (Sotelo, 2016)
[135] (Sotelo, 2016)

On the other hand, the figure below shows the Look Ahead program from the next two weeks of the project.



ITEM	DESCRIPCION DE ACTIVIDADES	UND
01	Enchapes areas comunes	m2
02	Carpinteria metalica	m2
03	Casa vecina (Arquitecta)	glb
04	Puertas interiores y exteriores	UND
05	Melamine cocinas	ml
06	Melamine closets	ml
07	Granito	ml
08	Piso laminado	m2
09	Contrazocalo y molduras	
10	Ventanas y mamparas	m2
11	1ra mano pintura	m2
12	Suavizado y masillado	m2
13	2da mano pintura	m2
14	Ductos vecino edificio tarrajeo y cierre junta	glb
15	Aparatos sanitarios	und
16	Carpinteria madera	und
17	Equipamiento	und

SEMANA DEL 27 al 04 de 03-2016							SEMANA DEL 06 al 11 de 03-2016						
L	M	M	J	V	S	D	L	M	M	J	V	S	D
27	28	01	02	03	04	05	06	07	08	09	10	11	12
escalera de sotanos							Remates						
masilla							acabado de barandas						
4	4	4	S	S	S		S	S	S	S	S	S	
observaciones - limpieza													
4	4	4	S	S	S								
											parte 02		
501		502		503			504		505		S	S	
2	2	2	2	2	2		3	3	3	3	3	3	
felpas - entrega							felpas - entrega						
							S1	S1	S1	S1	S1	S1	
A	A	A	A	A	A		S	S	S	S	S	S	
			2	2	2		2	2	3	3	3	3	
2	2	2	3	3	3		3	3	4	4	4	4	

Figure 42: *Look Ahead "Ficus" project*[136]

6.3 COMPARISON BETWEEN CASES STUDIES

While is true, both projects “Sucre” and “Ficus” are part of real estate projects, these two cases studies have differences between them. These controversies are:

The magnitude of each project. Sucre project belongs to medium size project (5MM dollars) while Ficus is a small-scale project (less than 1MM dollars).

The target group of the Sucre project was people with high incomes, while for Ficus project the target market was addressed to people with medium income. The price of each apartment will increase if the architectural finishes are more expensive, as well as the square meters of areas are more). In addition to this, if the building, including the apartment, has more services will help to increment the price of it.

The strong difference was the management system which each project had and also in which step of the development of the project, the company decided to involve the project manager and the general contractor or individual contractors.

Sucre project, hired the project manager after the offer was awarded. The risks were for both parties involved: the owner and the same contractor. Unfortunately, Sucre project had a weak management system which was improved and complemented after the contractor company hired the project manager. Risks concerns to the offer had high impacts on cost and time above the project, these risks not only affected the

[136] (Sotelo, 2016)

general contractor, even the owner because the company had to pay for many changes which were necessary to accomplish the scope of the project, most of these mistakes were incongruences on the engineering and architecture drawings. However, Ficus project included the project manager from the beginning of the project, and the percentage of risks were lower than the first project.

The management system in Ficus project was stable and aligned with PMP and Lean Construction philosophy, although there was some factor which affects the planned scheme of the project.

These differences depend mainly on the company and how updated they want to be in the market. Incorporate a management system for projects, which contains a Risk Management system, will improve the final result of the project and will make the company more competitive inside the construction market.

It is clear, the role which plays each stakeholder also impact on the good performance of the project. For Sucre project, the owner was different from the general contractor as well of the supervision company, all people involved in this project had diverse interest, so the project manager had to work more in order to reach the status quo of the project.

Nevertheless, Ficus project, the owner, and the contractor was the same entity. So the project manager had to lead with two internal stakeholders but both had the same interest in the success of the project. Any lost in cost would affect the contractor as well as the owner, that the reason to implement a management system to avoid negative impacts in cost and time.

Finally, is clear that Sucre, had more losses than the Ficus project and the reasons were explained in the paragraphs above.

6.4 STRATEGIC PLANNING IN PERUVIAN REAL ESTATE PROJECTS

A strategic plan must guide an official preventive plan to achieve the goals project.

1. SWOT Analysis

SWOT Analysis of Real Estate Projects in Peru:

Strengthens

- A positive image of construction business due to the development of the housing market throughout the country.
- Projects in multifamily housing, as a consequence of the dynamism in economic sectors and the higher purchasing power of families.
- Demand in self-construction shows sustained growth.
- Permanent investment flows despite crisis scenarios.

Opportunities

- Technical cooperation and availability of international financial resources in order to channel investments for rural and urban housing.
- Sustained growth of the national economy and employment.
- The process of decentralization and modernization of the State.
- Disposition of alternative and non-conventional technologies for the design and construction processes.
- Active participation of banks in housing financing.

Weakness

- Regulations not updated in construction. Lack of standards in construction procedures and bidding process.
- Lack of an ecological approach for construction that allows mitigating the environmental impacts.
- No proper training in the workforce of labors.
- Subcontracting in some cases generates no formal jobs.
- Housing deficit is consisting mainly of low-income families.

Threats

- Uncertainty in international economic trends, which may affect the profitability and expectations of investors.
- Increase in international prices of construction materials would affect domestic demand.
- Deficient management of Regional and Local Governments in public works.
- Informality that would affect the quality of the sector.

- The absence of programs to face the possible contingencies derived from natural disasters.

2. Vision statement Setting

In Peru, it is common fit a vision related to:

- The expansion of the company: Projects contract at the national level.
- Execute profitable projects: Projects over the amount of 1MM-2MM Americans Dollars, on which the surplus must be as a minimum 5% of the total project.
- Have a list of permanent clients: Win the client after the finalization of the project.
- Make the company competitive inside the construction market: Appropriate prices, time and meet the minimum quality standard on the final products.

Nevertheless, these statements will vary in accordance with the different stakeholders involved in the company. For a small and medium-size companies, the horizon of time to achieve these statements is normally between 3-5 years, usually after the second or third project of the company. Most of the company through the use of IT-Systems and implementing a management system in the company as well as the project, are able to achieve the statements stipulated.

3. Creating Objectives and strategic plan

The objectives will be according to the company, target group, stakeholders interest and how strict is the vision of the company.

- Clients: The company must define to which target group will be addressed the project. This research Is focus on families with medium incomes, S/. 7,5000 - S/. 30,000 Nuevos Soles gross per month, and families with high incomes more than S/. 30,000 Nuevos Soles. Furthermore, it is necessary to understand what are the client's needs and wishes related to housing. For example, for these target group are really important the well location of the project, easy accessibility, short distance to their workplace and schools, security, square meter area, parking lots, smart buildings, a different type of architectural finishes, and others more.

- Services: The entity should establish the list of services that will be provided. These services must be ordered according to the priority and focus to satisfy the client necessity. For example, the company besides the construction services can offer the maintenance and the service of operation as a part of facility management or can help in the inscription of the property at the Municipality and National Register of Property, after delivered to the client.

- Internal Processes: The company should develop its internal process aligned with the objectives. The enterprise offers as final products apartments, so, it is primarily for the core business that the final product accomplishes the requirement of time, cost and quality indicated in the contract. The most significant internal process for a real estate company after the development phase is the construction.

  Hence the development and the construction phase belong to the main core business in a real estate company, it is recommended to emphasize in aspects such as design, engineering, productivity in the executions of activities and others more.

- People and Knowledge: The success of a company, as well as projects, depends on its vast majority of human resources. It is really important that people have the commitment to the company and the accurate skills for the work position. Consequently, it is necessary to focus on people and knowledge areas which are related to the core business of the company. For example, for a real estate company, they must focus on areas like human resources, management area, construction area, security, QA/QC area and others more.

  It is recommended that the professional or the subcontractors meet the requirement and have the correct capability in relation to the area of work. Have the inadequate workforce could bring mistakes which can affect the cost, time, quality of the final product.

- Financial Resources: In this step, the company should make secure to cover the needed financial resources and to establish an accurate distribution of the financial capital in order to optimize it. For real estate projects, the sale of apartments guarantees the liquidity to construct the project.

4. Strategic Performance Measures

The concept of management indicators or KPIs will help the company to measure its goals, to understand if what had planned were achieved or not, further analyze the strategy had been utilized were the proper one or it needs to be updated, modified or radically changed.

For real estate companies could be as KPIs the following:

- The number of the apartment that was sold.
- For debts and loans, the yield of return.
- A number of the project in a year.
- Final margin in projects
- Satisfaction of clients after executed the project and others more.

The company can use the concept of Balance Score Card and divide the goals according to the area and establish for each area, the appropriate KPIs.

5. Strategic Initiatives

After the goals are established, the Company must implement the strategy to achieve them. These strategies must be effective, and according to the area of the objective, the team should have the skills and knowledge to handle them. However, the investment in a new system should economically reasonable.

For real estate companies in order to be a success must meet the basic requirement as:

- Implement a management system and KPIs in the company as well in their projects. For example Lean Construction, BIM, PMP, and others philosophy can help in different phases of the project.
- Promote the use of IT-system and tools. For example, ERP SAP module for cost and warehouse can connect the central logistics with logistics and administrative apartment on each project. They are connected online and the information is reachable for any authorized person. In addition to this, BIM tools can interrelate different areas in a company, mitigating in this way risks which can impact cost and time impact on the project.
- Accurate marketing to sell the final product of the company.

- Achieve the client satisfaction through the quality of the final product.

The list above are some basic issues that each company must considerate. Nevertheless, there is no a standard patron for control the company and projects. Each company has their own system to classify and control their cost and others resources. Even, the system can change in a different project from the same company.

The most accurate if that Peruvian Estate implements a Standard codification for all companies (national and private units). So, the public organism which is responsible to control projects and companies will have an easy way to audit.

6. Identify Strategic Risks

Managing risk is a key part of effective strategic planning. Risk management can be defined as the identification and mitigation of risks, which would hamper the execution of a strategy.

Strategic risks could be from the external environments such as context related to politics, economics, social issues, technology, the environment/climate, legalities and others more. Furthermore, strategic risks could be from internal environment related to human capital, processes, projects, service quality, and service timeliness.

The basic developing of risk management approach is Identification, Prioritization, Mitigation, and Monitoring. There are tools and software working in hand to hand with BIM which can reduce risks at the very beginning of a project, they can detect omissions in scope, incongruence between specialties and also add changes (a requirement by the clients) during the design phase. For risks which can be generated in the construction phase as lack of productivity or controlling cost & time, there are tools like The Last Planer from Lean Construction and Earned Value from PMP.

Chapter five, explain in detail the steps for developing a basic risk management plan for construction projects.

7. Managing the Strategy

After the company implements the strategies is necessary to ensure that the strategy is effectively used as a management tool. Strategy review meetings can help drive organizational focus, ensure individual accountability and drive desired results.

7.0 CONCLUSIONS AND SUGGESTIONS

Risk Management is a field that is being implemented in today's projects in Peruvian Real Estate companies as a preventive plan.

Concerns to small-medium size companies in Peru, the main factors which generate risks are the lack of knowledge in management, to do not have the accurate staff of professionals to manage a company as well as the projects, subcontractor's informalities, omission of the scope, incompatibilities of the different specialties and wrong bidding process.

From both developed cases studies the percentage of risks for each project is 4.73% (Sucre) and 3% (Ficus) from the total amount of each budget. Those risks in their majority come from the offer due to human mistakes and for not using an accurate software to solve incongruence between the specialties, however, the lack of formalities in subcontractors is one of the main factors which affects in drastically way the normal execution of a project.

It is really important to have an area inside the company, or an external area as a subcontractor or professional with experience in the field of contract management because according to the contract, risks with cost and time impacts can affect in dramatically way the project. For Sucre project, the contract was a lump sum, so errors in quantities, wrong budgeting, and omission of scope they should not have been covered by the client. But an "act of good faith" and the good relationship with the client, help the company to afford part of these risks. These risks represented 4.73% of the total amount of Sucre Budget.

Furthermore, a non-expert bidding area plus the non-use of an IT-system as BIM for discharge incompatibilities between specialties could be a disaster in a small-medium sized company, due to 1% of the budget represent 1 point in their profit. Normally these types of company, forecast 5% of the total amount of the budget as profit.

On the other hand, additional changes not agreed in the contract, the client should pay for them and in the case that these additional works affect the critical path of the schedule, it is necessary that the client grants extension in days to the project. For project Sucre, these additional changes represented 5.21% while for Ficus project only 0.93%, this strong contrast is due to the different target group which each project was addressed. However, this additional changes in some part of the project became a risk

because the delay from the client or final users to approve and pay the budget for this new works, take more time than the planned, affecting the procurement of new materials and extra cost for standby hours from machines and labors from others contractual activities coming after the changes.

The large and experienced companies in Peru have a management system implemented in the different areas of the companies as well as in their projects. The main reason is that they have a well economic capacity and can dispose of a budget for the areas of management to achieve market excellence. In contrast, small and medium-sized companies, many of them see this investment as an extra expense or waste of money. They do not foresee this investment as a cost-benefit in the future. Many of the owners of these companies are reluctant to change, to be updated and use new systems, tools and software's that are currently used in the national and international construction market. Implement a management system demand a special budget and commitment because is not only by the software, is also capacitate the staff and a strong commitment from the whole company to make this implementation worth.

Finally, while is true that, the allocation of construction risk, contractor payment mechanisms, subcontractors and strategic procurement mechanisms were identified as the aspects to be investigated; It is not only recommended that these areas need to be improved to achieve success in a project. However, these are the areas where it is thought that meaningful improvements can be obtained given the resources and constraints present.

Risk allocation strategy recommends the accurate contractors, and it has been shown that only these contractors are able to obtain their required return if the client seeks to limit their contingencies and profit in exchange for guarantees of work.

The planning of the execution of the project must be consistent through all aspects of work and functions involved to achieve the objectives successfully. Any targets set for contractors in terms of time or cost ceilings must be realistic and deliverable so that both parties can clearly see that they have been met.

In determining the risk allocation and so contract strategy, it is important to apply risk analysis and management techniques to ensure that the worst-case scenarios have been anticipated and provision have been made to deal with risks events as and when

they occur. The term of the contract must be chosen logically, depending upon the nature of the work, its certainty, its urgency, the motivation of all stakeholders and others factors.

7.1 SUGGESTIONS

There tools and software which is reachable in Peru, for all companies and professionals. Some of this software is MS. Project, Excel, Revit, S10 Cost and Oracle.

Philosophies such as PMP and Lean Construction can help to have a better management system in a company, to improve productivity in works, to achieve better planning, and for monitoring and controlling the project.

It is suggested to use a system to standardize the structure in a company as well in projects. There are many international standards for cost and project phases that could start using in Real Estate companies in Peru, an example of these standards are HOAI and DIN276 which are used currently in Germany.

Declaration of Authorship

I hereby declare that the attached Master's thesis was completed independently and without the prohibited assistance of third parties, and that no sources or assistance were used other than those listed. All passages whose content or wording originates from another publication have been marked as such. Neither this thesis nor any variant of it has previously been submitted to an examining authority or published.

Germany, Berlin, 03.09.2018 — Location, Date

Margarita Sotelo Cabrera — Signature of the student

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