A proposal of "snapshot" methodology in project management complexity assessment: a case study applied to a software project.

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INTRODUCTION

The purpose of this document is to provide a brief review about state of the art of the complexity assessment focused on project management. The next part of the document is meant to propose a new project assessment methodology called "Snapshot" based on projects experience, the opinion of IT experts and guidance of IPMA[i] members. Last part will be focus on applying the "Snapshot" methodology to a specific IT banking project.

Nowadays, project managers are not able to identify purely a "complex" situation; when things are wrong on the project deliverables, it is easy blame stakeholders due to a lack of competencies (failing on requirements, planning, objectives, risk management, results, etc.) or just saying that issues are due to a complex environment. Main idea on complexity assessment is to allow project managers and companies to really identify if a project require certain level of skills or follow up; complexity assessment will help to conduct sudden changes or interactions into benefit. When "standard" management it is not enough to work with projects, a complexity management framework could be the answer to achieve the project success.

It will be concluded that the complex project management requires a proper complexity snapshot measure, to decide and infer the best way to continue project stages.

[i] IPMA International Project Management Association

1 State of the art of complexity in the context of project management

Fist of all, before going further in complicated definitions about state of the art, it will be presented the key words: "complex" and "complicated"; that will allow to introduce future points and provide a better understanding of the document contents.

1.1 Complex vs complicated

As a brief introduction, this section is meant to highlight the key words to be used and what is their most simple definition found.

From Colins dictionary [1]: "*Complicated*" means "made up of intricate parts or aspects that are difficult to understand or analyse", this could emphasize that for a normal person it is not easy to see what it is shown, but what if we review the meaning of *"Complexity"?. I*t is "*the state or quality of being intricate or complex*". Now going further, it is possible to review what complex stand for; definition shows "a whole made up of interconnected or related parts".

The examples below can provide a better understanding of the above definitions:

"Complicated"

What can easily describe a "complicated" situation or task is when you need to do a 18000 pieces puzzle (109" x 755") like the one below [2]:

Figure 1 Complicated issue

As you can see even if the first view of the issue could not be clear on the way to perform the next steps, you have a well-defined view of the start and end point. It could be long but for sure it is possible to get a target.

"Complex"

It is not the same case when the issue it is for instance, how you deal with an asteroid that could crash the earth?:

Figure 2 Complex issue [3]

Here there is no certainty about all the things that you need to cover, or how changes and interactions will made your decisions change, you will be trying to find out the best way about how to deal with. Therefore, the only certainty here is where you are. Possibly the best reactions or decisions could result in a success (you can be a survivor). The key point here with "complexity" is that you don't know what to do even if you are qualified.

With above definitions, it is possible to accentuate that in project management, we could have "complicated projects" and really "complex projects". And for sure the size is not the only parameter to be taking into account for the complexity assessment.

1.2 Complexity

"The term 'complexity'" denoted "used to express a state or condition is best defined as a question. How complex is it? An answer would be, its complexity (some metric)." [5], the target of this document is to define a way to perform a complexity assessment so this key word will be treated in future points.

1.3 Complex project

The CSCPM[ii] mentions "complex projects like flight control centres, railroads, etc. but other authors like Morris and Hough [4] categorised this as Major projects, these projects are complicated as a whole, but can be entirely understood reducing them into their parts" [5].

"Currently there is not a way to infer that a project is complex like the use of a binary, as the assessment is not easy, then when used the complexity it is not easy answer to the question "what is and is not a complex project?" [5].

[ii] For more details check "The Competency Standards for Complex Project" Managers (CSCPM), https://iccpm.com/content/cpm-competency-standards

Baccarini (1996) analysed the project complexity in relation with the organizational complexity (focusing attention on the number of hierarchies on the charts and dependences between them), but other authors have tried to go further with proposals and methodologies that could try to achieve the project complexity handling.

Currently there is no single theory about project complexity, what is sure is that the body of knowledge about this topic should be based on evidence, most authors provide definitions but leave for future research the test of the proposals [5].

As commented on [6] project "complexity can be defined as consisting of many varied interrelated parts and can be operationalized in terms of differentiation and interdependency." Applied to the proper dimension of the project processes such as: Organization, technology, environment, information, decision making and systems. Therefore it is important to infer which type of complexity is present to deal with it properly. Complexity is a different concept to other project characteristics like size and uncertainty." [6]

What is true is that a project manager should focus on the work of catching the root cause of the problems to prevent or decide new management approaches; in a major project this task could be difficult.

For this document the most accepted definition will be the one presented in [6] then Complex Project is where the team members have the proper level of skills to develop a project, but the amount of interactions and changes on the project does not allow managing properly. The point below (1.4 Complex management) will describe further this definition.

Now that interactions are mentioned, this figure it is a brief example, which describes factors that can impact the project and a manager could not control on an easy manner.

Figure 3 Project External Interactions Example [7]

But, in addition to external factors, the project pieces in complex project have their own matrix of interactions like the one below:

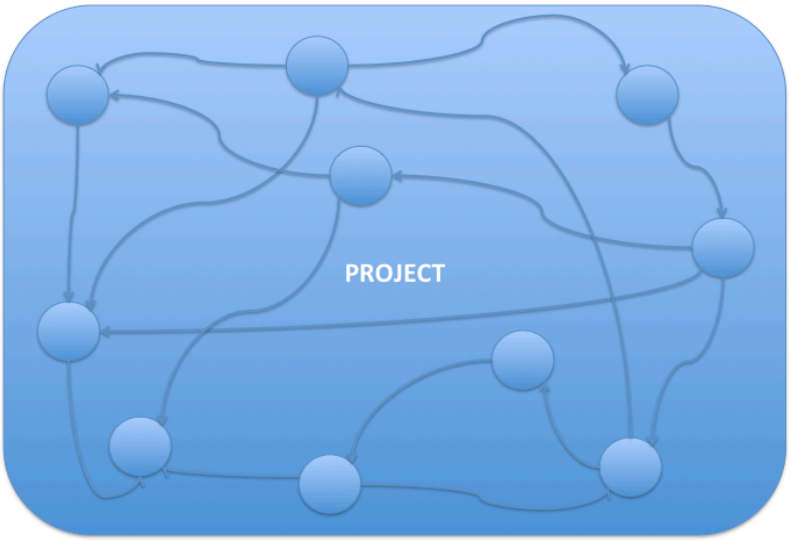


Figure 4 Project Internal Interactions (dependencies)

In summary, what a complex management should target is how to deal with such amount of interactions and dependencies.

1.4 Complex management

Complex Management should be focused on controlling the changes and interactions of the project components, but these comments are really interesting: "In addition to tools and techniques" [8] from other standards (PMI, IPMA, Prince, etc), "how does one manage or attempt to control a truly complex system? What kind of interventions are useful, and which interventions simply exacerbate problems" [8].

Management in complex projects must be connected with the benefit, "the higher the project complexity the greater the time and cost" [9-10]. Further actions to be performed should be in the same line with the potential improvement of the complex situation.

The graph below is a brief example about how the project path (in terms of decisions, organization changes, tracking and control, outsourcing, reporting, integration, or any kind of asset that a project or program manager could use to solve a complex project issue) should be adjusted in order to adequate the management to achieve the project targets.

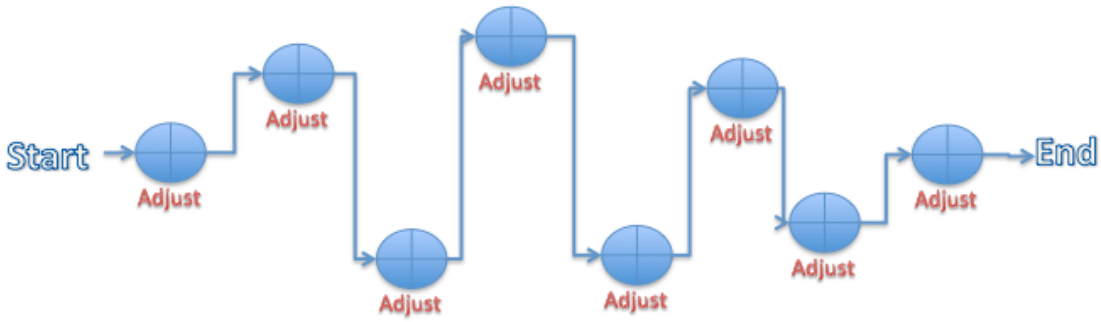


Figure 5 Project life cycle path and complexity adjustment

Consequently, **the complex project management requires a proper complexity snapshot of the project status to decide the best way to continue.**

1.5 Project complexity assessment

Reviewing the history, the complexity was studied more related to the computational complexity, and dealing with some project management issues, anyway, further investigations were performed on scheduling [11].

The second group of complexity measures are related to project graphs, like tasks, organizational, charts, etc. Nevertheless, this kind of measures does not provide a holistic view of the project.

The third group of complexity measures gathers more holistic methods oriented to infer the status of the project or the portfolio. **This document will be oriented on this kind of complexity measures.**

"Existing measures have shown their limits for several reasons. First, some limits have been highlighted about the reliability of such measures. Second, these measures are often non intuitive for the final users and thus give results which are difficult to communicate on. Finally, these measures mainly refer to a model of the project system". [11]

The evolution of the complexity assessment has been on sync with the body of knowledge of the standards in project management.

1.5.1 Why complexity assessment it is important?

Authors like (L.-A. Vidal et al.) [11] Have suggested that a "project ever growing complexity is an ever growing source of project risks identifying existing project complexity sources and levels of project complexity has, thus become a crucial issue in order to assist modern project management. The main objective is then to build up a project complexity index, so it can be used as an indicator, notably when facing the issue of project selection". Consequently, it is recognized the priority of being able to reinforce the management and decision-making with some kind of assessment tool.

The tracking of a complexity indicator in project management could be the project vane to define the course. "Complexity is one such critical project dimension" [12].

2 Complexity assessment, different approaches

2.1 PMI

"Navigating Complexity, a practice guide" [13] is a proposal providing ideas to project managers in order to perform a check of the current status of the project (assessment) in terms of complexity. Depending on the results of the assessment, it provides empirical comments and concepts to infer what could be the next step (decision) for the PM. It is important to note that this methodology is spread to portfolio and projects. Please note that this publication is currently considered only a guide for PMI, it is a result of volunteers and/or seeks out the views of persons who have an interest in the topic covered, PMI administers the process and establishes rules to promote fairness in the development. [iii]

2.1.1 Methodology summary

The figure below provides a brief summary of the steps suggested by the PMI in order to deal with complexity. Mainly, it is an evaluation cycle that can be performed in any phase of the project to define the course of actions for the PM.

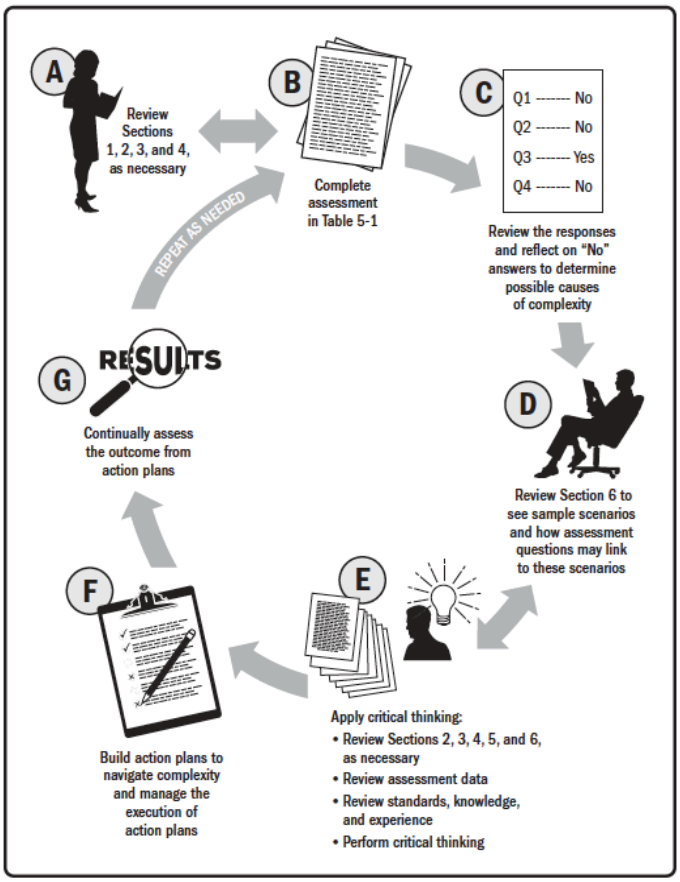


Figure 6 PMI complexity assessment and management methodology, from [13]

[iii] Further information on PMI http://www.pmi.org/learning/Project-Complexity.aspx

The below is a brief summary of the steps defined from [13]:

Step A. Become familiar with the definitions of the guide about complexity on the knowledge areas of a portfolio or a project. Here, lot of topics are considered as complexity sources, the table below shows a brief example about what PMI considers the Areas of causes of complexity.

Areas of Causes of complexity	Human Behavior	System Behavior	Ambiguity
Causes of Complexity	• Individual Behavior • Group, Organizational, and Political Behavior • Communication and Control • Organizational Design and Development	• Connectedness • Dependency • System Dynamics	• Emergence • Uncertainty

Table 1 PMI Areas of causes of complexity [13]

Step B. Complete the assessment by fulfilling a questionnaire about the project complexity; the mentioned questionnaire is located on the annex section ”9.1 PMI Assessment Questionnaire”
Step C. Consider any “No” responses in order to determine the possible causes of complexity and reflect on possible actions to treat these causes, Caused are gathered on Annex “9.2 Complexity Scenarios PMI”
Step D. Review of all the suggested complexity scenarios and possible actions; in order to reflect on how the assessment questions may link to these scenarios.
Step E. Apply critical thinking of the assessment.
Step F. Build action plans to navigate complexity and manage the execution of the action plans. Further information on Annex “9.3 PMI actions for Complexity Scenarios”.
Step G. Continually assess the outcomes from the action plans and repeat the appropriate steps as required.

The use of the questionnaire with Y/N answer, made easy for the PM the review of the data, when more options are provided it could be confused and move away the opinion of PM from accurate data.

The tool methodology provides the way to infer the sources of the complexity.

2.1.2 Limitations of PMI Guide

On the scenarios review and possible actions, it depends of the questions answered as “No” the possibilities are huge in terms of next suggested actions, therefore, could not be easy to define which further steps should be take into account.

The methodology provides the impression to be a way to allow the PM to have a self-brainstorming about the status of the project or the portfolio, and how to deal with it.

2.2 CIFTER

CIFTER provides a tool for the project assessment of 7 factors that impact the project management. What the evaluator should do is to assign the proper ratings to each factor about the project to evaluate and the result of the assessment will be a number (called "complexity factor") that locates the complexity in a predefined scale.

2.2.1 Methodology summary

Each factor is qualified in 4 levels (i.e. from "1" as very low to "4" high or very high). In order to get the final score, once finished the sum of the factors a total is achieved which is called the "Complexity Factor".

The following table describes the scores:

Project Management Complexity Factor	Descriptor and Points			
1. Stability of the overall project context	Very High (1)	High (2)	Moderate (3)	Low or very low (4)
2. Number of distinct disciplines, methods, or approaches involved in performing the project	Low (1)	Moderate (2)	High (3)	Very High (4)
3. Magnitude of legal, social, or environmental implications from performing the project	Low (1)	Moderate (2)	High (3)	Very High (4)
4. Overall expected financial impact (positive or negative) on the project's stakeholders	Low (1)	Moderate (2)	High (3)	Very High (4)
5. Strategic importance of the project to the organization or organizations involved	Very Low (1)	Low (2)	Moderate (3)	High (4)
6.Stakeholder cohesion regarding the characteristics of the product of the project	High (1)	Moderate (2)	Low (3)	Very Low (4)
7. Number and variety of interfaces between the project and other organizational entities	Low (1)	Moderate (2)	High (3)	High (4)

Table 2 GAPPS Factor Table For Evaluating Roles (CIFTER) [14]

Note: this table is called "Crawford-Ishikura Factor Table for Evaluating Roles" (In honor of Crawford-Ishikura) or CIFTER

"With the final set of seven factors and a point scale of 1 to 4, the following ranges were set" from [14]:

• Point total less than 11: this project cannot be used to provide evidence for a GAPPS compliant performance assessment.
• Point total 12 or higher: this project can be used to provide evidence for a GAPPS compliant performance assessment at Global Level 1. [iv]
• Point total 19 or higher: this project can be used to provide evidence for a GAPPS compliant performance assessment at Global Level 2.

2.2.2 Limitations of CIFTER

The CIFTER does not accommodate individuals managing multiple projects, since ratings for multiple projects cannot be summed. However, an assessment process could allow evidence from more than one project as long as each individual project meets the requirements for the level being assessed. [14]

[iv] GAPPS Level 1 includes five units (called "Competency Units") from GAPPS body of knowledge; meanwhile Level 2 includes 6 units more.

In some application areas, multiple project managers may share overall responsibility for the project. These projects cannot be used for assessment since it would not be clear which project manager was responsible for which results. [14]

Ratings on individual factors will often vary for the same project. For example, one person might consider the stability of the overall project context to be "high" meanwhile another practitioner is viewing this as "moderate." However, experience has shown that such differences balance out and that the project totals are quite consistent. [14]

This method it is not oriented to be used on the decision-making; it is meant to be only a guide.

2.3 IPMA 4-L-C

Philosophy of IPMA 4-L-C is more or less the same to the one proposed by Crawford-Ishikura, but this time, the number of factors used is increased by 10, therefore IPMA 4-L-C adapts the Crawford-Ishikura model to assess the degree of competences that a candidate has for their certification model. The mentioned adaptation is done under ICRG (IPMA Certification and Regulations Guidelines).

This document will review the IPMA Level B certification points of assessment.

2.3.1 Methodology summary

Once of the steps of the IPMA Level B certification process is the assessment of the practitioner about the complexity of projects that he has managed. The topics below are the factors considered on this evaluation:

Criteria	High complexity		Low complexity	
	complexity very high (4)	complexity high (3)	complexity low (2)	complexity very low (1)
1. Objectives, Assessment of Results				
2. Interested Parties, Integration				
3. Cultural and social context				
4. Degree of innovation, general conditions				
5. Project structure, demand for coordination				
6. Project organisation				
7. Leadership, teamwork, decisions				
8. Resources incl. finance				
9. Risk and opportunities				
10. PM methods, tools and techniques				

Table 3 Complexity factors for the assessment of complexity IPMA 4-L-C

This scheme is used to assess the complexity of project management in a project. Each indicator is rated according to four levels of complexity (4 = very high complexity, 3 = high complexity, 2 = low complexity, 1 = very low complexity).

If the total complexity value is equal or exceeding 25 points, a project is appropriate to be used in a certification process on IPMA Level B. Ratings between

23 and 27 points need a careful verification. For a complete evaluation all criteria have to be rated.

2.3.2 Limitations of IPMA 4-L-C

This method has more or less the same limitations shown on the "2.2.2 Limitations of CIFTER". In addition it is important to remark that this evaluation is based on a certification process and it does not intend to help on complex management (not a methodology focused in complexity).

2.4 AHP from L.-A. Vidal et al

The overall ambition of this method presented under [11] paper is to define a measure of project complexity in order to assist decision-making. I will not be necessary to have further knowledge about management to use this project evaluation method.

Authors of the paper propose a multi-criteria approach to project complexity evaluation, through the use of the AHP[v].

Complexity scales and subscales are defined in order to highlight the most complex alternatives and their principal sources of complexity within the set of criteria and sub-criteria, which exist in the hierarchical structure.

2.4.1 Methodology summary

They have defined a framework in order to perform the assessment of the project complexity, this framework was build by using questionnaires fulfilled by experts using pair-wise comparison and applying to them AHP; from [11] "Choosing the most suitable multi-criteria methodology is in itself a multi-criteria choice.

Finally the framework looks like as the table below, the criteria and sub-criteria columns are the main factors considered adding complexity to projects and the other columns show how important they are.

[v] AHP Analytic Hierarchy Process

Criteria ©	C Weights	Sub-Criteria SC	SC weights	Total Weights	Relative value
C1 - Project Size	0,142	SC1 - Number of stakeholders	1,000	0,142	0,804
C2 - Project variety	0,151	SC2 - Variety of information systems to be combined	0,057	0,009	0,049
		SC3 - Geographic location of the stakeholders	0,295	0,045	0,252
		SC4 - Variety of the interests of the stakeholders	0,649	0,098	0,555
C3 - Project Interdependencies	0,556	SC5 - Dependencies with the environment	0,092	0,051	0,290
		SC6 - Availability if people, material and ..... due to sharing	0,042	0,024	0,133
		SC7 - Interdependence between sites, departments and....	0,062	0,034	0,194
		SC8 - Interconnectivity/Feedback loops in the project networ	0,020	0,011	0,062
		SC9 - Team cooperation and communication	0,189	0,105	0,596
		SC10 - Dependencies between schedules	0,042	0,024	0,133
		SC11 - Interdependence of information systems	0,019	0,011	0,060
		SC12 - Interdependence of objectives	0,122	0,068	0,383
		SC13 - Level of Interrelations between phases	0,094	0,052	0,297
		SC14 - Specifications Interdependence	0,318	0,177	1,000
C4 - Project Context-dependenc	0,151	SC15 - Cultural configuration and variety	0,633	0,096	0,542
		SC16 - Environment organisational complexity	0,260	0,039	0,223
		SC17 - Environment technological complexity	0,106	0,016	0,091

Table 4 AHP, Overall criteria and sub-criteria weights: Project complexity factors comparison

This proposal described by the authors is oriented to fulfil the below principles:

- Reliable, meaning the user can be confident with the measure.
- Intuitive and user-friendly
- Assessment should be Independent of the project models.
- Able to highlight project complexity sources when building up the measure in order to improve decision-making.

On the paper L.-A. Vidal et al (2011) have defined a "Complexity index" based on the work of Saaty (1980) work [15].

The below "Complexity index" ratio (CI_i) displays the relative complexity of an alternative under evaluation, into the particular context of a set of alternatives (S(i)).

$$CI_i = \frac{S(i)_{Under\ Evaluation}}{\max(S(i)_{Found})} \rightarrow 0 \leq CI_i \leq 1$$

Ecuation 1 Complexity Index AHP method

Being $S(i)_{Under\ Evaluation}$ and $S(i)_{Found}$ the priority scores of alternatives obtained due to AHP calculations ($0 \leq S(i) \leq 1$).

A relative project complexity scale between 0 and 1 can be built with this approach (this index permits to classify projects/project scenarios/project areas according to their global score regarding the main project complexity sources). Subscales can then be defined in the same manner to focus on specific aspects of project complexity and highlight how a project is complex regarding interdependencies or context for instance.

2.4.2 Limitations of AHP method

AHP method does not integrate the correlation between the different complexity factors, AHP method is simple but it could be criticized as methods like ANP are

more approached to the reality. It is important to link the interrelation between criteria and sub criteria.

Analysis of the alternatives must be done by trying to get as much information as experts can about the projects, as the pair-wise comparison quality could be reduced due to lacks of information for the alternative under evaluation, changing the final values of the complexity assessment.

This method of complexity assessment is oriented towards decision-makers and it is not focused on the project development it self.

2.5 CCPM

This CPMCS[vi] have defined a methodology to perform the complexity assessment and classification of the projects.

From [16] it shown the PCAT [vii] framework for the project complexity assessment providing tools for:

- Categorizing projects by their systems types
- Determining the appropriate project strategy and contracts
- Selecting appropriately competent project managers

2.5.1 Methodology summary

PCAT categorises projects into five types:

· Traditional Projects: PCAT types 5 and 4
· Complicated Projects: PCAT type 3
· Complex Projects: PCAT types 2 and 1

From the CPMCS perspective the equivalences of the PCAT categories vs IPMA vs CPM[viii] levels is shown below [16]:

[vi] CPMCS Complex Project Manager Competency Standards
[vii] PCAT Project Categorization Framework
[viii] CPM Complex Project Managers

PCAT Type	Project Description	IPMA Level	Project Management Competency	CPM Level
PCAT 1	Highly complex project		Complex Project Management (CPM)	Level 1
PCAT 2	Complex project		Complex Project Management (CPM)	Level 2
PCAT 3	Traditional project within a highly political environmen	Level A	Executive Project Management (ExecPM)	
PCAT 4	Traditional project	Level B	Traditional Project Management (TPM)	
PCAT 5	Minor works	Levels C	Minor works project management	
	Project Team	Level D		

Table 5 CPMCS view of complexity levels from different standards

PCAT have defined mainly 4 measures for the complexity assessment "Emergence", "Internal System Complexity", "External System Complexity", "Cost"; please note that information about these measures was extracted from [16].

2.5.1.1 Level of Emergence

From [16], The project is a journey driven by a vision. There is high uncertainty in scope definition. Systems function as a whole, so they have properties above and beyond the properties of the parts that comprise them. These are known as emergent properties, and they emerge from the system whilst in operation. You cannot predict the behaviour of an emergent system from studying its individual parts.

Criteria:

The level of emergence is a measure of the:
Scale of strategic change
Depth of cultural change
Level of technical emergence in the project.

2.5.1.2 Internal System Complexity

Criteria:

Project Team Complexity: It is a measure of the complexity of the internal architecture of the project team, and the maturity of the project team in this type of project.

Technical Difficulty: It is a measure of the novelty of the project, and inherent complexities that arise from technical undertakings such as conflicting user requirements, integration with supra system, project architecture, design and development, assembly, technical emergence, incremental/modular builds, integration, and test and acceptance

Commercial: The level of usage of relational performance based, phased, and layered incentive driven contracting arrangements, and the complexity of the commercial arrangements being managed, including the number and level of interdependent commercial arrangements.

Extracted from [16].

2.5.1.3 External System Complexity

Criteria:

Stakeholder Complexity: It is a measure of the complexity of the project's stakeholder relationships. It includes the number of stakeholders, the level of alignment versus pluralism, cultural diversity, and geographic dispersal

Schedule Complexity: It is a measure of the inherent complexity arising from schedule pressures on the project. The project is delivered using Wave Planning, and is subject to competing and conflicting priorities

Life Cycle: It is a measure of uncertainty arising from the maturity of the project delivery organization, and the environmental maturity within which the project will be operated, supported and sustained.

Extracted from [16].

2.5.1.4 Project Cost

Includes requirements development (empirically 6-10% of acquisition cost) and through life operating, maintenance and support costs, asset management and periodic upgrading (empirically 3- 4 times acquisition cost).

Extracted from [16].

2.5.1.5 Evaluation process

Now that the complexity measures have been described, then the way as the complexity is calculated is the one below.

The first step is assigning to criteria and sub-criteria of the project under assessment, ratings as low, moderate, high or very high.

Criteria	Subcriteria	Very High (4)	High (3)	Moderate (2)	Low (0)
Emergence measure	Scale of strategic change				
	Depth of cultural change				
	Level of technical emergence				
Internal System Complexity	Project team complexity				
	Technical difficulty				
	Commercial complexity				
External System Complexity	Stakeholder complexity				
	Schedule complexity				
	Life cycle complexity				

Table 6 PCAT Criteria for complexity assessment

Once ranking is done, the max value that a criteria can have is 12 and the minimum is 0, then CPMCS have defined some ranges to identify what is the final complexity value of the measures.

	Criteria		
Score Ranges	Emergence	Internal System Complexity	External System Complexity
score between 6 and 12	High Emergence	High internal system complexity	High external system complexity
score between 4 and 6	Moderate Emergence	Moderate internal system complexity	Moderate external system complexity
score between 0 and 4	Low Emergence	Low internal system complexity	Low external system complexity

Table 7 PCAT Score ranges

If result of the scores is between 6 and 12 it will indicate that the project is having complexity under the specific measure.

It is important to highlight that the "Project cost" was not considered at the moment, but the table below provides the final complexity picture considered by PCAT scale in order to be able to locate the project which is under evaluation, therefore the merge of project measures plus the cost is displayed on the table below:

PCAT	Project Description	Emergence	Internal system Complexity	External system Complexity	Cost (Euros)
1	**Highly complex project**	If at least two criteria are graded as high			> 2.0 b
2	**Complex project**	If at least two criteria are graded as high			> 1.0 but < 2.0 b
3	**Traditional project within a highly political environment**	At least two criteria grades are graded as moderate or higher			Programs > 100m, Projects > 500m
4	**Traditional project**	No more than one criteria is graded as moderate or higher			> 20m, but < 500m
5	**Minor Works**	All criteria are graded as low			< 20m

Table 8 PCAT Categorization

It is essential to mention that a PCAT only considers a "Highly complex project" if the cost of the project is greater than 2 billon €.

Section extracted from [16].

2.5.2 Limitations of PCAT

Authors like "Whitty et al." Have worked on reviewing further the CPMCS and the CPM, and they have concluded on the paper "And then came Complex Project Management" [5] that "it is required probe that any "standard" about complexity it is based on the evidence, it is a good open point for future research. It could be good the focus on the root cause of problems in major projects."

Limitations on this method are more related to call "standard" to the body of knowledge and not have a proper baseline/framework of this "standard" base in proper business cases, from [5] "It is clear that the Fellows of the College decide who they let in to their club;" then perception of CCPM[ix] point on that direction, and advise that, "the business case for this is not clear". On the other hand "it is not clear what research has underpinned its development, and the competence levels appear to have been allocated on an entirely arbitrary basis" not based in something further to be part of a standard world wide accepted.

In addition to the economic factors, this method looks fitting complex projects to be really specific, but as it was shown on the terms definition starting this document, even if a project is complicated it does not mean that it is complex.

2.6 Other Framework

Apart of the mentioned assessments, it is important to add a reference about one more methodology of complexity assessment, but anyway it is following the same approach as the one already reviewed.

2.6.1 ACAT, Defence Material Organization (DMO)

Defence Material Organization (DMO) from Australia [x] has developed a methodology of the Acquisition Categorization (ACAT) Policy for Categorization, which follow up same philosophy of the methodology shown on"21 CCPM". Therefore it is not required to go into a further review. It is used for categorising projects according to the project management complexity, political importance, technical difficulty, schedule etc. Categorised either as complex or traditional projects.

Most complex - ACAT I, ACAT II and ACAT III, or less complex – ACAT IV and ACAT V

[ix] CCPM College of Complex Project Managers
[x] For more details please check http://www.defence.gov.au/dmo/

2.7 Conclusion

IPMA method for project complexity assessment deal with organizational and technical aspects and treat the project and practitioner from an holistic point of view, CIFTER it is more a basic. AHP it is recognised as a good tool facilitating decision-making but has is missed a project management body to support the project complexity evaluation. All these methods emphasise the scoring of different aspects presented under a specific model, and then matching results on specific ranges to present a holistic snapshot of the project complexity.

Value added to the PMs and organizations working with complexity assessment it is that the focus of the assessment must not take for implementation more time than the affordable to take a decision. In consequence, the PMI it is a good framework and complexity tool, but could suffer with time constraints to perform evaluation cycles.

The table below represents a summary of the methods analysed before, highlighting the recognised focus of each one:

	Project Assesment	People Assesment	Methodology proposal
PMI	✔		✔
CIFTER	✔		
IPMA 4LC	✔	✔	
AHP from L.-A. Vidal et al	✔		
CCPM	✔		
ACAT	✔		

Table 9 Complexity Assessment Methods Comparison

Based on the above, it is shown that only IPMA 4-L-C is focused on the people skills assessment, **the proposal on this document is to go further in the details of IPMA B as it looks to cover more scenarios.**

It is important to remark that, at the time that there is an evaluation of people in complex project management it is implicit the complex project assessment. The battlefields for practitioners and project managers that are increasing their skills are the projects

3 IPMA 4-L-C

IPMA assessment, currently it is more focused on the certification process review; it depends of the certification type into which the candidate want to apply.

The accepted 4-L-C classifies managers into four different categories:

- The IPMA Level A is Certification for Project Directors
- The **IPMA Level B** is Certification for Senior Project Managers
- The IPMA Level C is Certification for Project Manager
- The IPMA Level D is Certification for Project Management Associate

IPMA meant to certificate practitioners based on project management competences (shown on "3.1 IPMA competence baseline"), and offer a career plan to upgrade certification into the 4 defined levels (4-L-C)

Note: **IPMA Level B** will be commented in detail to understand properly what is the use of the complexity assessment under this certification.

3.1 IPMA competence baseline

From [17], it is described that IPMA competence baseline (ICB) is a wider vision of the required competences of a project manager, meanwhile National Competence Baseline (NCB) is adapted to cultural aspects of the country.

The following figure shows a summary of the competence groups:

- Relations with the project's context (11 competences)
- Techniques of project management (20 competences)
- Professional behaviour of project management personnel (15 competences)

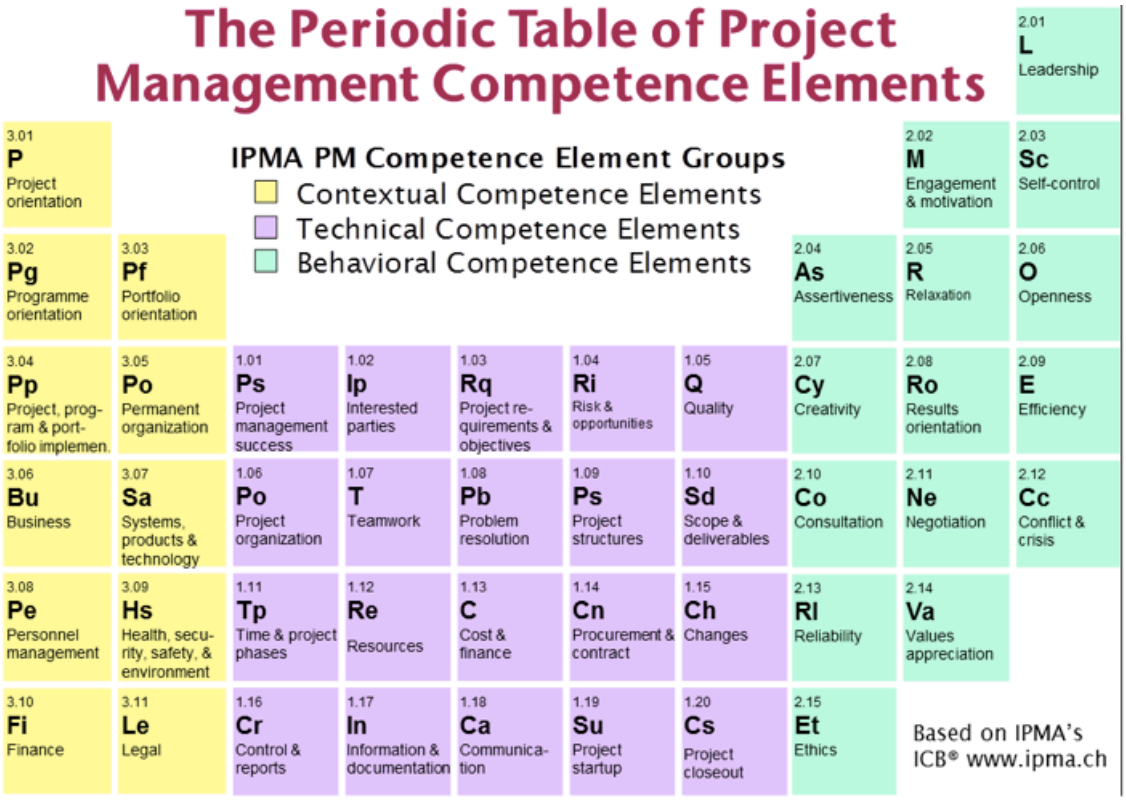


Figure 7 IPMA The Periodic Table of Project Management Competency Elements, Image from [17]

3.2 Required Competencies by 4-L-C

From [18], the table below shows how important the ICB element groups are, (highlighted on "3.1 IPMA competence baseline") into the 4-L.C.

Element Group	IPMA A %	IPMA B %	IPMA C %	IPMA D %
Technical	40	50	60	70
Behavioural	30	25	20	15
Contextual	30	25	20	15

Table 10 ICB Competency Elements weights on 4-L-C

More skills are required to opt for an upgrade on the 4-L-C certification levels.

3.3 IPMA B Complexity assessment

From the 4-L-C certification IPMA Level B, applicants must probe that they were/are responsible for all project management aspects of a complex project.

Therefore complexity assessment it is not mandatory to certify "IPMA Level C" and "IPMA Level D", basically 10 criteria are evaluated in order to infer if the project/practitioner meets expectation of complexity.

The table below shows the different factors with the description and the criteria take into account for the assessment, so on this way it is possible to infer the level of complexity to be achieve by the candidate [19].

Criteria	Description of the criteria	High Complexity	Low Complexity
1. Objectives, Assessment of Results	Mandate and Objective	uncertain, vague	defined, obvious
	Conflicting objectives	many conflicts	few conflicts
	Transparency of mandate and objectives	hidden	quite transparent
	Interdependence of objectives	very interdependent	quite independent
	Number and assessment of results	large, multidimensional	low, monodimensional
2. Interested Parties, Integration	Interested parties, lobbies	numerous parties	few parties
	Categories of stakeholders	many different	few uniform categories
	Stakeholder interrelations	unknown relations	few and well known relations
	Interests of involved parties	divergent interests	comparable interest
3. Cultural and social context	Diversity of context	diverse	homogeneous
	Cultural variety	multicultural, unknown	uniform, well known
	Geographic distances	distant, distributed	close, concentrated
	Social span	large, demanding	small, easy to handle
4. Degree of innovation, general conditions	Technological degree of innovation	unknown technology	known and proven technology
	Demand of creativity	innovative approach	repetitive approach
	Scope for development	large	limited
	Significance on public agenda	large public interest	public interest low
5. Project structure, demand for coordination	Structures to be coordinated	numerous structures	few structures
	Demand of coordination	demanding, elaborate	simple, straightforward
	Structuring of phases	overlapping, simultaneous	sequential
	Demand for reporting	multidimensional, comprehensive	uni-dimensional, common
6. Project organisation	Number of interfaces	many	few
	Demand for communication	indirect, demanding, manifold	direct, not demanding, uniform
	Hierarchical structure	multidimensional, matrix structure	uni-dimensional, simple
	Relations with permanent organisations	intensive mutual relations	few relations
7. Leadership, teamwork, decisions	Number of sub-ordinates	many, large control span	few, small control span
	Team structure	dynamic team structure	static team structure
	Leadership style	adaptive and variable	constant and uniform
	Decision-making processes	many important decisions	few important decisions
8. Resources incl. finance	Availability of people, material, etc.	uncertain, changing	available, known
	Financial resources	many investors and kinds of resources	one investor and few kinds of resources
	Capital investment	large (relative to project of the same kind)	low (relative to project of the same kind)
	Quantity and diversity of staff	high	low
9. Risk and opportunities	Predictability of risks and opportunities	low, uncertain	high, quite certain
	Risk probability, significance of impacts	high risk potential, large impact	low risk potential, low impact
	Potential of opportunities	limited options for actions	many options for actions
	Options for action to minimise risks	large potential of opportunities	low potential of opportunities
10. PM methods, tools and techniques	Variety of methods and tools applied	numerous, manifold	few, simple
	Application of standards	few common standards applicable	common standards applicable
	Availability of support	no support available	much support available
	Proportion of PM to total project work	high percentage	low percentage

Table 11 IPMA 4-L-C for IPMA Level B in detail

The IPMA evaluation uses above parameters to ensure that assessment it is properly understood.

Method it self it is easy to understand, but even if is easy it is required to ensure that IPMA evaluators follow up the same criteria to contrast the practitioner skills for certification.

Supplementary to the above 10 criteria, evaluators will consider also the topics below:

- Many interrelated subsystems / sub-projects and elements and relations to the project context
- Several companies and/or organisational units involved
- Several different disciplines working for the project
- Several different phases with considerable durations

As described on IPMA world page [20], the reference project must be important enough to provide evidence of competent management. Additional parameters that are taken in to consider include:

- Amount of time the applicant dedicates to the project
- Number of sub-projects
- Size of project as an investment
- Size of project organisation

A project need not be very extensive to be sufficiently complex, although complexity often coincides with project size. In certain cases projects with as little as 200 000 – 500 000 € costs can contain sufficient complexity.

3.4 IMPA 4-L-C Certification Steps

The table below shows a summary of the stages of the certification process for the IPMA 4-L-C, this point is referenced to the process described on IPMA world page [20]:

Long Title	Shot Title	Assesment	Certification Process					Validity
			Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	
Certified Projects Director	IPMA Level A	Knowledge + Experience	Application curriculum vitae, self assesment, project list, report proposal	References [+options]	Project Directors Reports [+options]	Inverview [+options]	Final Evaluation Feedback [+options]	5 years
Certified Senior Project Manager	IPMA Level B				Project Reports [+options]			5 years
Certified Project Manager	IPMA Level C			References Exam [+options]	Project Reports [+options]			5 years
Certified Project Manager Associate	IPMA Level D	Knowledge	Application curriculum vitae, self assesment, [+options]	Exam [+options]	[+options]	N/A		5 years

Table 12 IPMA 4-L-C certification stages

The assessment steps for individuals are applied to each of the IPMA competence levels A, B C, and D. If the Candidate meets the Competence Requirements he can apply directly to the desired Level. It's not necessary a lower Certificate Level to apply to a higher Certificate Level. The IPMA certification system is not completely rigid: Each Member Association adapts some factors and requirements to their local needs. In some cases, Member Associations add more roles to certain levels; this most-often happens with IPMA Level A® and IPMA Level B®.

The following table is from the IPMA Competence Baseline (IPMA ICB®), published in 2006. It shows the steps of the IPMA certification process in a different perspective from the one shown on "Table 12 IPMA 4-L-C certification stages". Some process steps are required, marked as "x", while others are optional, marked with as "(x)". Each Member Association's certification body uses this process as a starting point, in applying IPMA certification to their nation.

IMPA CERTIFICATION PROCESS STEPS	IPMA Certification Process			
	A	B	C	D
Application Form, Curriculum Vitae	x	x	x	x
List of projects, programmes, portfolios; references	x	x	x	-
Self-assesment	x	x	x	x
Admittance to attend the certification process	x	x	x	x
Written exam	(x)	(x)	x	x
Workshop	(x)	(x)	(x)	-
360-degree-assesment	(x)	(x)	(x)	-
Report	x	x	x	-
Interview	x	x	x	-
Certification Decision: Delivery, Registration	x	x	x	x

x=compulsory, (x)=option

Table 13 IPMA 4-L-C System and process

3.5 IPMA B Certification process

The below are the steps to be follow up by practitioners to apply for a IMPA B certificate, this point is based on the process described on the IPMA world Portal [21]. IPMA's Member Associations, rather than IPMA itself, administers all certifications. Each nation modifies the process (within reason) to fit the unique needs of each nation. Therefore the subsections below are an example of the IPMA B certification process.

3.5.1 IPMA B Requirements

- **Experience.** Three years in a responsible leadership position in the management of complex projects, plus two additional years in project management. All five years of experience must have been obtained during the last eight years.

- **Assessment considerations.** Candidates will be expected to provide evidence that they have done the following:

    a. **Were responsible for all project management aspects of a complex project. Already described on "3.3** IPMA B Complexity assessment"
    b. Managed a large project management team and led managers of sub-projects.
    c. Used appropriate project management processes, methods, techniques and tools.

3.5.2 Phase 1

From [21], The certification process starts with the submission of the application form (including CV), the project experience form, the self-assessment form, and the reference project proposal by the applicant:

The application form (including CV) comprises personal data, basic education, career history with task/responsibility descriptions, and competence development history including training or other educational activities relating to project management. The CV may be a free form, but must include a description of applicant's possible contribution to project management tools, techniques, methods, competence, etc. development.

The project experience form collects applicant's project experience, including a chronological list of projects, programs and portfolios and the applicant's roles and responsibilities in each one.

The reference project proposal is a 3 – 5 page free form summary describing the applicant's role in the project where applicant had the role as project manager, including:

- Description of backgrounds and facts needed for the assessment of the complexity including among others:
    - Project goals / objectives
    - Project size
    - Project uniqueness / novelty issues
    - Sub-projects / areas
    - Relations and interested parties of the project
    - Challenges to the project management
    - Enterprises and organisation units involved in the project implementation
    - Disciplines participated in the project implementation
    - Project phases and their durations
    - Project organisation
- Description of the applicant's role as a project manager including among others the roles in:
    - The definition and maintain of project strategy and objectives
    - The selection, employment, performance evaluation and rewarding of project personnel
    - The internal and external project coordination
    - The planning, follow up and decision making concerning project scope, costs resources and schedules
    - The leadership

NOTE: In case that sufficient detail is not available, the reference project will not be considered sufficiently complex for IPMA Level B certification. Only project management complexity will be taken in to consideration. Technical (i.e. industry specific) complexity, or lack thereof, will not affect the perceived level of complexity.

The self-assessment form addresses applicant's knowledge and experience according to the framework presented in IPMA National standards, and the competence level definitions on the self-assessment form.

If the submitted materials do not contain sufficient information, the entry requirements are not met, or the relevant instructions are not followed, the applicant will not be allowed to enter the certification process.

The application must be submitted to certification coordinator, preferably through e-mail. A signed copy of the application form must be presented to the assessors or mailed.

3.5.3 Phase 2

From [21], the applicant writes a project report of 15 – 25 pages and submits it to the certification coordinator.

The project report shall be addressed to the assessors. The structure of competence elements presented in National Competence Baseline 3.0, shall be employed as far as possible as the structure of the project report. The report must also explain the background of the project, client, methods and tools used for management of the project as well as the gained experiences and lessons learned concerning the management of the project.

The project report must contain appendices describing the project management in practice, e.g. content of the project plan, examples of project schedules, cost estimates, resource plans, budgets, project reports, minutes of project meetings, etc. The amount of appendices should be 10 as a maximum.

The report must indicate clearly the applicant's contribution to the project management and his/her project management skills.

Note: Material received from the applicant is only used for assessing the knowledge and experience of the applicant during the certification process. The representatives of certification body shall not use the material, any part of it or any reference to the material at any other circumstances. The received material is stored in a locked cabinet by the administrator of this certification process for the period of certificate being valid. After this period or in the case of unsuccessful certification process the material is destroyed. An organization involved in "sensitive" projects (i.e. defence, R&D or similar projects) whose project managers are prevented from submitting reports to external bodies can request special status.

3.5.4 Phase 3

From [21], the certification process is concluded with a two-hour personal interview with the assessors. This is for clarifying remaining open issues (if any), presenting personal feedback to the applicant and for collecting feedback from

him. Specific instructions can be addressed to the applicant before the interview as/if necessary. The assessors will propose for an IPMA Level B certificate to be granted to each applicant completing this certification process. The certification body board of directors makes the final decision on granting the certificate.

Applicant has to be prepared to identify himself (identity card, driver's licence or passport) in the interview.

3.6 IPMA B Certification Renewal

From [21], the IPMA Level B certificate is renewed through a continuous professional development program. This means the certificate holder must be able to demonstrate continued development in and practice of the certified project management principles at the relevant level. This may lead to candidacy in a higher-level project management certificate.

The certificate renewal process starts with the submission of the updated application form (including CV), the updated project experience form and a new self-assessment form by the applicant:

- The application form (including CV) comprises personal data, basic education, career history with task/responsibility descriptions, and competence development history including training or other educational activities relating to project management. The CV may be of free form, but must include a description of recertification applicant's possible contribution to project management tools, techniques, methods, competence and so on.

- The project experience form collects applicant's project experience, including a chronological list of projects, programs and portfolios and the applicant's roles and responsibilities in each one.

- The self-assessment form addresses applicant's knowledge and experience according to the framework presented in National Competence Baseline 3.0 and the competence level definitions on the self-assessment form.

The assessors will propose for a new IPMA Level B certificate to be granted to each certificate renewal applicant demonstrating continued development in and practice of the certified project management principles at the relevant level. The certification body board of directors makes the final decision on granting the certificate.

4 IT projects

Now that tools about the measure of complexity are clear, and it is decided to go further with the evaluation of projects using as baseline the IPMA B assessment, the time is now for presenting an overview of the IT projects in order to allow the reader to understand the key features and challenges present on this kind of projects.

Furthermore, it is going to be introduced the concept of complexity especially on IT projects.

Additionally, by presenting IT projects profiles (rates) relating to the failure and success, it will be possible to recognize the reality and performance of those and analyse what could be causing the lacks on IT projects.

Finally on this section, it is going to be presented a brief overview of banking projects, as the case of study it is related to this kind of projects.

Continuing with concepts, IT projects are a wide range focused on information technologies, from [22] it is recognized the following typology:

Typology of IT projects			
ID	**Criterion**	**Types of Projects**	**General Characteristics**
1	**The scope of realization**	**Basic**	A scope linked to the key business processes allowing the realization of basic activities, e.g. Implementing a production management module in a manufacturing company.
		Supplementary	A scope linked to business processes allowing for completion of supplementary activities, e.g. Implementing a tangible assets management module in a insurance company.
2	**The type of information system**	**A project consisting of implementing an adapted standard information system**	A project consisting of adapting a standard information system to the user requirements, e.g. An ERP system.
		A project consisting of building an information systems from scratch	A project consisting of building a single dedicated information system. E.g. An individual taxation system.
3	**Project size**	**Micro-projects**	The number of end users: 1-5; the number of key users: 1-2; duration: up to 3 months.
		Small Projects	The number of end users 5-20; the number of key users: up to 5; duration 3-6 months.
		Medium size projects	The number of end users up to 100; the number of key users: up to 10; duration 6-12 months.
		Big projects	The number of end users 1000; the number of key users: up to 50-100; duration 2-3 years.
		Large projects	The number of end users: over 1000; the number of key users: over 100; duration 4-6 years.
4	**Strategy**	**Market survival strategy**	Strategy linked to the company's survival on the market treats an information system implementation as a tool allowing the company to survive on the market.
		Achieving saltatory innovation	Strategy linked to the need to achieve innovation saltatorily treats an information system implementation as a tool achieving innovations quickly and momentaneously.
		Platform for changes strategy	Platform for changes strategy treats an ERP system implementation as a platform for introducing permanent, step changes in the period of the company's system lifecycle.
5	**Project lifecycle phase**	**Diagnostics Phase**	The design diagnostics phase consist of registering the actual course of organization, its analysis and evaluation, finding solutions and elements that are incorrect or may be perfected.
		Analytical-design phase	The analytical-design phase consist of identifying detailed technological and functional requirements of an information system and designing a theoretical prototype. The analytical-design phase is completed with a functional analysis document.
		Production or Software adaptation phase	The production or software adaptation phase consists of programing, parameterising and information system testing according to the designed theoretical prototype.
		Implementation phase	The implementation phase consist of conducting the acceptance test, trainings and documentation of the created software.
		Launch phase	The launch phase consist of the final launching of the created software
		Operation phase	The operational phase consists of establishing the system's work and using it on the bases of SLA (Service Level Agreement).
6	**Project Business Model**	**Cloud processing (virtualization)**	The processing model based on using services delivered by external organizations. It means that the original investment, i.e. Server and license purchase of the necessity to install and administer software, is eliminated
		Original investment model	A model based on investment realisation, i.e, purchasing all the necessary equipment and software, as well as software installation and administration services, in the initial phase.
		Interim model	An interim model between the cloud-processing model and the original investment model, e.g. Collocation service
7	**The type of information system and functionality**	**Type 1 - Support systems**	Office and administration support information systems. May also include teaching support systems.
		Type 2 - Transaction systems	Recording and reporting systems for operative level, e.g. Order fulfilment.
		Type 3 - management information systems	Organization monitoring systems: monitoring sections, surroundings or particular people.
		Type 4 - advisory systems	Decision-control systems using optimising and heuristic methods, simulating systems, genetic algorithms and neuron networks.
		Type 5 - Complex systems	Systems combining all of the above mentioned information systems characterising into one.
8	**Realization method**	**Internal team**	Only the employees of the company where the project is being completed participate.
		External team	Only the provider's employees participate.
		Mixed team	The project group consist of both the company's employees and external consultants.

Table 14 IT projects Typology

Note: Table referenced from “Information systems in management XVI” [22].

Combinations of IT projects typologies may lead on complex projects, that require adopting proper management methodologies. By understanding the type of projects, a PM is able to as least understand the context into which he is working into.

4.1 Complexity in IT projects

From [23] "Complex IT systems are integral to the functioning of our society. They contribute to the design, production and delivery of innumerable products and services that we encounter as we live, learn, work and play, and their significance will inevitably increase in coming years."

There is an interesting article with the conclusions of a study from Gartner about failed projects, resulting that "Complexity leads to failure" for IT projects.

From [24], "Gartner studied more than 50 projects that are on the public record as having experienced complete failure, they have been seriously compromised or have overrun their IT budgets significantly. The analysis has shown that the organisation's refusal to address complexity in the business process is the main reason of the failure. Complex projects with unrealistic goals, unproven teams and almost no accountability at all levels of the management and governance structure, means no one is responsible for failure."

"This means that when a program manager or product owner is assigned to lead the project, that project head must also be given the appropriate authority to make decisions in that capacity. Assignment of decision rights means the assignment of accountability and responsibility for making decisions and for managing the risks associated with those decisions."[24]

"When a project starts to stumble, increasing the volume and scope of upward reporting will only place more burden on the project and will be unlikely to improve the likelihood of success." [24]

"This is the way we have always done it" is not an adequate defence when senior management demands business improvement and best practice. There is almost always a disconnection between the ambitious objectives of the project and the demands of those at the management coalface to ensure that "the system" is modified to reflect, "how we work." The authority to make improvements and consequent changes must be reflected in the decision rights of the project." [24]

For IT companies that recognize that their projects are out of expectations, they should react by not adding barriers to the change, as this is the best way to deal with the complexity that can be impacted the projects, programs or portfolios.

4.2 IT projects profile

This section describes from different studies the behaviour of the IT projects in order to provide baseline knowledge about the performance, success and failure of this kind of projects.

4.2.1 The Standish Group CHAOS analysis of IT projects

Lot of studies are done around IT projects, anyway it is familiar the years of experience of Standish Group on the build of CHAOS report, one of the most complete studies which is yearly reviewed about the state of IT projects.

As mentioned on The Standish Group CHAOS 2015 Report [25], the below are the latest levels of success or failure on IT projects.

Modern Resolution for IT projects					
Project Status / Year	**2011**	**2012**	**2013**	**2014**	**2015**
Successfull	**29%**	**27%**	**31%**	**28%**	**29%**
Challenged	49%	56%	50%	55%	52%
Failed	**22%**	**17%**	**19%**	**17%**	**19%**

Table 15 Standish Group CHAOS Resolution of IT projects

Note: Table referenced from Chaos Report [25]

CHAOS report is build from a study of 50.000 IT projects, having one of the most powerful project performance databases about IT. **It is evident that near of 20% of the projects failed or they are cancelled, it is a very high number that it is good to be studied or assessed.**

"Challenged", on the report represents the project is completed and operational, anyway over-budget, over time estimate and offering fewer features and functions than originally specified.

And "Successful" describes project is completed, operational on time, functions and features additionally fitting planned budget. Recently Standish Group has added to this definition the value that the project is having for the organization/portfolio.

CHAOS Resolution by project size			
Project Size / Project Status	Successfull	Challenged	Failed
Grand	2%	7%	17%
Large	6%	17%	24%
Medium	9%	26%	31%
Moderate	21%	32%	17%
Small	62%	16%	11%

Table 16 Standish Group CHAOS Resolution software projects by project size 2011-2015

Note: Table referenced from Chaos Report [25]

It is shown that small projects have more chance of success that large ones.

It is clear now that lot of projects are actually failing on fulfilling expectations, the next step is go further on definitions and review that for instance on IT development projects dependant on the project method used (life cycle) the rates of success and failure can change. Waterfall or agile, may lead on the Resolution numbers diverging.

Project Size	Method	Successfull	Challenged	Failed
All Size Project	Agile	39%	52%	9%
	Waterfall	11%	60%	29%
Large	Agile	18%	59%	23%
	Waterfall	3%	55%	42%
Medium	Agile	27%	62%	11%
	Waterfall	7%	68%	25%
Small	Agile	58%	38%	4%
	Waterfall	44%	45%	11%

Table 17 Standish Group CHAOS Resolution software projects by project size and Method used 2011 - 2015

Note: Table referenced from Chaos Report [25]

The above table is exposing that agile development projects have more chance of success in comparison with waterfall projects. **Therefore, method used on project management must be present on any assessment of project complexity.**

4.2.2 Dr Doods - Scott W. Ambler Survey (2010)

Another study about the IT project success is the one performed by Scott Ambler [26] (results can be found here [27]). This study provides data to contrast results provided on the CHAOS report.

There is not a standard definition of success for all the studies found, anyway the chart below is if a good picture about a similar study like the one performed by Standish Group and the CHAOS report (please check "Table 17" comparing Agile vs Waterfall). Survey report has confirmed that iterative and agile methods (project life cycles) have more success than traditional approaches.

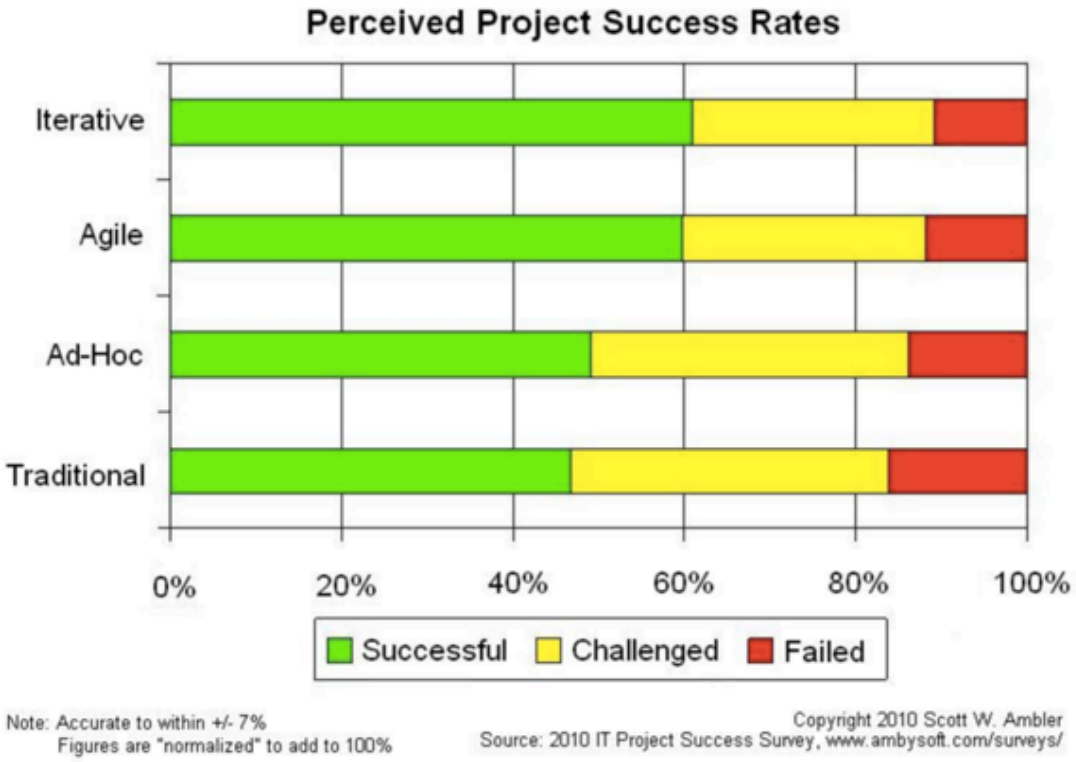


Figure 8 "2010 IT Project Success Rates" Dr Doods - Scott W. Ambler Survey 2010 [26]

4.2.3 Distribution of success/failure on IT projects based on budget

From a GARTNER survey on 2012 [28], they have studied the success of IT projects based on the budget that they were driven.

The figure below will display the comparison of that study, displaying failure and success of IT projects dependant of the range of budget invested.

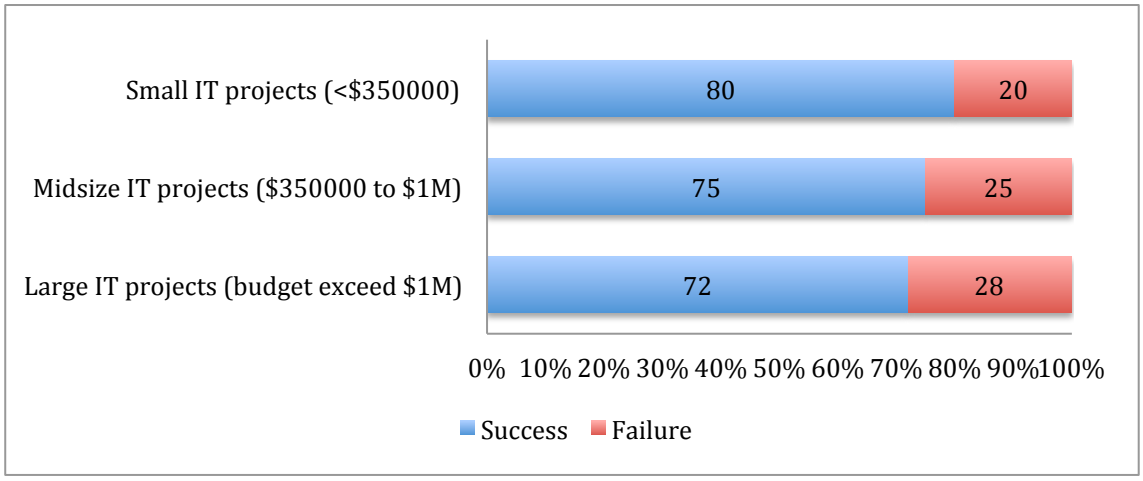


Figure 9 IT Project success/failure Gartner Survey (2012) [28]

Big budgeted IT projects have more chance failure, meanwhile small project not.

4.3 Banking sector IT projects

The banking sector is well known due to the level of investment in the IT sector, a bank is competitive if can adjust and respond quickly to market or regulatory changes. They have the responsibility of manage huge amount of information (and personal data which should be protected "due diligence") across their IT systems.

The challenge for IT companies or departments is to offer a service with a level of quality for the bank to retain the reputation. Banks are concern of any breach or risk that could result on a potential lost of money or sensitive data, consequently it is normal when working with IT banking that projects are impacted by lot of audits.

The environment into which a project is developed it is not stable at all (unless the maintenance projects) and require to PMs to work closer stakeholders to ensure that objectives and expectations are not lost.

5 Complexity Factors

This section mean to define the different sources of complexity impacting projects, initially for any kind of projects and at the finally focused on IT projects.

5.1 PMI complexity factors

PMI has defined the below complexity factors classification [13]

"Human Behaviour"

"Human behaviour is the source of complexity that may arise from the interplay of conducts, demeanours, and attitudes of people. These behaviours may be the result of factors such as changing power relationships, political influence, and individuals' experiences and perspectives. These factors may hinder the clear identification of goals and objectives." [13]

"System Behaviour"

"Programs and projects may be viewed as systems existing within other systems. In a complex environment, programs and projects are interdependent through connections among their parts or components. As an example, consider the project and its sponsoring organization, which may include systems such as human activities, organizational structures, organizational processes, and rules of engagement. Complexity can occur as a result of component connections and when there are disconnects among these components." [13]

"Ambiguity"

"Ambiguity can be described as a state of being unclear and not knowing what to expect or how to comprehend a situation. Unclear or misleading events, cause-and-effect confusion, emergent issues, or situations open to more than one interpretation in programs and projects lead to ambiguity. Ambiguity is a common aspect in programs and projects with complexity." [13]

Here is ratified that a complex environment is due to, many interconnections/dependences, situations raised suddenly and not expected.

5.2 Inherent complexity in IT projects

The table below shows the main the inherent complexity in IT projects, from [29]:

Inherent Complexity in Projects	Description
Simple/Rational System Approaches to Complex Systems	It is not possible represent or fully understand the system model, it is like some parts will not be there due complexity, therefore focusing on understanding the missing pieces will help on manage them. Dependant of the project methodology used, documentation database can be always out of date, due to turbulences and permanent changes.
Actors in the Complex System Environment	People must be prepare for changes, and to maintain a proper level of uncertainty with complex systems to maintain and enahance those. As normally project manager is focused and aligned to the plan, but project team usually is more close to the system, therefore reactions/response to change can vary.
Non-linear Behavior within a System	Project interrelations as a nature of complex projects implies that systems and of course project does not have a "linear" behaviour. Random events can affect positive or negative to the project, on the other hand when reusing components (lets say on the software projects) sometimes re-work could lead in less time and effort, then project management approach must care about this.
Non-ergodicity within a System	"Non-ergodicity is characteristically one in which a subsequent stage depends only on the current stage", therefore on a project, enhancements or improvements can made the main functionality to be lost or impossible to ensure that it is not impacted due to new functionality.
Emergence within a System	Complex projects are decomposed on parts/modules, which can forget the holistic view, causing new modules not able to integrate properly to the system. Mentioned characteristics, are causing project failures, projects out of budget/time, with client expectations not fulfil.

Table 18 inherent complexities in IT projects

Therefore on complex IT project it is not easy to understand even the systems. (No one is able to have a clear picture of the system into which the practitioner it is working into).

5.3 IT projects failure - Paper "The Root Cause of Failure in Complex IT Projects: Complexity Itself" paper

This paper [29] is providing a well detailed state of the art of the IT project complexity, as it has identified further studies about complexity factors and the issues which are causing projects failures.

Some authors like "Lyytien and Hirchheim" has defined project failures as shown below:

Lyytien and Hirchheim	
Correspondence failure	Systems design objectives or specifications not met.
Process failure	System cannot be developed within the allocated budget or schedule.
Interaction failure	User attitude, satisfaction, and frequency of use do not correspond to the level of system usage, i.e. the system is implemented out of necessity and without increased task performance.
Expectation failure	System does not meet stakeholder requirements, expectations, or values

Table 19 Lyytien and Hirchheim failure categories

Other author like Murray (2000) [30] has recognized the below project failure characteristics:

Murray	
Project Complexity	Unrealistic project scope given the available resources and project development experience.
	Improper management of scope creep, the continuous expansion of the project scope.
	New technology that is critical to the project has not been previously developed.
	The organization's issues are not understood.
	Custom work is needed for the organization's business activities.

Table 20 Murray Project Failure Characteristics

Another author Kweku Ewusi-Mensah (2003) [31], has focus his research on the IT projects failure factors, with projects which were cancelled, he has called this as "Abandonment Factors" and it is shown on the table below, these are based on the project risks associated which triggered the failure:

Ewusi-Mensah, 2003	
Abandonment Factors	Unrealistic project is
	Project management and control problems
	Inadequate technical expertise
	Problematic technology base/infrastructure
	Lack of executive or support/commitment
	Changing requirements
	Cost overruns and schedule delays

Table 21 Kweku Ewusi-Mensah Software Abandonment Factors

5.4 IT complexity factors CHAOS report

The below is a summary of the complexity factors highlighted on the 2013 CHAOs report [32], **on black** you can find factors which are not highlighted on subsequent groups.

Factor group	Factor Description
Project Success Factors	User Involvement
	Executive Management Support
	Clear Statement of Requirements
	Realistic Expectations
	Proper Planning
	Competent Staff
	Clear Vision & Objectives
	Smaller Project Milestones
	Ownership
	Hard-Working, Focused Staff
Project Challenged Factors	Lack of User Input
	Lack of Executive Support
	Incomplete Requirements & Specification
	Changing Requirements & Specifications
	Unrealistic Expectations
	Unrealistic Time Frames
	Lack of Resources
	Unclear Objectives
	Technology Incompetence
	New Technology
Project Impaired Factors	Lack of User Involvement
	Lack of Executive Support
	Incomplete Requirements
	Changing Requirements & Specifications
	Unrealistic Expectations
	Lack of Planning
	Lack of Resources
	Didn't Need It Any Longer
	Lack of IT Management
	Technology Illiteracy

Table 22 CHAOS report 2013 Project Factors impacting IT Development Projects

Here it is important mention that one of the main factors is related to the user involvement on the project development, on the other hand it is also important to have proper sponsorship of the executive management to promote the project to success. Other critical factor are the requirements; as normally a project starts with the vision and objectives clear, but this is not the case in all IT development projects because sometimes the requirements are build on iterations made to the product (lets say on the use of methodologies like Agile), therefore it is imperative drive realistic expectations of project stakeholders to ensure the project success.

Resources and their skills are key factors on project success, as well know how about new technologies to be applied/developed (occasionally the technologies are not enough mature to be implemented, then they may lead in problems, issues and of course further risk for the project).

Finally, other reason for project failures is the lack of the planning and organization; this is exacerbated if IT management is not doing the right thing for projects.

5.5 IT factors adding risk to projects

On a Delphi study about IT projects offshore vs domestic projects, it is possible to find another proposal of factors impacted IT projects, therefore taking as reference the findings of [33] it is recognized that commitment of top management is essential for projects, additionally there are other barriers like communication, cross national cultural references, constraints due to time zones, and so on.

Other important factor is that inadequate user involvement looks to be another key factor for IT projects (as shown on "5.4", CHAOS report has this on the TOP 3 of the factors affecting IT development projects).

On a complex project, it is mandatory the adding of change controls, to retain the focus of the vision and objectives of the project.

The following table shows the conclusions of the Delphi study about the risk factor impacting IT projects.

ID	Risk factor
1	Lack of top management commitment
2	Original set of requirements is miscommunicated
3	Language barriers in project communications
4	Inadequate user involvement
5	Lack of project management know-how by client
6	Failure to manage end-user expectations
7	Lack of business know-how by offshore team
8	Poor change controls
9	Lack of required technical know-how by offshore team
10	Failure to consider all costs
11	Telecommunications and infrastructure issues
12	Vendor viability
13	Difficulties in ongoing support and maintenance
14	Low visibility of project process
15	Cross-national cultural differences
16	High turnover of vendor employees
17	Constraints due to time-zone differences
18	Lack of continuous, face-to-face interactions across team members
19	Threats to the security of information resources
20	Negative impact on employee morale
21	Unfamiliarity with international and foreign contract law
22	Differences in development methodology/processes
23	Political instability in offshore destinations
24	Negative impact on image of client organization
25	Currency fluctuations

Table 23 Domestic project and offshore projects risk factors

Technology it is other of the factors impacting IT projects, on the different phases of the project systems are open to infrastructure failures delaying deliverables,

opening gaps on maintenance and business stability. End users are worried about the stability of the system, when issues arise, the project can be recognized as failed.

6 Thesis proposal

It is clear now the state of the art about complexity in projects and the assessment of the same, so, this the right time to propose which factors to be included on the assessment of IT project managers / projects / programs. (Please remember that the target is to define the "Snapshot" tool).

It was discussed before that this document should have as baseline the assessment done on the IMPA B complexity factors. Recognizing the limitation of the factors mentioned on "3.3" which are not focused on the scope IT projects, it is concluded that **some factors must be added** and other removed from a proposal of an assessment template in order to build an "snapshot" tool that can do measures of the complexity focused on IT.

Therefore thesis section will analyse which factors need to be included on the IT project assessment "snapshot" tool or removed from the IMPA B. Please note that thesis section will be validated with a Survey fulfilled by expert IT project managers and project team members with the enough expertise and years working on the section to validate with their knowledge the thesis proposal.

6.1 IT Project management factors not included on IPMA B – thesis proposal

Based on the different factors studied and analysed before, here you have the conclusions about which IT complexity factors are not covered by IMPA B assessment, this is because IPMA B is meant to cover a wider range of projects. Therefore, new factors will be added to the baseline IPMA B assessment knowledge ("3.3") but those focused on the assessment of IT project managers and then IT projects.

6.1.1 Objectives, requirements and expectations

In addition to the factors covered on IMPA B, here you have introduced the requirement of managing stakeholder's expectations, as this is a key for IT project that could help to the project to a success. Therefore, the below are new points to be included on objectives, requirements and expectations section.

6.1.1.1 Clear Statement of Requirements:

Formal presentations, explanation and follow up of the requirements, into any part of the life cycle of the IT project. They should have good quality by accomplishing characteristics like the ones below (From [34]):

- Testable (verifiable)
- Unambiguous
- Clear (concise, terse, simple, precise)

- Correct
- Understandable
- Feasible (realistic, possible)
- Independent
- Atomic
- Necessary
- Implementation-free (abstract)
- Consistent
- Non redundant
- Complete

6.1.1.2 Realistic Expectations

Success of a project is guided by the expectations of the stakeholders; therefore, a proper management of the complexity it is a management of expectations, this new factor will help to IT projects to be considered a success.

6.1.1.3 Clear Strategic Objectives (organizational)

As it was shown on CHAOS report, nowadays the success of the project it is more connected to the impact of the same over the strategic organizational objectives (SWOT analysis), then "Clear Strategic Objectives" is a point to be considering for project managers to follow up. Any project should add value to the organization.

6.1.1.4 Certainty of Regulatory Requirements

On the IT project implementations, some requirements comes from external sources like regulators, it is important to have the proper tracking and a holistic view of requirements of this type. They can impact the planning and project results, if they are not considered or estimated.

6.1.2 Interested Parties, Integration

The below are the new points to be included in "Interested Parties, Integration".

6.1.2.1 User Involvement

On IT as a big difference with any other kind of projects, the participation of the final user is significant; dependant of the methodology used on the project lifecycle, a permanent user feedback ensures the success of the product created. Please note forums like user acceptance testing mean to solve what is showstopper or not fulfilling properly the expectations.

Uncommitted final users may lead on the project failure; therefore, a PM driving properly the complexity should ensure that it is applying other mechanisms to validate the product generated.

6.1.2.2 Project Sponsor supports project methodology

IT projects are not fix on the methodology applied, then it is imperative that the project sponsor is aligned with the project approach to ensure the success of the decisions and accomplish the project phases (milestones). Project sponsor must be actually the promoter of the project.

PM should be able to have a good relation with project sponsor, as for the issues that are out of control from PM, the sponsor should solve them.

6.1.3 Leadership, teamwork, decisions

On the team section there are 4 items to be added which are strongly related to IT projects.

6.1.3.1 Team motivated by the project

A team motivated is a happy team. A good working environment made easy the development of ideas, the search of alternative solutions. A good PM is searching for such good project environment. Subsequently, on the assessment of the capacity of the PM dealing with complexity this motivation factor is key.

6.1.3.2 Hard-Working, Focused Staff

A team focused on the project objectives and deliverables will not lose time on what is not adding value to the project. A PM should be able to communicate, control and guide correctly with his leadership stile to the team members focusing them on the required duties.

6.1.3.3 Near shore / Offshore teams involved

IT projects can be developed on the same country where the project is requested, but this is not the normal behaviour of IT projects, where the outsourcing of some parts of the projects reduces the cost and increase the economical benefits.

Beyond of the cost benefits, offshore solutions add other issues/risks anyway to projects that the PM should deal with. Offshore teams can be cheap, but may not be able to provide the proper expertise and not having the "know how" of the project aspects.

Overseas communication is a vital for the PM. The leadership stile should adapt to delegate properly on the offshore team the responsibility on certain aspects of the project where the risk is affordable.

6.1.3.4 Offshore / Near shore teams are familiar with technical and business aspects of project

This factor is adding more complexity to the project if existing. Enhancing the definition of the factor shown on "6.1.3.3" here the issue is more close to "know how" about the technical and business aspects of the project. Offshore team should understand the context into which the project is developed so they participate on the product and they are not converted into an obstacle on achieving objectives.

The PM must identity lacks of the teams involved on the development of the project; as on this way, he is covering properly the required roles to reach the success.

6.1.4 PM methods, tools and techniques

Here is a new factor helping on getting more IT project success. Points "4.2.1" and "4.2.2" have shown the importance of the methodology used on the project success, in large projects it is a huge benefit the use of iterative methodologies. Meanwhile the use of waterfall methodology looks to provide similar results with small projects compared with iterative.

IT projects sometimes are a mix of methodologies that does not fit any standard approach.

6.1.4.1 Incremental or iterative methodology

This factor will add more value in terms of complexity to the use of iterative methodologies, rather than the use of waterfall approaches. An IT PM which is talented to deal with iterative approach and able to convince DB Sponsor on adapt the project to its use will have more likelihood of success, because it is adapting the project development to the search of fulfil the stakeholders expectations.

6.1.5 New complexity group: Technology

IPMA B assessment ("3.3") does not have at the moment the representation of the Technology factors which are part of the project, this is because it is more representative on IT projects, so, 5 new factors will be considered to be evaluated on the assessment of a complex project / programs or practitioner.

6.1.5.1 Incompetence on using / applying Technology

Technological Incompetence in any of the project chain links, could lead on project delays, this factor does not mean that the a stakeholder does not know about the technology, it only means that it is not competent to use it.

6.1.5.2 New Technologies

Sometimes new technologies can be the downside of a project. People can think on this factor as positive or negative, dependant of the benefit that a new technology can provide to the project. Anyway the use of many new technologies may lead on the project to be more complex; therefore the PM should drive properly the implicit risk of using those.

6.1.5.3 IT Management Support

This IT factor is key on the development of IT projects; they should collaborate with the project phases and in general with the project development. IT Management is a facilitator of all the project aspects, and they help to align the project with the company strategy.

6.1.5.4 Technology Illiteracy

The stakeholders should be aligned on the technologies used on IT projects, when the project starts, the PM should work on drive properly the landing of the participants into the proper level of knowledge about technologies used. Team members should have more further technical and deeper knowledge of the technology, than other stakeholders. For instance, when a product/prototype is presented to end users, they should have the proper training on the usage of the same.

6.1.5.5 Infrastructure, Telecommunication Constraints

Lot of technological interfaces acting over the project. It is recognized that the increase of the amount of interfaces within the project are translated on more complexity.

A complex technological infrastructure framework is build around the project that the PM should deal with. In addition, there are other kinds of telecommunications constraints to be handled that can charge huge bills to the project budget.

6.2 Thesis Summary

The table below shows the draft version of the factors that should be analysed when performing the assessment of complex IT projects/ programs /practitioners

Criteria	Description of the criteria
1. Objectives, Requirements and Expectations	Mandate and Objective
	Conflicting objectives
	Transparency of mandate and objectives
	Interdependence of objectives
	Number and assessment of results
	Clear Statement of Requirements
	Realistic Expectations
	Clear Strategic Objectives (organizational)
	Uncertain and changing regulatory Requirements
2. Interested Parties, Integration	Interested parties, lobbies
	Categories of stakeholders
	Stakeholder interrelations
	Interests of involved parties
	User Involvement
	Executive Management Support
	Project Sponsor committed with project methodology
3. Cultural and social context	Diversity of context
	Cultural variety
	Geographic distances
	Social span
4. Degree of innovation, general conditions	Technological degree of innovation
	Demand of creativity
	Scope for development
	Significance on public agenda
5. Project structure, demand for coordination	Structures to be coordinated
	Demand of coordination
	Structuring of phases
	Demand for reporting
6. Project organisation	Number of interfaces
	Demand for communication
	Hierarchical structure
	Relations with permanent organisations
7. Leadership, teamwork, decisions	Number of sub-ordinates
	Team structure
	Leadership style
	Decision-making processes
	Team motivated by the project
	Hard-Working, Focused Staff
	Near shore / Offshore teams involved
	Offshore / Near shore teams are familiar with technical and business aspects of project
8. Resources incl. finance	Availability of people, material, etc.
	Financial resources
	Capital investment
	Quantity and diversity of staff
9. Risk and opportunities	Predictability of risks and opportunities
	Risk probability, significance of impacts
	Potential of opportunities
	Options for action to minimise risks
10. PM methods, tools and techniques	Variety of methods and tools applied
	Application of standards
	Availability of support
	Proportion of PM to total project work
	Incremental or iterative methodology used in the project
11. Technology	**Incompetence on using / applying Technology**
	New Technologies
	IT Management Support
	Technology Illiteracy
	Infrastructure, Telecommunication Constraints

Table 24 Thesis Proposal, Complexity assessment factors for IT projects

The able table is allocating into the IPMA B assessment ("3.3"), the factors recognized by reviewing the state of the art of complexity in IT projects.

Highlighted on green as displayed on the above table, you can recognize all the new IT complexity factors that are going to be evaluated with a survey accomplished with IT specialist.

The target of the survey is to verify that all new factors are actually valid to perform assessment of IT projects / programs / practitioners. **On the other hand, the Survey will provide the baseline knowledge to build the "Snapshot tool" for the assessment of complexity in projects.**

6.3 Survey

Based on the "6.2 Thesis Summary", the next step is the complexity factors validation by building a survey on the most straightforward manner with IT specialist with lot experience on the IT projects sector. In order to get this, it was reviewed the best way to publish the survey, despite the numerous options available the best option analysed was https://manager.e-encuesta.com/ [35].

This web page has lot of experience and provides online tools to formulate survey methodology.

6.4 Survey Objective

The survey is done to validate the thesis shown on "6.2 Thesis Summary"

6.5 Survey Methodology

In order to allow most people to response to the survey, it was built in Spanish and English. Raw survey can be found annex "9.4 Complexity in IT projects survey", anyway the points below will describe more in detail the structure of the questions and the objective of the same.

6.5.1 Expert profiles, questions 1 - 3

The survey looks for IT experts (ideally project managers) with good experience working in projects, these professionals are the targets of the survey and they can provide the better feedback based on their knowledge and challenges that they have experienced on their careers.

The questions below on the survey were designed to infer part of the profile of the experts, and it will help to validate the survey results.

Therefore, three questions were raised to infer the expert profiles; here the Subject Matter Expert (SME – IT specialists) should pick only one option from each question:

- Industry sector of the IT practitioner.

IT industry Sectors
Technology
Aerospace, defence & security
Asset management
Automotive
Banking & capital markets
Capital projects and infrastructure
Chemicals
Communications
Energy, utilities & mining
Engineering & construction
Entertainment & media
Financial services
Forest, paper & packaging
Government and public services
Healthcare
Hospitality & leisure
Industrial manufacturing
Insurance
Metals
Pharmaceuticals & life sciences
Private equity
Retail & consumer
Sovereign wealth funds
Transportation & logistics
Other

Table 25 Survey IT profile, Industry Sector

- Years of experience working on IT projects

Years of experience
0 years
1-5 years
5-10 years
10-15 years
>15 years

Table 26 Survey IT profile, years of experience

Note: 0 Years was used as a filter to infer if practitioner was actually related to IT projects, or just someone not related to IT with access to the survey.

- IT profile

IT Profile
Chief Information Officer
Chief Technology Officer
Director
Manager
Portfolio Manager
Program manager
Project manager
IT Specialist
Subject Matter Expert
Business Specialist
Project Sponsor
End User
Other

Table 27 Survey IT profile, IT role

6.5.2 Questions related complexity groups, questions 4-5

On "Table 24 Thesis Proposal, Complexity assessment factors for IT projects" was shown that 11 complexity groups meant to build the complexity framework for IT projects.

Criteria
1. Objectives, Requirements and Expectations
2. Interested Parties, Integration
3. Cultural and social context
4. Degree of innovation, general conditions
5. Project structure, demand for coordination
6. Project organisation
7. Leadership, teamwork, decisions
8. Resources incl. finance
9. Risk and opportunities
10. PM methods, tools and techniques
11. Technology

Table 28 Complexity Groups

Two questions were built to infer how complex the complexity groups are for IT projects, and secondly how important they are for the project.

Target of these questions:

These questions will be use for the "snapshot tool" to infer how to order the complexity groups on the tool.

6.5.3 Question related to particular complexity factors, questions 6-10

Next round of questions on the survey meant to validate the new factors added to "Table 24 Thesis Proposal, Complexity assessment factors for IT projects" into specific complexity groups.

Just as a reminder, these factors were commented on "6.1".

Therefore questions related to complexity factors are all of them based on allowing practitioner to rank the factors on the complexity group and discard them if required.

Target of these questions:

These questions will be used for the "snapshot tool" to infer if a complexity factor should be removed from the group or retained.

Apart of above objective, results can be used to understand which of the factors are considered the most complex factors under the complexity group.

6.5.4 Survey publication channels

Subject matter experts (SMEs) were involve on the survey under the below channels:

- Personal contact, for practitioners from the company of the author of this document (German Company).
- Third party support, 2 program managers who help me to publish the survey on a multinational company (French).
- IT Chief Technology Officer of a Banking IT company in Colombia
- Close friends who shared Carrera with the author of this document.
- Social Networks used to get in touch with practitioners

Link built:

It was used the app.bitly.com[xi] application in order to build a short link of the survey, as the usage of this kind of on-line tools, provides a profile about how the access was done to the survey.

[xi] For more details please check on https://bitly.com/ Bitly | URL Shortener and Link Management Platform

6.6 Survey Results

This section will gather the results from the survey, the first part meant to describe the way as the survey was accessed, second part will start digging into the particular survey questions, with a brief analysis inferring what is the impact for IT of the new complexity factors/group added.

6.6.1 Survey response profile

From the functionality provided by "Bitly"[xii], it is possible to infer how the responses to the survey where gathered.

The following graph represents the locations were the survey was clicked:

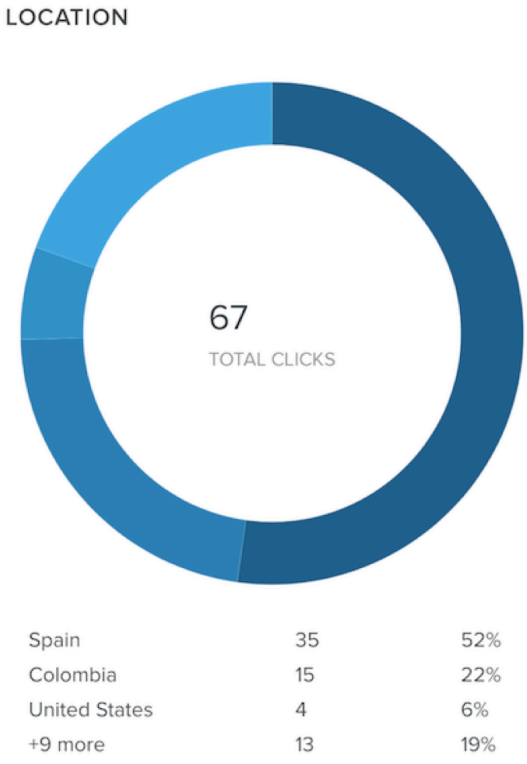


Figure 10 Location where the survey was accessed

As shown, most of the practitioners came from Spain and Colombia.

[xii] For more details please check on https://bitly.com/ Bitly | URL Shortener and Link Management Platform

The graph below represents the distribution of the access to the survey in time:

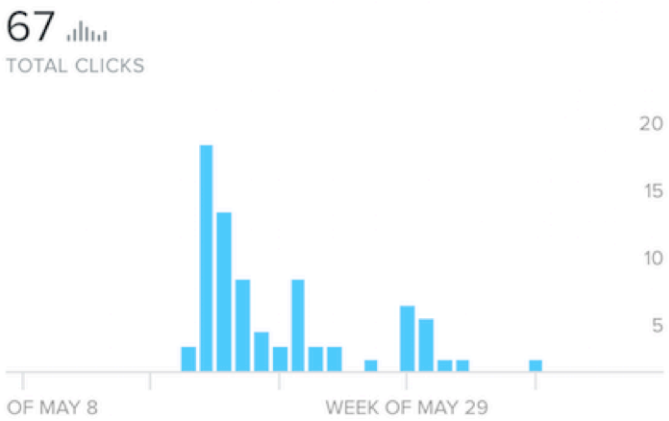


Figure 11 Distribution of Responses in time

Major number of responses was catch once the survey was published, then the survey end was properly planned as not too much response were expected in June 2016

The graph below will provide a quick view of the channels used to access the survey:

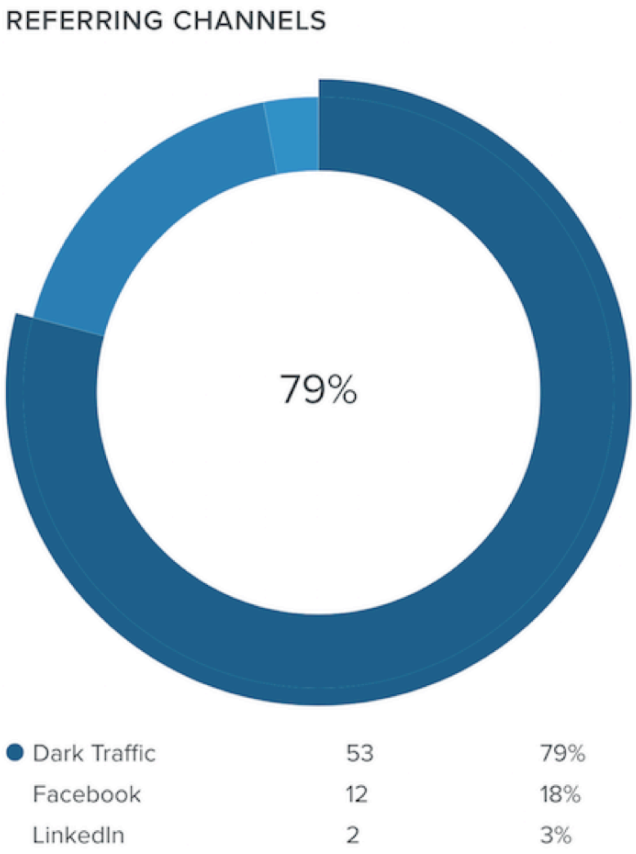


Figure 12 Referring channels to the survey

Most of the answers come from direct contact “Dark Traffic” represents that the link was not clicked from a Social Network.

6.6.2 Survey data analysis

From the total of people accessing to the survey, the following figure shows the final status of their answers:

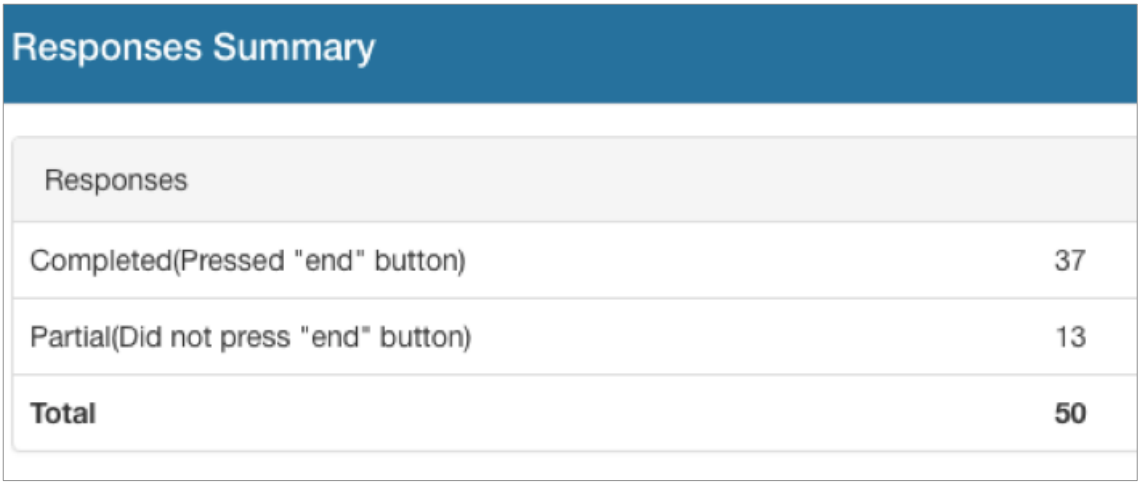


Figure 13 Survey Responses Summary

From these 50 answers, **it is required to remove for the study purposes the thirteen partial answers as the study must be done with comparable items.**

Conclusion

Thirteen incomplete questions are going to be removed, in addition to people that have accessed the link only:

Therefore by using an "individual responses" tool from [35] as exposed on the screenshot below the invalid responses were removed.

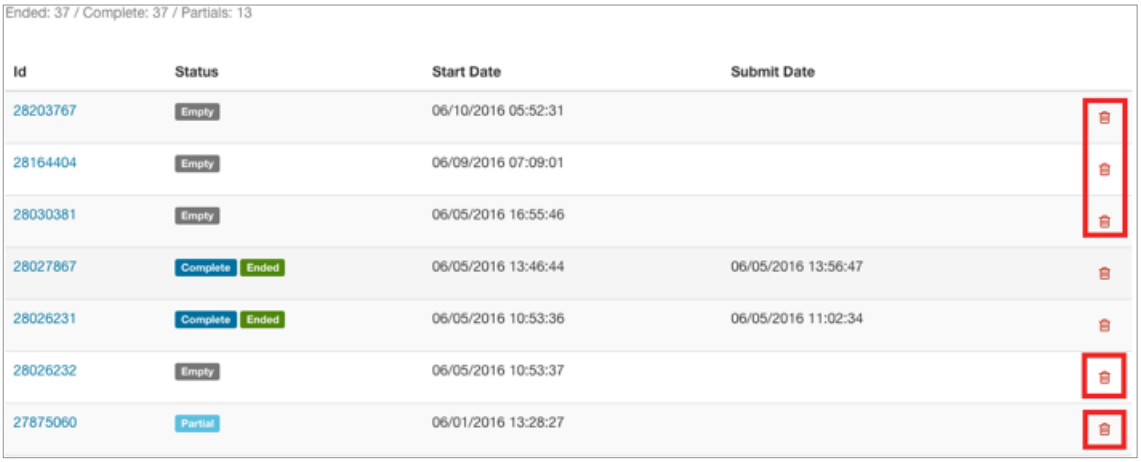


Figure 14 Survey Responses filtering

Therefore total valid respondents for the study are 37.

6.6.2.1 IT profile of respondents

6.6.2.1.1 Question 1

"Please advise to which industry section you belong to"

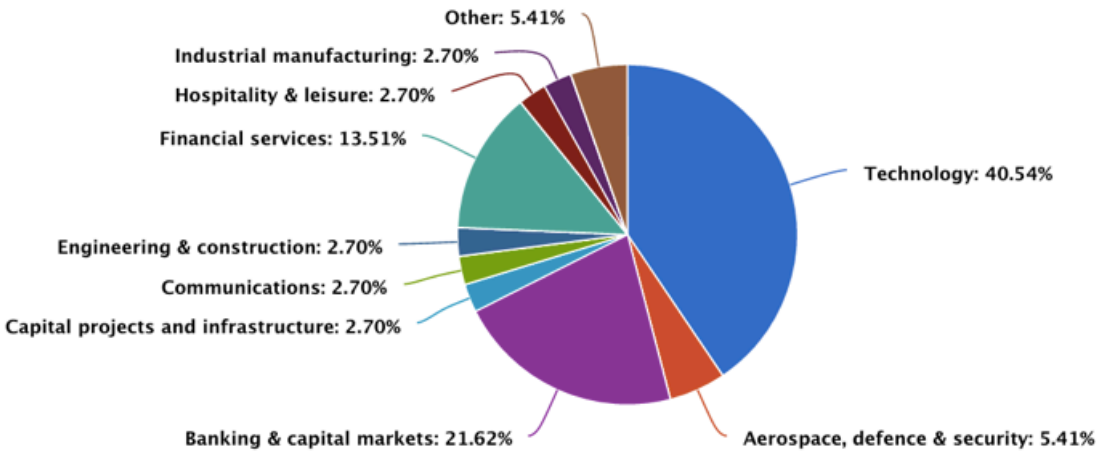


Figure 15 Respondents Profile, Industry Sector (%)

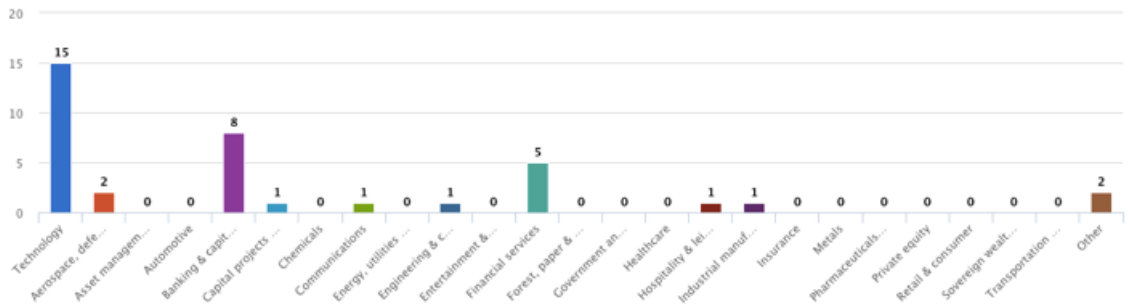


Figure 16 Respondents Profile, Industry Sector (number)

Conclusion:

Most of the practitioners are from Technology, Banking and financial services.

6.6.2.1.2 Question 2

"Years of experience on IT projects"

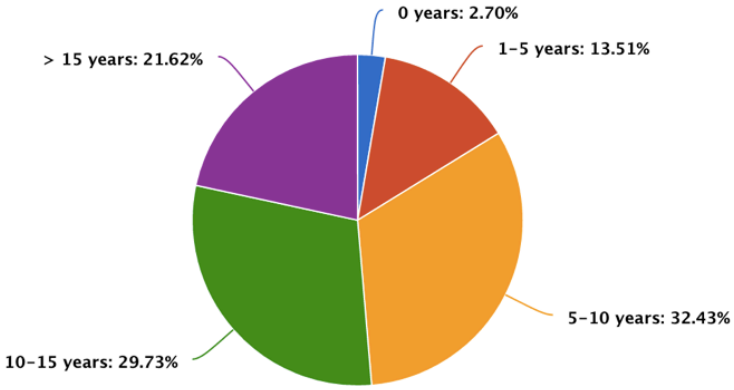


Figure 17 Respondents Profile, Years of experience (%)

Answer	Percent	Count
0 years	2.70%	1
1-5 years	13.51%	5
5-10 years	32.43%	12
10-15 years	29.73%	11
> 15 years	21.62%	8
	Total responses	37

Figure 18 Respondents Profile, Years of experience (number)

Conclusion:

More than 50% of the respondents have more than 10 years of experience working on IT projects, and nearly the third part is having at least [5-10] years. This is a good profile of IT roles.

Only 1 respondent is having 0 years of experience working on IT projects, but he is a end user, therefore his answer will be considered anyway as valid for the study.

6.6.2.1.3 Question 3

"IT profile"

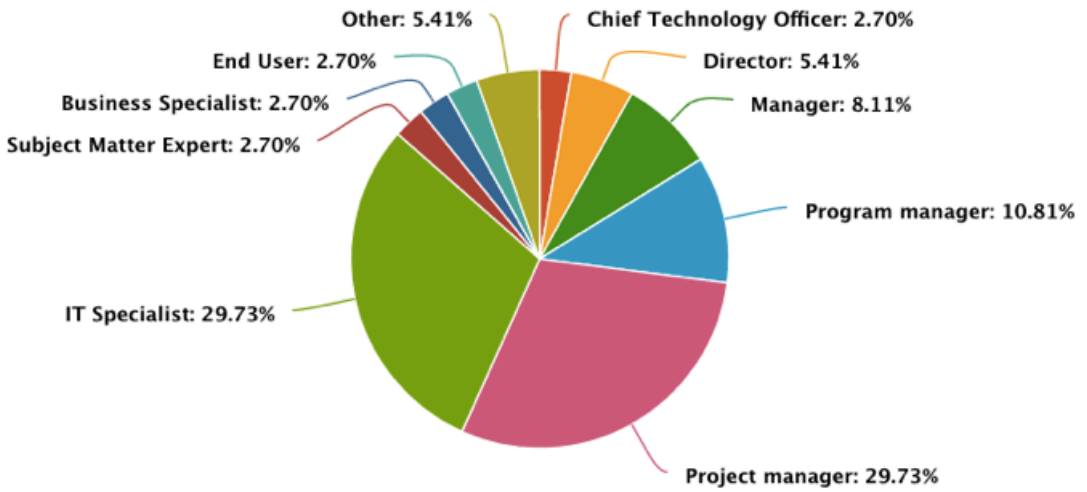


Figure 19 Respondents Profile, IT profile (%)

Answer	Percent	Count
Chief Information Officer	0.00%	0
Chief Technology Officer	2.70%	1
Director	5.41%	2
Manager	8.11%	3
Portfolio Manager	0.00%	0
Program manager	10.81%	4
Project manager	29.73%	11
IT Specialist	29.73%	11
Subject Matter Expert	2.70%	1
Business Specialist	2.70%	1
Project Sponsor	0.00%	0
End User	2.70%	1
Other	5.41%	2
	Total responses	37

Figure 20 Respondents Profile, IT Profile (number)

Conclusion

Around 57% of the respondents are having management profiles; therefore that is a good sample for the study of complexity issues on IT projects. Remaining

percentage are SMEs, which are part of projects with a more technical and business role.

6.6.2.1.4 Question 4

Note: the analysis below is done with the set of a raking pondering the results. Most complex item will have a weight of 11 (as there are 11 complexity groups) and the least complex having a weight of 1, finally each weight is multiplied dependant of the amount of responses.

"In relation with IT project management, please order the below complexity groups. Please locate the one adding more complexity on TOP, to the least on the bottom."

Figure 21 Complexity groups, Ranking of complexity on IT projects

Conclusion:

From the survey the below should be the order of the complexity groups according to the responses of the practitioners:

Complexity groups
Objectives, Requirements, Expectations
Interested Parties, Integration
Project structure, demand for coordination
Technology
Leadership, teamwork, decisions
Degree of innovation, general conditions
Project organisation
Cultural and social context
Risk and opportunities
Resources incl. finance
PM methods, tools and techniques

Table 29 Groups Ranked by complexity

On the top of the rank, and with some distance over the remaining complexity groups, its revealed "Objectives, Requirements, Expectations" and "Interested

Parties, Integration" as the groups adding more complexity to IT projects; remaining groups does not have such marked differences.

6.6.2.1.5 Question 5

"Please rank 1-5 the importance of the below project aspects for IT projects. 1 being least important and 5 most important"

The graph below gathers the information percentage about all the answers from the respondents, the column average is going to be used to compare between the complexity groups what is the relative importance of each factors for the SMEs.

	1	2	3	4	5	Average	Total responses
Objectives, Requirements, Expectations	3 8.11%	2 5.41%	2 5.41%	5 13.51%	25 67.57%	4.27	37
Interested Parties, Integration	1 2.70%	1 2.70%	7 18.92%	12 32.43%	16 43.24%	4.11	37
Cultural and social context	3 8.11%	3 8.11%	22 59.46%	8 21.62%	1 2.70%	3.03	37
Degree of innovation, general conditions	1 2.70%	5 13.51%	12 32.43%	15 40.54%	4 10.81%	3.43	37
Project structure, demand for coordination	3 8.11%	3 8.11%	7 18.92%	19 51.35%	5 13.51%	3.54	37
Project organisation	4 10.81%	3 8.11%	5 13.51%	14 37.84%	11 29.73%	3.68	37
Leadership, teamwork, decisions	3 8.11%	3 8.11%	3 8.11%	15 40.54%	13 35.14%	3.86	37
Resources incl. finance	2 5.41%	3 8.11%	12 32.43%	9 24.32%	11 29.73%	3.65	37
Risk and opportunities	1 2.70%	2 5.41%	9 24.32%	17 45.95%	8 21.62%	3.78	37
PM methods, tools and techniques	3 8.11%	6 16.22%	12 32.43%	10 27.03%	6 16.22%	3.27	37
Technology	2 5.41%	6 16.22%	13 35.14%	9 24.32%	7 18.92%	3.35	37

Figure 22 Complexity groups, importance in IT projects

Conclusion:

By using the "Average" column it is possible to order the relative importance of the factors for IT projects. The table below is a summary of this concept:

Complexity	Avarage
Objectives, Requirements, Expectations	4.27
Interested Parties, Integration	4.11
Leadership, teamwork, decisions	3.86
Risk and opportunities	3.78
Project organisation	3.68
Resources incl. finance	3.65
Project structure, demand for coordination	3.54
Degree of innovation, general conditions	3.43
Technology	3.35
PM methods, tools and techniques	3.27
Cultural and social context	3.03

Table 30 Groups Ranked by importance

On the same way as it was highlighted on "6.6.2.1.4 Question 4", with difference "Objectives, Requirements, Expectations" and "Interested Parties, Integration" are on the top of the importance list for IT projects. Remaining complexity groups are closer in average value.

The table below is a comparison of the complexity groups responses for Importance vs Complexity:

Question 4 - Importance	Question 5 -Complexity
Objectives, Requirements, Expectations	**Objectives, Requirements, Expectations**
Interested Parties, Integration	**Interested Parties, Integration**
Project structure, demand for coordination	Leadership, teamwork, decisions
Technology	Risk and opportunities
Leadership, teamwork, decisions	Project organisation
Degree of innovation, general conditions	Resources incl. finance
Project organisation	Project structure, demand for coordination
Cultural and social context	Degree of innovation, general conditions
Risk and opportunities	Technology
Resources incl. finance	PM methods, tools and techniques
PM methods, tools and techniques	Cultural and social context

Table 31 Comparison of groups by importance and complexity

They have as common factor the top complexity groups. Another curious data highlighted is that from "6.6.2.1.4 Question 4" top 3 and top 4 items were at that time "Project Structure, demand for coordination" and "Technology", but, in relation with importance, they are relegated to the second half (less important) of the complexity groups.

6.6.2.1.6 Question 6

Complexity group: Objectives, Requirements and Expectations

"Please rank from 1 (least complex factor) to 5 (most complex factor) impacting IT projects. Please mark "Does not apply" if you think that factor it is not applicable to IT projects"

	1	2	3	4	5	Does not apply	Average	Total responses
Mandate and objective uncertain, vague	1 2.70%	0 0.00%	4 10.81%	15 40.54%	16 43.24%	1 2.70%	4.25	37
Many conflicting objectives	1 2.70%	5 13.51%	4 10.81%	17 45.95%	8 21.62%	2 5.41%	3.74	37
Hidden mandate and objectives	0 0.00%	1 2.70%	5 13.51%	19 51.35%	11 29.73%	1 2.70%	4.11	37
Very interdependent objectives	0 0.00%	6 16.22%	13 35.14%	9 24.32%	8 21.62%	1 2.70%	3.53	37
Large number of objectives and multidimensional assessment of results	1 2.70%	4 10.81%	12 32.43%	13 35.14%	6 16.22%	1 2.70%	3.53	37
Unclear requirements	1 2.70%	3 8.11%	1 2.70%	7 18.92%	25 67.57%	0 0.00%	4.41	37
Expectations unlikely to be achieved	0 0.00%	2 5.41%	6 16.22%	15 40.54%	11 29.73%	3 8.11%	4.03	37
Strategic Objectives (organizational) uncertain, vague	0 0.00%	0 0.00%	10 27.03%	18 48.65%	8 21.62%	1 2.70%	3.94	37
Uncertain and changing regulatory Requirements	2 5.41%	1 2.70%	8 21.62%	12 32.43%	11 29.73%	3 8.11%	3.85	37

Figure 23 Objectives, Requirements and Expectations factors, relative complexity raking

Conclusion:

All the complexity factors looks to be relevant for the study, score on "Does not apply" column is too low to consider to remove any factor for the "Snapshot tool", there are anyway some factors which are clearly most important than others, for instance "Unclear requirements" and "Mandate and objective uncertain, vague" most of the responses were a 4 or a 5.

The table below is having the values sorted by the average column just to allow the reader to visualize better the relative complexity of the factors from the point of view of the practitioners.

Complexity factor	Avarage
Unclear requirements	**4.41**
Mandate and objective uncertain, vague	4.25
Hidden mandate and objectives	4.11
Expectations unlikely to be achieved	**4.03**
Strategic Objectives (organizational) uncertain, vague	**3.94**
Uncertain and changing regulatory Requirements	**3.85**
Many conflicting objectives	3.74
Very interdependent objectives	3.53
Large number of objectives and multidimensional assessme	3.53

Table 32 Objectives, Requirements and Expectations factors, relative complexity

New IT complexity factors from the thesis are well ranked (highlighted **on black**); therefore this is a good signal to include those on the proposal of the future "snapshot" tool. It looks to be really important for IT that requirements are clearly defined to ensure the success of the projects.

6.6.2.1.7 Question 7

Complexity group: Interested Parties, Integration

"Please rank from 1 (least complex factor) to 5 (most complex factor) impacting IT projects. Please mark "Does not apply" if you think that factor it is not applicable to IT projects"

	1	2	3	4	5	Does not apply	Average	Total responses
Numerous interested parties and lobbies	0 0.00%	3 8.11%	7 18.92%	15 40.54%	10 27.03%	2 5.41%	3.91	37
Many different categories of stakeholders	2 5.41%	8 21.62%	9 24.32%	9 24.32%	8 21.62%	1 2.70%	3.36	37
Unknown stakeholders interrelations	2 5.41%	4 10.81%	7 18.92%	11 29.73%	11 29.73%	2 5.41%	3.71	37
Divergent interest of involved parties	0 0.00%	3 8.11%	10 27.03%	15 40.54%	8 21.62%	1 2.70%	3.78	37
User uncommitted with the project	2 5.41%	1 2.70%	5 13.51%	8 21.62%	20 54.05%	1 2.70%	4.19	37
Executive management uncommitted with the project	2 5.41%	1 2.70%	5 13.51%	13 35.14%	14 37.84%	2 5.41%	4.03	37
Sponsor uncommitted with project methodology	1 2.70%	5 13.51%	10 27.03%	10 27.03%	10 27.03%	1 2.70%	3.64	37

Figure 24 Interested Parties, Integration factors, relative complexity raking

Conclusion:

All the complexity factors looks to be relevant for the study, score on "Does not apply" column is too low to consider to remove any factor from the "Snapshot tool", there are anyway some factors which are clearly most important than others, for instance "User uncommitted with the project" and "Executive management uncommitted with the project" most of the responses were a 4 or a 5 and they are part of the proposed thesis.

The table below is having the values sorted by the average column just to allow the reader to visualize better the relative complexity of the factors from the point of view of the practitioners.

Complexity factor	Avarage
User uncommitted with the project	**4.19**
Executive management uncommitted with the project	**4.03**
Numerous interested parties and lobbies	3.91
Divergent interest of involved parties	3.78
Unknown stakeholders interrelations	3.71
Sponsor uncommitted with project methodology	**3.64**
Many different categories of stakeholders	3.36

Table 33 Interested Parties, Integration factors, relative complexity

On the above table there is a clear evidence that the role of the user on IT project, helping on removing complexity, on the other hand the executive management commitment is a must have to ensure the success of IT projects, as it was shown on the CHAOS report either. As a difference with IPMA B assessment for this complexity group, on IT projects there are new factors (highlighted **on black**);, which are considered most important to be checked/assessed.

6.6.2.1.8 Question 8

Complexity Group: Leadership, teamwork, decisions

"Please rank from 1 (least complex factor) to 5 (most complex factor) impacting IT projects. Please mark "Does not apply" if you think that factor it is not applicable to IT projects"

	1	2	3	4	5	Does not apply	Average	Total responses
Many sub-ordinates, large control span	2 5.41%	8 21.62%	12 32.43%	11 29.73%	4 10.81%	0 0.00%	3.19	37
Dynamic team structure	3 8.11%	5 13.51%	11 29.73%	9 24.32%	7 18.92%	2 5.41%	3.34	37
Adaptive and variable leadership style	5 13.51%	4 10.81%	13 35.14%	9 24.32%	5 13.51%	1 2.70%	3.14	37
Many important decisions in place	3 8.11%	8 21.62%	10 27.03%	7 18.92%	6 16.22%	3 8.11%	3.15	37
Little motivation of the project team	0 0.00%	3 8.11%	10 27.03%	10 27.03%	14 37.84%	0 0.00%	3.95	37
Dispersed team, not focused	0 0.00%	1 2.70%	11 29.73%	10 27.03%	15 40.54%	0 0.00%	4.05	37
Offshore teams/Near shore teams involved	3 8.11%	9 24.32%	15 40.54%	4 10.81%	4 10.81%	2 5.41%	2.91	37
Offshore / Near shore teams are NOT familiar with technical and business aspects of project	0 0.00%	1 2.70%	10 27.03%	15 40.54%	9 24.32%	2 5.41%	3.91	37

Figure 25 Leadership, teamwork, decisions, relative complexity raking

Conclusion:

Here again there is not a relevance of the "Does not apply" column, therefore all the factors can be considered to be part of the snapshot tool. This time just the "Dispersed team" is emerging as the most complex one to deal with.

On the same way done for other complexity groups, the table below is showing sorted the averages of the factors into "Leadership, teamwork, decisions" complexity group.

Complexity factor	Avarage
Dispersed team, not focused	**4.05**
Little motivation of the project team	**3.95**
Offshore / Near shore teams are NOT familiar with technical and business	**3.91**
Dynamic team structure	3.34
Many sub-ordinates, large control span	3.19
Many important decisions in place	3.15
Adaptive and variable leadership style	3.14
Offshore teams/Near shore teams involved	**2.91**

Table 34 Leadership, teamwork, decisions, relative complexity

The result here is really interested, as 3 or the 4 new IT complexity factors (highlighted on back) from the thesis ("6.1.3 Leadership, teamwork, decisions") **are on the top of the average** (highlighted **on black**).

6.6.2.1.9 Question 9

Complexity group: Technology

"Please rank from 1 (least complex factor) to 5 (most complex factor) impacting IT projects. Please mark "Does not apply" if you think that factor it is not applicable to IT projects"

	1	2	3	4	5	Does not apply	Average	Total responses
Incompetence on using / applying Technology	1 2.70%	3 8.11%	6 16.22%	10 27.03%	16 43.24%	1 2.70%	4.03	37
Too many new technologies in place	1 2.70%	9 24.32%	9 24.32%	15 40.54%	3 8.11%	0 0.00%	3.27	37
No IT management support	2 5.41%	1 2.70%	7 18.92%	15 40.54%	12 32.43%	0 0.00%	3.92	37
Stakeholders technology illiteracy	1 2.70%	4 10.81%	16 43.24%	11 29.73%	5 13.51%	0 0.00%	3.41	37
Many Infrastructure, Telecommunication Constraints	1 2.70%	4 10.81%	12 32.43%	17 45.95%	3 8.11%	0 0.00%	3.46	37

Figure 26 Technology, relative complexity raking

Conclusion:

As the results of the column "Does not apply" are too low, therefore no factors should be removed of the future proposal of the "snapshot tool". "Incompetence on using / applying technology" is the most relevant factor of this group.

As it was done before, the table below is the ordered average of responses to this question:

Complexity factor	Avarage
Incompetence on using / applying Technology	4.03
No IT management support	3.92
Many Infrastructure, Telecommunication Constraints	3.46
Stakeholders technology illiteracy	3.41
Too many new technologies in place	3.27

Table 35 Technology, relative complexity

On IT projects it is imperative be competent on the use and the application of technologies. Project team member may know that the technology exists but if not able to use that properly the project will be having more complexity. There are not big differences on the average of the factors. It is curios that too many new technologies in place looks to be adding fewer barriers than people capable to use technologies.

6.6.2.1.10 Question 10

PM methods, tools and techniques
"Please rank from 1 (least complex factor) to 5 (most complex factor) impacting IT projects. Please mark "Does not apply" if you think that factor it is not applicable to IT projects"

	1	2	3	4	5	Does not apply	Average	Total responses
Numerous/manifold, variety of methods and tools applied	1 2.70%	4 10.81%	14 37.84%	8 21.62%	9 24.32%	1 2.70%	3.56	37
Few common standards applicable	1 2.70%	7 18.92%	9 24.32%	10 27.03%	7 18.92%	3 8.11%	3.44	37
No assistance to project management available	1 2.70%	6 16.22%	7 18.92%	17 45.95%	6 16.22%	0 0.00%	3.57	37
High percentage/proportion of PM work from total project work	4 10.81%	3 8.11%	8 21.62%	14 37.84%	4 10.81%	4 10.81%	3.33	37
Totally Iterative methodology used	4 10.81%	5 13.51%	12 32.43%	10 27.03%	5 13.51%	1 2.70%	3.19	37

Figure 27 PM methods, tools and techniques, relative complexity raking

Conclusion:

No factors will be removed for the "Snapshot tool", in addition this group of factors looks not to be adding too much complexity to IT projects as the values shown on the average column does not exceed the 4.

The table below displays the average of the complexity factors; the new IT complexity factor (highlighted on **black**) is not recognized as too much relevant. It looks to be something that should be there, but not really impacting to IT projects.

Complexity factor	Avarage
No assistance to project management available	3.57
Numerous/manifold, variety of methods and tools applied	3.56
Few common standards applicable	3.44
High percentage/proportion of PM work from total project work	3.33
Totally Iterative methodology used	**3.19**

Table 36 PM methods, tools and techniques, relative complexity

The result here looks to be aligned with the results and conclusions found for "PM methods, tools and techniques" shown on "6.6.2.1.4 Question 4**" and "6.6.2.1.5** Question 5**" where this complexity group was the least important.**

6.6.2.1.11 Summary Question 6 – Question 10

As a summary of the averages checked on the mentioned questions, the table below shows together all the factors studied on the survey:

Order	Complexity factor relative complexity	Avarage
1	**Unclear requirements**	**4,41**
2	Mandate and objective uncertain, vague	4,25
3	**User uncommitted with the project**	**4,19**
4	Hidden mandate and objectives	4,11
5	**Dispersed team, not focused**	**4,05**
6	**Expectations unlikely to be achieved**	**4,03**
7	**Executive management uncommitted with the project**	**4,03**
8	**Incompetence on using / applying Technology**	**4,03**
9	**Little motivation of the project team**	**3,95**
10	**Strategic Objectives (organizational) uncertain, vague**	**3,94**
11	**No IT management support**	**3,92**
12	Numerous interested parties and lobbies	3,91
13	**Offshore / Near shore teams are NOT familiar with technical a**	**3,91**
14	**Uncertain and changing regulatory Requirements**	**3,85**
15	Divergent interest of involved parties	3,78
16	Many conflicting objectives	3,74
17	Unknown stakeholders interrelations	3,71
18	**Sponsor uncommitted with project methodology**	**3,64**
19	No assistance to project management available	3,57
20	Numerous/manifold, variety of methods and tools applied	3,56
21	Very interdependent objectives	3,53
22	Large number of objectives and multidimensional assessment of r	3,53
23	**Many Infrastructure, Telecommunication Constraints**	**3,46**
24	Few common standards applicable	3,44
25	**Stakeholders technology illiteracy**	**3,41**
26	Many different categories of stakeholders	3,36
27	Dynamic team structure	3,34
28	High percentage/proportion of PM work from total project work	3,33
29	**Too many new technologies in place**	**3,27**
30	Many sub-ordinates, large control span	3,19
31	**Totally Iterative methodology used**	**3,19**
32	Many important decisions in place	3,15
33	Adaptive and variable leadership style	3,14
34	**Offshore teams/Near shore teams involved**	**2,91**

Table 37 Summary Question 6 – Question 10

On the above table is highlighted on **black** the new IT complexity factors proposed on "6.2 Thesis Summary".

Just to check better the data and analyse how the new IT factors are distributed, the graph below can provide a better visual of the same data:

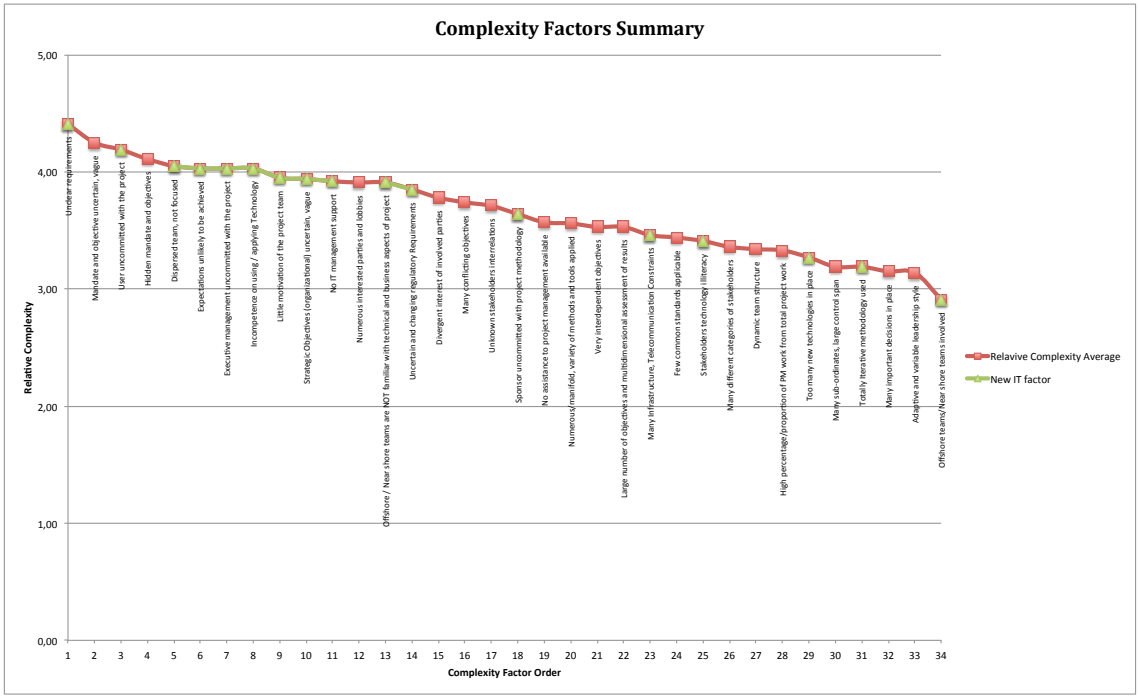


Figure 28 Complexity Factors Survey Summary

Conclusion:

From the new IT complexity factors suggested ("6.2 Thesis Summary"), most of them are in the first half of the relative complexity raking, **this is really good as now the next step is to work on the proposal of the "snapshot tool" for the measure of complexity**. Differences between the factors can suggest a future investigation by doing a paired comparison in order to infer what is actually the weight of each one of the factors studied.

As it was shown on the survey results analysis, there are not factors considered out of the scope of the "Snapshot tool", maximum value of responses to eliminate a single factor was close to 10%, which is not considered enough reason to remove them from the tool.

6.7 Snapshot Tool draft proposal

After the validation of the thesis by the experts, it is now possible to present what it could be the "Snapshot Tool" based on the "6.2 Thesis Summary" now is the time to extend this knowledge and define from each one of the complexity factors what could represent a complexity being:

- "Very Low"
- "Very High"

In order to get this, the table below gathers "Very Low" and "Very High" values for each factor, please note that "Very High" value is the one used on the Survey questions:

Criteria	Description of the criteria	Low Complexity	High Complexity
1. Objectives, Requirements and Expectations	Mandate and Objective	defined, obvious	uncertain, vague
	Conflicting objectives	few conflicts	many conflicts
	Transparency of mandate and objectives	quite transparent	hidden
	Interdependence of objectives	quite independent	very interdependent
	Number and assessment of results	low, monodimensional	large, multidimensional
	Clear Statement of Requirements	**Requirements perfectly clear**	**Unclear requirements**
	Realistic Expectations	**Easily achievable**	**Expectations unlikely to be achieved**
	Clear Strategic Objectives (organizational)	**defined, obvious**	**uncertain, vague**
	Uncertain and changing regulatory Requirements	**available, known**	**uncertain, changing**
2. Interested Parties, Integration	Interested parties, lobbies	few parties	numerous parties
	Categories of stakeholders	few uniform categories	many different
	Stakeholder interrelations	few and well known relations	unknown relations
	Interests of involved parties	comparable interest	divergent interests
	User Involvement	**User available and committed to the project**	**User uncommitted wth the project**
	Executive Management Support	**Executive management committed to the project**	**Executive management uncommitted to the project**
	Project Sponsor committed with project methodology	**Sponsor committed with project methodology**	**Sponsor uncommitted with project methodology**
3. Cultural and social context	Diversity of context	homogeneous	diverse
	Cultural variety	uniform, well known	multicultural, unknown
	Geographic distances	close, concentrated	distant, distributed
	Social span	small, easy to handle	large, demanding
4. Degree of innovation, general conditions	Technological degree of innovation	known and proven technology	unknown technology
	Demand of creativity	repetitive approach	innovative approach
	Scope for development	limited	large
	Significance on public agenda	public interest low	large public interest
5. Project structure, demand for coordination	Structures to be coordinated	few structures	numerous structures
	Demand of coordination	simple, straightforward	demanding, elaborate
	Structuring of phases	sequential	overlapping, simultaneous
	Demand for reporting	uni-dimensional, common	multidimensional, comprehensive
6. Project organisation	Number of interfaces	few	many
	Demand for communication	direct, not demanding, uniform	indirect, demanding, manifold
	Hierarchical structure	uni-dimensional, simple	multidimensional, matrix structure
	Relations with permanent organisations	few relations	intensive mutual relations
7. Leadership, teamwork, decisions	Number of sub-ordinates	few, small control span	many, large control span
	Team structure	static team structure	dynamic team structure
	Leadership style	constant and uniform	adaptive and variable
	Decision-making processes	few important decisions	many important decisions
	Team motivated by the project	**Highly Motivated**	**Little motivation**
	Hard-Working, Focused Staff	**Focused team**	**Dispersed team**
	Near shore / Offshore teams involved	**Domestic teams**	**Offshore teams/Near shore teams involved**
	Offshore / Near shore teams are familiar with technical and business aspects of project	**Good know how in offshore / near shore teams**	**Teams unfamiliar with business / Technical aspects of the project**
8. Resources incl. finance	Availability of people, material, etc.	available, known	uncertain, changing
	Financial resources	one investor and few kinds of resources	many investors and kinds of resources
	Capital investment	low (relative to project of the same kind)	large (relative to project of the same kind)
	Quantity and diversity of staff	low	high
9. Risk and opportunities	Predictability of risks and opportunities	high, quite certain	low, uncertain
	Risk probability, significance of impacts	low risk potential, low impact	high risk potential, large impact
	Potential of opportunities	many options for actions	limited options for actions
	Options for action to minimise risks	low potential of opportunities	large potential of opportunities
10. PM methods, tools and techniques	Variety of methods and tools applied	few, simple	numerous, manifold
	Application of standards	common standards applicable	few common standards applicable
	Availability of support	much support available	no support available
	Proportion of PM to total project work	low percentage	high percentage
	Incremental or iterative methodology used in the project	**Totally Incremental Methodology used**	**Totally Iterative methodology used**
11. Technology	**Incompetence on using / applying Technology**	**Technological competence in all of the project chain links**	**Technological Incompetence in any of the project chain links**
	New Technologies	**Well known technologies used**	**Too many new technologies in place**
	IT Management Support	**Full IT Management support**	**No IT management support**
	Technology Illiteracy	**Stakeholders technology literacy**	**Stakeholders technology illiteracy**
	Infrastructure, Telecommunication Constraints	**Few**	**Many**

Table 38 Snapshot tool Draft

The missing part here is how to perform actually the measures of complexity based on the above items.

Please note that IPMA B complexity assessment, is considering a complex project if the measure of complexity is reaching the 62,5 %, therefore the "Snapshot tool" will be based on the same principle, the difference is that the new tool is focus on the measure of IT projects. **It was already described on "2.3.1".**

7 A proposal of "snapshot" tool in project management complexity assessment

Finally, it is the time for the final "Snapshot" tool proposal. The state of the art provided the deeper knowledge about what is available to perform this kind of assessment activities; the survey has validated with the feedback of experts on IT what is actually impacting IT projects. First draft of the snapshot tool is shown on "6.7 Snapshot Tool draft proposal". This section will describe the look and feel of the tool and the functionality that provides.

Just as a reminder the tool meant to perform the assessment of complexity in IT projects.

7.1 "Snapshot" tool look and feel

"Snapshot" tool complexity groups will be presented based on "6.5.2.1.4 Question 4" complexity groups order; it will show to the user the most relevant groups first. The tool was build on excel to facilitate the learning curve of the user of the case study.

Final look and feel of the tool is the one below:

Instructions: Please fulfill the "Complexity Rank" field from 1 to 4 by updating the number highlighted on green OR slide the bar next to the number.		Complexity			
Complexity Group	**Criterias**	**very low (1)**	**low (2)**	**high (3)**	**very high (4)**
1. Objectives, Requirements and Expectations	Mandate and Objective	defined, obvious			uncertain, vague
	Conflicting objectives	few conflicts			many conflicts
	Transparency of mandate and objectives	quite transparent			hidden
	Interdependence of objectives	quite independent			very interdependent
	Number and assessment of results	low, monodimensional			large, multidimensional
	Clear Statement of Requirements	Requirements perfectly clear			Requirements unclear
	Realistic Expectations	Easily achievable			Unlikely to be achieved
	Clear Strategic Objectives (organizational)	defined, obvious			uncertain, vague
	Uncertain and changing regulatory Requirements	available, known			uncertain, changing
	Complexity Rank 1				
2. Interested Parties, Integration	Interested parties, lobbies	few parties			numerous parties
	Categories of stakeholders	few uniform categories			many different
	Stakeholder interrelations	few and well known relations			unknown relations
	Interests of involved parties	comparable interest			divergent interests
	User Involvement	User available and committed to the project			User uncommitted with the project
	Executive Management Support	Executive management committed to the project			Executive management uncommitted to the project
	Project Sponsor supports project methodology	Sponsor committed with project methodology			Sponsor uncommitted with project methodology
	Complexity Rank 1				
3. Project structure, demand for coordination	Structures to be coordinated	few structures			numerous structures
	Demand of coordination	simple, straightforward			demanding, elaborate
	Structuring of phases	sequential			overlapping, simultaneous
	Demand for reporting	uni-dimensional, common			multidimensional, comprehensive
	Complexity Rank 1				
4. Technology	Incompetence on using / applying Technology	Technological competence in all of the project chain links			Technological Incompetence in any of the project chain links
	New Technologies	Well known technologies used			Too many new technologies in place
	IT Management Support	Full IT Management support			No IT management support
	Technology Illiteracy	Stakeholders technology literacy			Stakeholders technology illiteracy
	Infrastructure, Telecommunication Constraints	Few			Many
	Complexity Rank 1				
5. Leadership, teamwork, decisions	Number of sub-ordinates	few, small control span			many, large control span
	Team structure	static team structure			dynamic team structure
	Leadership style	constant and uniform			adaptive and variable
	Decision-making processes	few important decisions			many important decisions
	Team motivated by the project	Highly Motivated			Little motivation
	Hard-Working, Focused Staff	Focused team			Dispersed team
	Near shore / Offshore teams involved	Domestic teams			Offshore teams/Near shore teams involved
	technical and business aspects of project	Good know how in offshore / near shore teams			Teams unfamiliar with business / Technical aspects of the project
	Complexity Rank 1				
6. Degree of innovation, general conditions	Technological degree of innovation	known and proven technology			unknown technology
	Demand of creativity	repetitive approach			innovative approach
	Scope for development	limited			large
	Significance on public agenda	public interest low			large public interest
	Complexity Rank 1				
7. Project organisation	Number of interfaces	few			many
	Demand for communication	direct, not demanding, uniform			indirect, demanding, manifold
	Hierarchical structure	uni-dimensional, simple			multidimensional, matrix structure
	Relations with permanent organisations	few relations			intensive mutual relations
	Complexity Rank 1				
8. Cultural and social context	Diversity of context	homogeneous			diverse
	Cultural variety	uniform, well known			multicultural, unknown
	Geographic distances	close, concentrated			distant, distributed
	Social span	small, easy to handle			large, demanding
	Complexity Rank 1				
9. Risk and opportunities	Predictability of risks and opportunities	high, quite certain			low, uncertain
	Risk probability, significance of impacts	low risk potential, low impact			high risk potential, large impact
	Potential of opportunities	many options for actions			limited options for actions
	Options for action to minimise risks	low potential of opportunities			large potential of opportunities
	Complexity Rank 1				
10. Resources incl. finance	Availability of people, material, etc.	available, known			uncertain, changing
	Financial resources	one investor and few kinds of resources			many investors and kinds of resources
	Capital investment	low (relative to project of the same kind)			large (relative to project of the same kind)
	Quantity and diversity of staff	low			high
	Complexity Rank 1				
11. PM methods, tools and techniques	Variety of methods and tools applied	few, simple			numerous, manifold
	Application of standards	common standards applicable			few common standards applicable
	Availability of support	much support available			no support available
	Proportion of PM to total project work	low percentage			high percentage
	Incremental or iterative methodology used	Totally Incremental Methodology used			Totally Iterative methodology used
	Complexity Rank 1				

Figure 29 Snapshot tool look and feel

Please note that the form is advising to the user to rank the complexity groups accordingly with the 4 levels of complexity defined (Similar to the one done on IPMA B Assessment). The sum of the ranks will provide the final complexity factor of the project / program / practitioner under the assessment.

The next point will describe the functionality of a complexity group assessment.

7.1.1 Complexity group assessment functionality

The following example shows how a user of the tool can fulfil the complexity measure of a particular "Complexity Group":

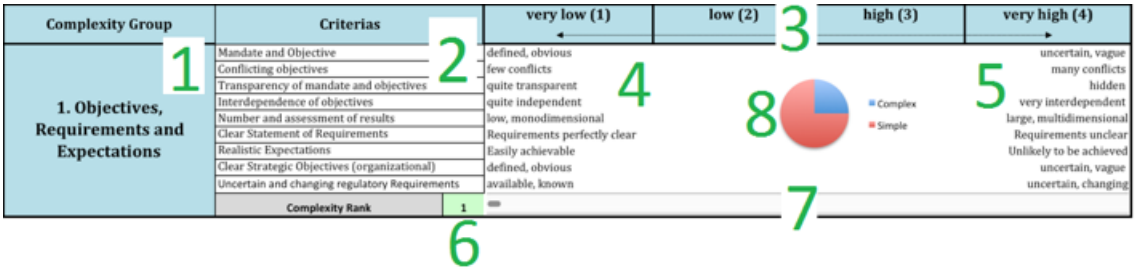


Figure 30 Complexity group functional description

From the above figure and highlighted on green, each number represents:

	Field type	Comment
1)	Read only	Complexity group description
2)	Read only	Criterias under the complexity groups
3)	Read only	4 levels of complexity from Very low to Very high
4)	Read only	Description what a very low value represents
5)	Read only	Description what a very high value represents
6)	User input field	User field to rank complexity of group
7)	User input bar	Another option to slide the Complexity Rank measure
8)	Read only	Graph of the complexity from the group

7.1.2 Bottom part of the "Snapshot" tool – Assessment Result

The bottom part of the spreadsheet shows a graph which provides to the user the final result of the assessment, advising finally if the project / program under evaluation is complex or the practitioner is having skills to drive complex projects/programs.

The figure below is the example of the look and feel of the assessment result:

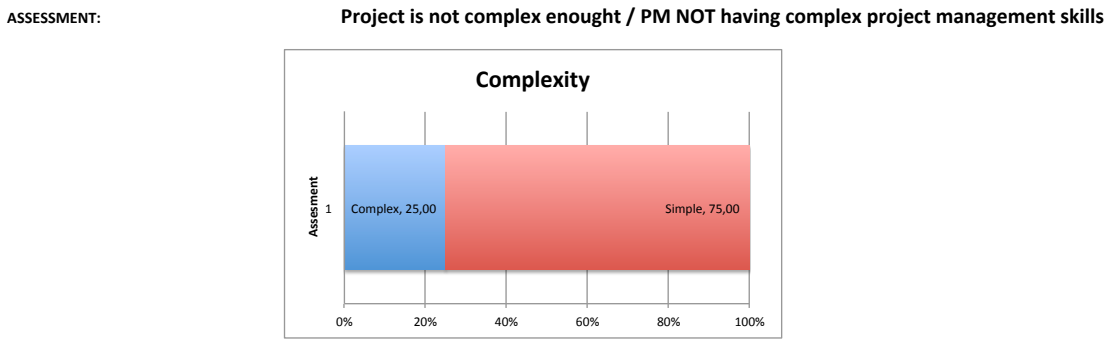


Figure 31 "snapshot" tool assessment result look and feel

On the above figure you can find that the **complexity score** for the particular example is equals to 25%. At the time that the user is changing the values of the assessment, the graph is reflecting the complexity changes.

7.1.3 Conclusion

The tool is ready; therefore, it is possible to start with the assessment of a project, program or practitioner. The chapter below describes the use and application of the "Snapshot" tool to a particular study case.

8 Study case

The study case is divided in two parts; the first one is the description of the taxonomy of the IT project helping to understand what is the start point of the assessment. Please note that project will be having 2 pictures about how it was in 2015 and the new status in 2016 (slightly differences will be recognized).

The second part is the application of the "Snapshot" tool to the mentioned project in 2015 and 2016 status (differences shown on "8.1.8.2"); please note that the assessment was performed by the PM of the project for both years. The PM is having more than 15 years of experience and has guided to this the project to success despite of the complex environment.

8.1 Project Overview

The project to be analysed on the study case it is a banking project of software development, with maintenance and support operations. Project could be described as a consolidation layer for external systems information, which fit the data into a predefined normalized format, in order to report risk measures to downstream systems.

The Project it is part of a wholesale banking system and clients are split around the world. Different vendors are hired to handle different aspects from the project.

8.1.1 Locations

Resources are split in 5 countries, anyway project suppose to be based in UK (in terms of management).

8.1.2 Vendors

Three main vendors are recognized and or charge of the aspects mentioned below:

- Vendor 1: PM, Analysis, Infrastructure, Quality.
- Vendor 2: PMs, Development, Support
- Vendor 3: Support level 1 and 2 (operations)

8.1.3 Stakeholders

As a summary these were in 2015 36 upstream systems, another 10 downstream systems and 4 support systems that provide reference data to the project. On the other hand there are audit systems reviewing the Project, therefore, in some basis some Ad hoc audit teams comes with new requirements.

The Project hardware and some software is reinforced by specialist which receive tickets for supporting activities of the infrastructure, therefore some projects activities can have one off basis ramp up of resources assigned for an specific activity all of them working under SLAs (Service Level Agreements).

It is important mention that each system it is an external team, with its own organization chart (therefore they are not a single stakeholder), on the other hand, it is almost sure that they are working with offshore teams too. Then communication matrix between stakeholders is not easy to be inferred.

The figure below can provide a brief overview about the projects relations and dependencies within information flows of the stakeholders.

8.1.4 Data flow and external stakeholders, project interactions

The following figure shows the different systems that provide information to the project (each box represents an stakeholder).

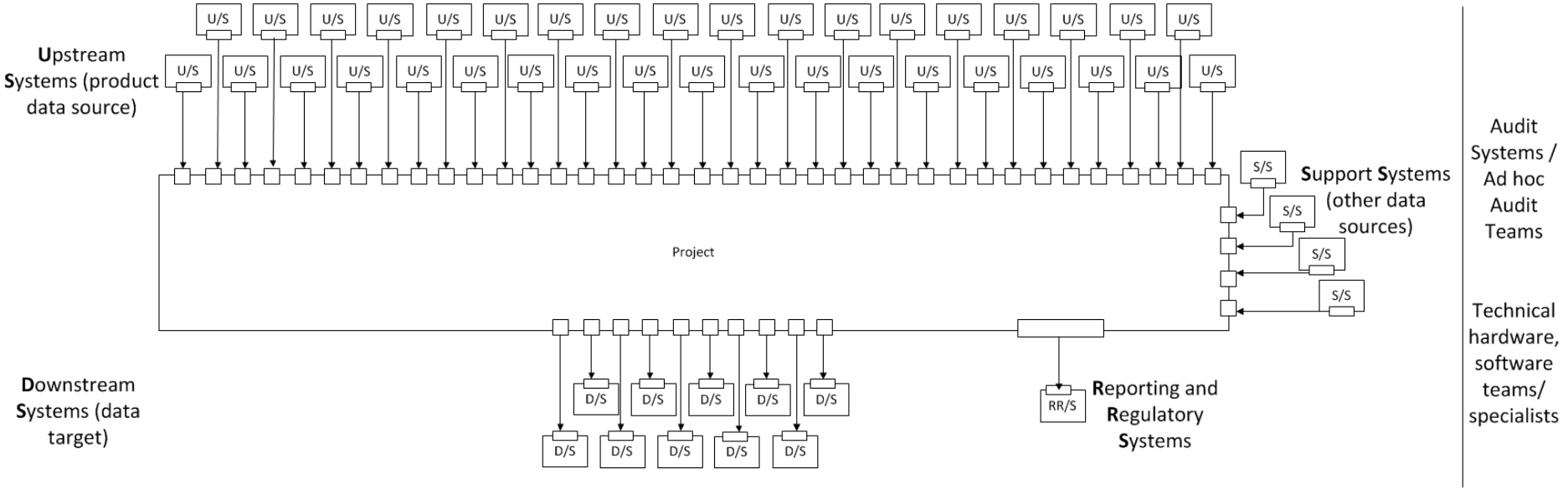


Figure 32 Data flow and external stakeholders

8.1.5 Project Organization Chart

The point below will show the specific organization chart from the Project.

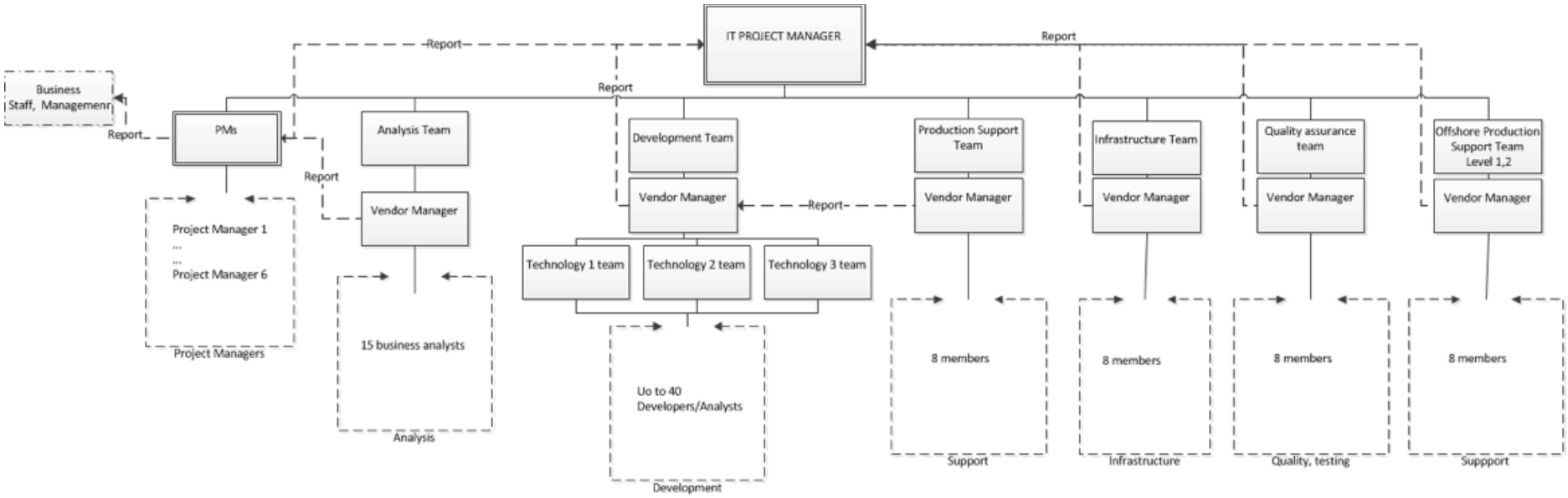


Figure 33 Project Organization Chart

The demand of coordination is high to plan the deliverables, due to the amount of people involved on the development.

8.1.6 Requirements Flow

Main requirements flows suppose to come from Business teams. Anyway every single stakeholder could be in the position of raise requirements; therefore a complicated issue on the project is to assign right priorities to deliverables.

8.1.7 Task Management

It is based on tracking tools, where team members fulfil templates advising/reporting task status.

8.1.8 Deliverables

Priorities are gathered and sorted in particular deliverables (Releases). Then a product increase is delivered once requirements are agreed, developed, tested, reviewed by quality and signed off by business stakeholder.

8.1.8.1 Constraints

- Priorities definition.
- Communication issues (Matrix is too complex)
- Cultural side of things
- Team member's rotation is high
- Learning curve is slow due to the amount of components from the project.

8.1.8.2 Differences between 2015 and 2016

In 2016, some downstream were integrated to the project; therefore the deliverables were more complex. On the other hand there was an initiative to move features to offshore teams (ending 2015), afterwards, there was a transition phase and knowledge transfer to work with them.

8.2 "Snapshot" methodology a case of study applied to a software project.

Practical application of the "snapshot" tool is the assessment of the complexity of the described IT project, therefore this section will explain the profile of the manager who has done the assessment and then it will present the results obtained from the assessment of the project for comparing 2015 vs 2016.

8.2.1 IT expert profile

PM who has worked on the study case has more than 15 year working on IT projects, he is PhD in Chemistry and PMI-certified. He is an IT Delivery professional with consulting experience working with industry leaders across public and private sectors, including managing multi-million budgets and complex programme organisations.

8.2.2 Assessment methodology

The IT expert of the study case was contacted by email, explaining how the snapshot tool works, but without any interference on performing the assessment.

There was not any influence over him to get a particular result. His responses were impartial about the project complexity.

As reply to the email the IT expert get back with copies of the "snapshot" tool spreadsheet, one for the 2015 year status of the project and another for 2016.

8.2.3 2015 project complexity assessment

The figure below is the result of IT PM expert assessment for the project on the 2015 year:

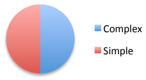
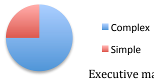
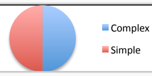
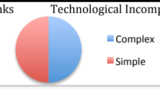
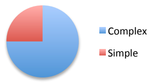
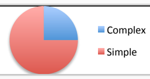
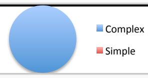
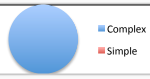
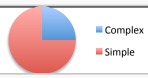
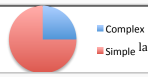
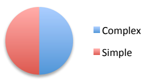
Instructions: Please fulfill the "Complexity Rank" field from 1 to 4 by updating the number highlighted on green OR slide the bar next to the number.		Complexity		
Complexity Group	**Criterias**	**very low (1)** / **low (2)**		**high (3)** / **very high (4)**
1. Objectives, Requirements and Expectations	Mandate and Objective	defined, obvious		uncertain, vague
	Conflicting objectives	few conflicts		many conflicts
	Transparency of mandate and objectives	quite transparent		hidden
	Interdependence of objectives	quite independent		very interdependent
	Number and assessment of results	low, monodimensional		large, multidimensional
	Clear Statement of Requirements	Requirements perfectly clear		Requirements unclear
	Realistic Expectations	Easily achievable		Unlikely to be achieved
	Clear Strategic Objectives (organizational)	defined, obvious		uncertain, vague
	Uncertain and changing regulatory Requirements	available, known		uncertain, changing
	Complexity Rank: 2			
2. Interested Parties, Integration	Interested parties, lobbies	few parties		numerous parties
	Categories of stakeholders	few uniform categories		many different
	Stakeholder interrelations	few and well known relations		unknown relations
	Interests of involved parties	comparable interest		divergent interests
	User Involvement	User available and committed to the project		User uncommitted with the project
	Executive Management Support	Executive management committed to the project		Executive management uncommitted to the project
	Project Sponsor supports project methodology	Sponsor committed with project methodology		Sponsor uncommitted with project methodology
	Complexity Rank: 3			
3. Project structure, demand for coordination	Structures to be coordinated	few structures		numerous structures
	Demand of coordination	simple, straightforward		demanding, elaborate
	Structuring of phases	sequential		overlapping, simultaneous
	Demand for reporting	uni-dimensional, common		multidimensional, comprehensive
	Complexity Rank: 2			
4. Technology	Incompetence on using / applying Technology	Technological competence in all of the project chain links		Technological Incompetence in any of the project chain links
	New Technologies	Well known technologies used		Too many new technologies in place
	IT Management Support	Full IT Management support		No IT management support
	Technology Illiteracy	Stakeholders technology literacy		Stakeholders technology illiteracy
	Infrastructure, Telecommunication Constraints	Few		Many
	Complexity Rank: 2			
5. Leadership, teamwork, decisions	Number of sub-ordinates	few, small control span		many, large control span
	Team structure	static team structure		dynamic team structure
	Leadership style	constant and uniform		adaptive and variable
	Decision-making processes	few important decisions		many important decisions
	Team motivated by the project	Highly Motivated		Little motivation
	Hard-Working, Focused Staff	Focused team		Dispersed team
	Near shore / Offshore teams involved	Domestic teams		Offshore teams/Near shore teams involved
	technical and business aspects of project	Good know how in offshore / near shore teams		Teams unfamiliar with business / Technical aspects of the project
	Complexity Rank: 3			
6. Degree of innovation, general conditions	Technological degree of innovation	known and proven technology		unknown technology
	Demand of creativity	repetitive approach		innovative approach
	Scope for development	limited		large
	Significance on public agenda	public interest low		large public interest
	Complexity Rank: 1			
7. Project organisation	Number of interfaces	few		many
	Demand for communication	direct, not demanding, uniform		indirect, demanding, manifold
	Hierarchical structure	uni-dimensional, simple		multidimensional, matrix structure
	Relations with permanent organisations	few relations		intensive mutual relations
	Complexity Rank: 4			
8. Cultural and social context	Diversity of context	homogeneous		diverse
	Cultural variety	uniform, well known		multicultural, unknown
	Geographic distances	close, concentrated		distant, distributed
	Social span	small, easy to handle		large, demanding
	Complexity Rank: 4			
9. Risk and opportunities	Predictability of risks and opportunities	high, quite certain		low, uncertain
	Risk probability, significance of impacts	low risk potential, low impact		high risk potential, large impact
	Potential of opportunities	many options for actions		limited options for actions
	Options for action to minimise risks	low potential of opportunities		large potential of opportunities
	Complexity Rank: 1			
10. Resources incl. finance	Availability of people, material, etc.	available, known		uncertain, changing
	Financial resources	one investor and few kinds of resources		many investors and kinds of resources
	Capital investment	low (relative to project of the same kind)		large (relative to project of the same kind)
	Quantity and diversity of staff	low		high
	Complexity Rank: 1			
11. PM methods, tools and techniques	Variety of methods and tools applied	few, simple		numerous, manifold
	Application of standards	common standards applicable		few common standards applicable
	Availability of support	much support available		no support available
	Proportion of PM to total project work	low percentage		high percentage
	Incremental or iterative methodology used	Totally Incremental Methodology used		Totally Iterative methodology used
	Complexity Rank: 2			

Figure 34 2015 Project assessment with "Snapshot" tool

Very high complexity groups:

Most of the complexity highlighted by the expert is located in "Project organization" due to the amount of interfaces that the project has, the demand of communication, the hierarchical structure of the project and the teams.

In addition, the other group on the top of complexity is the "Cultural and social context" as it was mentioned on the project description, the large diversity of project context, together with the cultural variety of the teams involved (globally), local, near shore and offshore teams working together plus geographical distances of teams, have made of this group one which is really complex.

High complexity groups:

Two groups are under this complexity; first one is "Interested parties, integration" of the project, that highlights the variety of stakeholders, interrelations and even the lobbies that are presents on the project.

Second group is "Leadership, teamwork and decisions" **reflecting the required adaptive leadership stile** to drive properly the dynamic teams structures which are build dependant of the level of requirements. **Decision-making is other important factor for the project under this group.**

8.2.3.1 2015 complexity score

From the assessment, the final result is the one below:

ASSESSMENT: **Project it is not complex enought / PM NOT having complex project management skills**

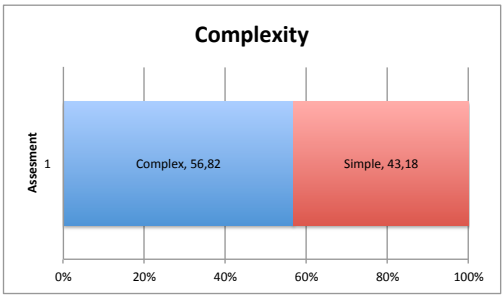


Figure 35 Study case complexity score for 2015

Complexity Score is equals to 56,82 % therefore according to the definition of the "snapshot" tool, it does not fit to consider the project as complex. (As a reminder the minimum defined is 62,5%).

8.2.4 2016 project complexity assessment

The graph below is the result of IT PM expert assessment of the project for the 2016 year:

Instructions: Please fulfill the "Complexity Rank" field from 1 to 4 by updating the number highlighted on green OR slide the bar next to the number.		Complexity			
Complexity Group	**Criterias**	**very low (1)**	**low (2)**	**high (3)**	**very high (4)**
1. Objectives, Requirements and Expectations	Mandate and Objective	defined, obvious			uncertain, vague
	Conflicting objectives	few conflicts			many conflicts
	Transparency of mandate and objectives	quite transparent			hidden
	Interdependence of objectives	quite independent			very interdependent
	Number and assessment of results	low, monodimensional			large, multidimensional
	Clear Statement of Requirements	Requirements perfectly clear			Requirements unclear
	Realistic Expectations	Easily achievable			Unlikely to be achieved
	Clear Strategic Objectives (organizational)	defined, obvious			uncertain, vague
	Uncertain and changing regulatory Requirements	available, known			uncertain, changing
	Complexity Rank 3				
2. Interested Parties, Integration	Interested parties, lobbies	few parties			numerous parties
	Categories of stakeholders	few uniform categories			many different
	Stakeholder interrelations	few and well known relations			unknown relations
	Interests of involved parties	comparable interest			divergent interests
	User Involvement	User available and committed to the project			User uncommitted with the project
	Executive Management Support	Executive management committed to the project			Executive management uncommitted to the project
	Project Sponsor supports project methodology	Sponsor committed with project methodology			Sponsor uncommitted with project methodology
	Complexity Rank 3				
3. Project structure, demand for coordination	Structures to be coordinated	few structures			numerous structures
	Demand of coordination	simple, straightforward			demanding, elaborate
	Structuring of phases	sequential			overlapping, simultaneous
	Demand for reporting	uni-dimensional, common			multidimensional, comprehensive
	Complexity Rank 3				
4. Technology	Incompetence on using / applying Technology	Technological competence in all of the project chain links			Technological Incompetence in any of the project chain links
	New Technologies	Well known technologies used			Too many new technologies in place
	IT Management Support	Full IT Management support			No IT management support
	Technology Illiteracy	Stakeholders technology literacy			Stakeholders technology illiteracy
	Infrastructure, Telecommunication Constraints	Few			Many
	Complexity Rank 2				
5. Leadership, teamwork, decisions	Number of sub-ordinates	few, small control span			many, large control span
	Team structure	static team structure			dynamic team structure
	Leadership style	constant and uniform			adaptive and variable
	Decision-making processes	few important decisions			many important decisions
	Team motivated by the project	Highly Motivated			Little motivation
	Hard-Working, Focused Staff	Focused team			Dispersed team
	Near shore / Offshore teams involved	Domestic teams			Offshore teams/Near shore teams involved
	technical and business aspects of project	Good know how in offshore / near shore teams			Teams unfamiliar with business / Technical aspects of the project
	Complexity Rank 3				
6. Degree of innovation, general conditions	Technological degree of innovation	known and proven technology			unknown technology
	Demand of creativity	repetitive approach			innovative approach
	Scope for development	limited			large
	Significance on public agenda	public interest low			large public interest
	Complexity Rank 1				
7. Project organisation	Number of interfaces	few			many
	Demand for communication	direct, not demanding, uniform			indirect, demanding, manifold
	Hierarchical structure	uni-dimensional, simple			multidimensional, matrix structure
	Relations with permanent organisations	few relations			intensive mutual relations
	Complexity Rank 4				
8. Cultural and social context	Diversity of context	homogeneous			diverse
	Cultural variety	uniform, well known			multicultural, unknown
	Geographic distances	close, concentrated			distant, distributed
	Social span	small, easy to handle			large, demanding
	Complexity Rank 4				
9. Risk and opportunities	Predictability of risks and opportunities	high, quite certain			low, uncertain
	Risk probability, significance of impacts	low risk potential, low impact			high risk potential, large impact
	Potential of opportunities	many options for actions			limited options for actions
	Options for action to minimise risks	low potential of opportunities			large potential of opportunities
	Complexity Rank 2				
10. Resources incl. finance	Availability of people, material, etc.	available, known			uncertain, changing
	Financial resources	one investor and few kinds of resources			many investors and kinds of resources
	Capital investment	low (relative to project of the same kind)			large (relative to project of the same kind)
	Quantity and diversity of staff	low			high
	Complexity Rank 1				
11. PM methods, tools and techniques	Variety of methods and tools applied	few, simple			numerous, manifold
	Application of standards	common standards applicable			few common standards applicable
	Availability of support	much support available			no support available
	Proportion of PM to total project work	low percentage			high percentage
	Incremental or iterative methodology used	Totally Incremental Methodology used			Totally Iterative methodology used
	Complexity Rank 2				

Figure 36 2016 Project assessment with "Snapshot" tool

Very high complexity groups:

They remain the same as already reviewed for 2015

High complexity groups:

They remain the same as already reviewed for 2015, but there is one new group under this complexity level:

"Objectives, requirements and expectations", as the project becomes bigger in scope, with the inclusion of some downstream systems as part of the project then

it was more difficult to deal with this group in 2016. More stakeholders also means that the project expectations have slightly changes, on the other hand the strategic expectations about amending the project scope were adding pressure to the project from senior management.

8.2.4.1 2016 complexity score

From the assessment for 2016 the final result is the one below:

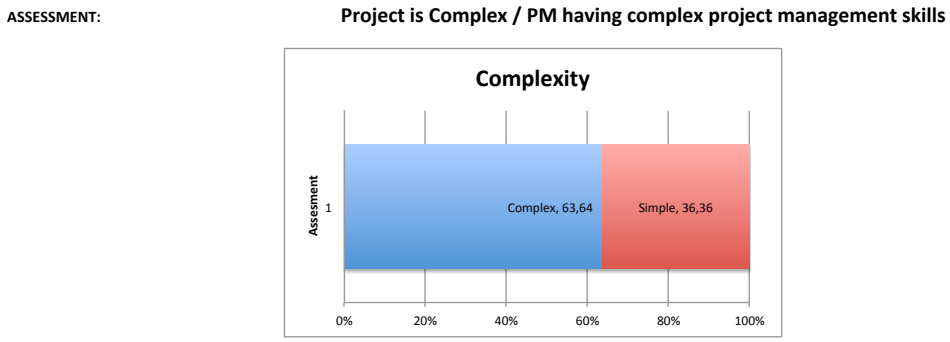


Figure 37 Study case complexity score for 2016

Complexity Score is equals to 63,64% therefore project can be considered as complex as defined for the "snapshot" tool. (As a reminder the minimum defined is 62,5% in order to consider this as complex).

8.2.5 Comparison of IT expert PM responses for 2015 and 2016

The table below shows a comparison of the 2015 complexity factors groups vs 2016, in addition the overall complexity score of the project for each year.

Complexity Group	2015	2016
1. Objectives, Requirements and Expectations	2	3
2. Interested Parties, Integration	3	3
3. Project structure, demand for coordination	2	3
4. Technology	2	2
5. Leadership, teamwork, decisions	3	3
6. Degree of innovation, general conditions	1	1
7. Project organisation	4	4
8. Cultural and social context	4	4
9. Risk and opportunities	1	2
10. Resources incl. finance	1	1
11. PM methods, tools and techniques	2	2
Overall Complexity Score	**56,82**	**63,64**

Table 39 Comparison of IT expert PM responses for 2015 and 2016

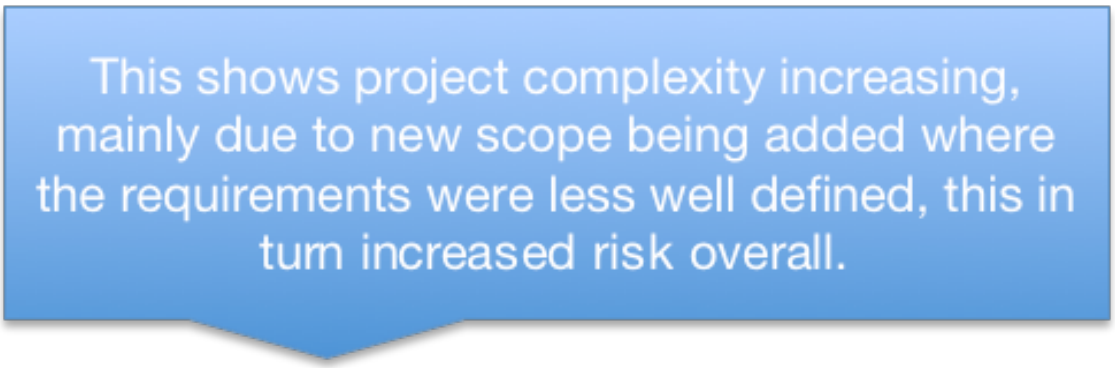
Conclusion:

The increase of complexity that is highlighted on red has lead on the project become a complex one.

The tool can be very helpful to understand the snapshot complexity of a project / program of project manager at any time, providing a guide to senior management, certification institutions, or practitioners about where they are in terms of complexity.

8.2.6 IT PM comment about the complexity increase

The PM has commented the below about the results and the complexity assessment that he has performed about the case study:



His comment describes properly what was analysed on the complexity assessment performed with the snapshot tool.

CONCLUSIONS

- There is not a standard tool for the measure of complexity in project management; the different approaches have shown that currently standardization on this topic is not close. Therefore, lack of standardization is good to promote investigations around complexity assessment.

- Complexity measure on IT projects can help on decrease the level of failure and cancelations of projects. It can collaborate on analysing which factors or complexity groups are impacting the project, providing information to the PMs to work on mitigating or driving properly the complexity.

- The survey performed has confirmed that complexity is specific for the project sector. IPMA B applies to all kind of projects but it was shown that IT projects requires an specific complexity framework due to topics like specific project life cycles (Iterative, waterfall, etc.) or the importance of the a clear definition of objectives, expectations and user involvement.

- PMs in complex projects must adapt their behaviour to the situation and respond accordingly to the complex circumstances, in order to guide the project and achieve success. The study case has shown the critical points adding complexity to the project, they were empirically mitigated/addressed by the PM but the "Snapshot" has described better the complexity groups into which the PM must adapt his behaviour.

- "Snapshot" tool can help on decide when is the right time to perform adjustments on the project management, as shown on "Figure 5 Project life cycle path and complexity adjustment".

- By analysing the study case, it was recognized the value of the "snapshot" tool on gathering information about taken different photos of the project status, it has provided more accurate information about the evolution of the project complexity and has advised which complexity groups have become more complex.

- The "snapshot" assessment tool can be very helpful to understand the snapshot complexity of a project / program of project manager at any time, providing a guide to senior management, certification institutions, or practitioners about where they are in terms of complexity focused on IT.

<u>Future research suggestions:</u>

- Results of the analysis shown on "6.6.2.1.11" from the survey conducted, may suggest a future investigation line by doing pairwise comparison of the complexity factors in order to infer what is actually the weight of each one of those, and work on building a future "Snapshot" tool 2.0 based on specific

weights of the complexity factors. The same case applies for the complexity groups.

- Dependant of the type of projects, the complexity is presented in different manners, then it is required to have new adaptive frameworks dependant of the industry sector of projects to understand that, for instance an IT project in terms of complexity is different than an architectural project. Furthermore specific "snapshot" tools can be defined with the new frameworks suggested.

Proposal for enterprises

- "Snapshot" tool can be more powerful if that is connected to companies information systems, instead of having a practitioner working with the tool, the data can be extracted from enterprise databases generating complexity scores for projects, guiding the senior management with the decision-making.

- With the implementation of mitigation strategies in project management like "snapshot" tool, companies may reduce the huge amount of projects which are cancelled or failed (it was shown that it is around 20% of projects on IT), therefore the explanation of investment in I+D around tool implementation can be justified. Furthermore, the portfolio management on the companies could have baseline data of projects complexity, even before they have started (offer stage) to infer if an investment in new projects can be justified (for instance consulting companies looking contracts).

ABREVIATIONS

IPMA - International Project Management Association
PM - Project Manager
CPM - Complex Project Manager
CPMCS - Complex Project Manager Competency Standards
CCPM - College of Complex Project Managers
PCAT - Project Categorization Framework
AHP - Analytic Hierarchy Process
IT - Information Technology
4-L-C - Four Level Certification
ICB - IPMA competence baseline
NCB - National Competence Baseline.
SWOT – Strengths, Weaknesses, Opportunities, Threats
SME - Subject Matter Expert
SLAs - Service Level Agreements

9 ANNEX

9.1 PMI Assessment Questionnaire

From [13] the following table shows the questions that determine the assessment procedure proposed by the PMI guide.

No	No Question Yes No
1	Can the program or project requirements be clearly defined at this stage?
2	Can the program or project scope and objectives be clearly developed?
3	Are there only a few quality requirements to which the program or project needs to conform that do not contradict one another?
4	Are the program or project assumptions and constraints likely to remain stable?
5	Are stakeholder requirements unlikely to change frequently?
6	Are there a limited number of dependency relationships among the components of the program or project?
7	Does the program or project manager have the authority to apply internal or external resources to program or project activities?
8	Are there plans to transition processes and/or products to the customer or client?
9	Will the deliverable(s) of the program or project utilize only a few different technologies (e.g., electrical, mechanical, digital)?
10	Will the deliverable(s) of the program or project have a manageable number of components, assemblies, and interconnected parts?
11	Does the program or project have clearly defined boundaries with other programs or projects and initiatives that may be running in parallel?
12	Is there consistency between what the customer communicates and what the customer actually needs?
13	Are the program or project team members based within the same region?
14	Is it feasible to obtain accurate program or project status reporting throughout the life of the project?
15	Is the program or project being coordinated within a single organization?
16	Will the program or project be conducted in a politically and environmentally stable country?
17	Will the program or project team members primarily work face-to-face (rather than virtually) throughout the program or project?
18	Is there open communication, collaboration, and trust among the stakeholders and the program or project team?
19	Will the program or project have an impact on a manageable number of stakeholders from different countries, backgrounds, languages, and cultures?
20	Does the organization have the right people, with the necessary skills and competencies, as well as the tools, techniques, or resources to support the program or project?
21	Is the senior management team fully committed to the program or project?
22	©2014 Project Management Institute. Navigating Complexity: A Practice Guide5 - NAVIGATING COMPLEXITY: THE ASSESSMENT QUESTIONNAIRENo Question Yes No22 Will the program or project be conducted over a relatively short period of time, with a manageable number of stakeholder changes?
23	Does the program or project have the support, commitment, and priority from the organization and functional groups?
24	Is funding for the program or project being obtained from a single source or sponsor?
25	Have the success criteria for the program or project been defined, documented,and agreed upon by stakeholders?
26	For a multiorganizational-sponsored program or project, are all organizations aligned regarding project management processes, tools, and techniques?
27	Are there a manageable number of third-party program or project relationships?
28	Has this type of program or project ever been undertaken by the organization?
29	Are the actual rate and type or propensity for change manageable?
30	Does the program or project have a manageable number of issues, risks, and uncertainties?
31	Are the legal or regulatory requirements to which the program or project must comply manageable?
32	Will suppliers be able to meet commitments to the program or project?
33	Is there a high degree of confidence in the estimate to complete (ETC) for the program or project?
34	Have realistic expectations been set around the program or project success criteria?
35	Will the program or project deliver to the committed deadlines?
36	Is the client prepared to accept and sign off on the deliverables?
37	Are the program or project documents and files being kept current in an accessible location for the team (e.g., plan baseline, final plan, change authorizations,payments, correspondence, or contracts)?
38	Have all contracts related to the program or project been free of any claims filed by suppliers or customers?
39	Have all parts of the program or project been free from any financial penalties?
40	Is an agreed framework in place for financial tracking at a work package level?
41	Are the program or project metrics appropriate, stable, and reported regularly?
42	Is there a high level of confidence that new information generated from progressive elaboration is captured appropriately in the program or project plan?
43	Is there a high level of confidence that the interconnected components of the program or project will perform in a predictable manner?
44	Is it possible to terminate, suspend, or cancel a program or project activity when there is evidence that achievement of the desired outcome is not possible?
45	Are team members or stakeholders able to accept the program or project data or information that may be contrary to their beliefs, assumptions, or perspectives?
46	Is there an effective portfolio management process within the organization to facilitate strategic alignment and enable successful delivery of programs and projects?
47	Does the sponsor organization or project organization conduct its business(e.g., make decisions, determine strategies, set priorities, etc.) in a manner that promotes transparency and trust among its internal and external stakeholders?
48	Are there a manageable number of critical paths in the program or project?

Figure 38 Annex - PMI Assessment Questionnaire

Once the questionnaire is finished, therefore the PM can review what kind of issue is the project having, by looking the "Complexity Scenarios" defined on [13].

9.2 Complexity Scenarios PMI

Dependant of the answers provided by the PM on [9.1] the table below will provide the way to infer into which complexity scenario the PM is (table was summarized from [13]):

Applicable Assessment Question (If negative responses to assesment)	Scenario	Description
1, 2, 3, 4, 5, 6, 8, 12, 18, 21, 22, 25, 28, 29, 30, 34, 35, 36, 37, 38, 41, 42, 43, 44, 45, 46, 47	Complexity Scenario 1	The program or project requirements change frequently or cannot be clearly defined due to conflicting information received from various stakeholders.
2, 3, 4, 5, 6, 9, 10, 12, 19, 20, 21, 22, 24, 25, 28, 29, 30, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47	Complexity Scenario 2	It has become apparent that the program or project is no longer going to deliver what the customer needs.
1, 2, 4, 6, 9, 10, 20, 28, 30, 34, 35, 41, 42, 43, 44, 45, 46, 47	Complexity Scenario 3	The combination of the advanced and technical nature of the program or project has several interconnected components and/or processes that have not been encountered previously by the organization. In addition, team members do not have the necessary skills or experience.
4, 5, 9, 10, 22, 25, 29, 30, 34, 35, 37, 41, 42, 43, 44, 45, 46, 47	Complexity Scenario 4	The technologies available at the beginning of the program or project will be eclipsed by new technologies required to complete the deliverables.
13, 14, 15, 16, 17, 34, 45, 46	Complexity Scenario 5	The program or project team members are dispersed globally, and have cultural, language, and time zone challenges.
3, 4, 5, 6, 13, 14, 15, 16, 17, 18, 19, 25, 26, 27, 28, 30, 32, 33, 34, 39, 40, 41, 43, 44, 45, 46	Complexity Scenario 6	The program or project has numerous stakeholders, with disparate teams and sponsors from multiple organizations, each with their own methods and processes. There are also various third-party suppliers and the management structure and responsibilities are unclear.
1, 2, 3, 4, 5, 15, 18, 19, 21, 23, 25, 26, 27, 30, 32, 33, 35, 39, 40, 41, 42, 43, 44, 45, 46	Complexity Scenario 7	Requirements originate from a variety of sources with differing or conflicting objectives. In addition, regulatory or quality requirements may have overarching impact to the program or project.
2, 4, 5, 6, 8, 10, 11, 12, 20, 21, 23, 25, 26, 27, 29, 30, 31, 32, 33, 34, 35, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46	Complexity Scenario 8	The program or project has encountered an increasing volume of change requests. People are no longer motivated to do their work. In addition, there are unresolved claims from the suppliers, customer, or contractor. Many of the key performance indicators and other metrics are pointing to the trend that the program or project is in trouble.
1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 18, 19, 21, 22, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48	Complexity Scenario 9	The project is unlikely to meet the agreed dates due to the numerous dependencies and relationships and lack of supplier or contractor commitment to the dates. This is compounded by the amount of change that the project is encountering.
1, 2, 3, 4, 5, 6, 7, 11, 14, 18, 21, 23, 25, 26, 27, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46	Complexity Scenario 10	The degree of complexity encountered in the program or project is impeding efforts at performance assessment and reporting.
1, 2, 3, 4, 5, 6, 11, 18, 19, 20, 21, 24, 25, 26, 27, 30, 32, 33, 34, 37, 38, 39, 40, 41, 42, 45, 46	Complexity Scenario 11	The project is funded from various sponsors and sources each with their own objectives and agendas.
1, 2, 3, 4, 5, 7, 13, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 34, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46	Complexity Scenario 12	The program or project manager is having difficulty applying and acquiring organizational resources for the program or project activities. In addition, the functional group's objectives are not in alignment with the goals and objectives of the program or project.

Figure 39 Annex – Complexity Scenarios PMI

PMI has defined for complexity scenarios some actions that the PM can apply to the project to manage project complexity.

9.3 PMI actions for Complexity Scenarios

Mentioned scenarios intended to provide a guide of actions for the PM guiding the management Strategy. The tables below are a summary of [13]

Scenario	Description	Suitable Actions for PM
Complexity Scenario 1	The program or project requirements change frequently or cannot be clearly defined due to conflicting information received from various stakeholders.	• Assign resources to verify the information received and to establish an objective basis for decision making. • Balance and negotiate the requirements as stated by customers based on the recommendations from program or project team experts, in order to stabilize requirements. • Scrutinize requirement changes for implications (for example, benefits, impact on other requirements) and take immediate steps to adjust the program or project as necessary. • Put in place the appropriate program or project organizational structure to facilitate communications. • Develop and maintain an online site to share with all key stakeholders to allow for collaboration and tracking of requirements approval. • Be aware of small changes in the tone and context of communications among stakeholders to capture early signs of potential issues. • Hold workshops involving stakeholder groups to understand and resolve views and opinions regarding requirements. • Obtain the explicit commitment of stakeholders to a shared overall strategy for the program or project. • Facilitate face-to-face meetings with a social dimension to nurture collaborative behavior and help develop trust toward a collective sensemaking of project goals, risks and uncertainty, and a shared (no-blame) understanding of consequences of scope change. • Manage the program or project with success in mind, but always within the boundaries of ethics in the given context and personal sense of accountability and responsibility. • Be resourceful conversationally; build collective devotion to the project through various techniques (e.g., storytelling). • Form important personal alliances with key stakeholders. • Develop a strong identity as the manager of projects with complexity and become established as an expert in order to gain respect and support from stakeholders. • Arrange to meet and discuss the consequences with those accountable for original decisions and reassess risks with them against the agreed KPI (key performance indicators) for the project. • Continually engage stakeholders on success criteria as success can change over time. • Identify potential biases among stakeholders, understand their motives, and then develop mitigation
Complexity Scenario 2	It has become apparent that the program or project is no longer going to deliver what the customer needs.	• Create a prototype or pilot a process or service to understand the potential gaps while consulting and coordinating with subject matter experts. • Introduce iterative development techniques when appropriate. • Assess whether in-process change activities help or hinder alignment to the customer's needs. • Hold value-engineering workshops. • Consult and coordinate with team members to generate innovative solutions. • Communicate with the customer in person whenever possible. • Take quick action to communicate the situation and possible alternative approaches to the customer. • Reassess scope and requirements to determine the viable outcomes that can be delivered by the program or project and seek concurrence from the customer that the change in outcomes is acceptable. • Reexamine how customer needs relate to the strategic objectives of the organization. • Work with the customer to identify the optimum way forward. • Assess the viability of the program or project. • Conduct interim lessons learned to avoid unnecessary future changes.
Complexity Scenario 3	The combination of the advanced and technical nature of the program or project has several interconnected components and/or processes that have not been encountered previously by the organization. In addition, team members do not have the necessary skills or experience.	• Compile and analyze the implications of the individual interconnected components or processes and their impact on achieving the overall objectives of the program or project. • Consult directly with the program or project sponsor and the customer to decompose the interconnected scope elements to the extent possible. Clearly identify the artifacts and data needing to be coordinated. Reprioritize the newly decomposed scope elements. • Request that the team take on the necessary training and development to enhance skills for alignment with the needs of the program or project. • Encourage team members to question assumptions and constraints of the program or project in order to promote creativity and innovation. • Conduct frequent team briefings to acknowledge and celebrate accomplishments and provide updates on current challenges. • Ensure that succession plans are in place for key team members so that knowledge is retained. • Encourage knowledge sharing among team members, using techniques such as shadowing and workshops. • Engage key leaders from other functional units in team meetings and encourage collaboration by discussing how each unit can work together and achieve successful outcomes for the program or project including organizational benefits. • Utilize technology readiness assessments to understand the maturity of the technology utilized for the program or project and the impacts on delivery reliability. Develop technology maturity to an acceptable technology readiness level (TRL) that enables reliable program and project execution. • Include efforts for testing new technologies and the necessary system regression testing for the transition to new technologies. • Diligently research external organizations that have successfully undertaken similar types of programs or projects in order to develop good practices. • Investigate techniques from other industries for innovative approaches and processes. • Undertake a resource gap analysis focused on the competency of team members and provide additional training or look for external resources.

Scenario	Description	Suitable Actions for PM
Complexity Scenario 4	The technologies available at the beginning of the program or project will be eclipsed by new technologies required to complete the deliverables.	• Ask the technical lead to create a technology road map to replace obsolescent technologies. • Develop alternative strategies (for example, iterative or parallel development) to deliver success in the face of unknown technology changes. • Assess the likely costs and benefits of investing in new technologies in order to complete the deliverables. • Include efforts that involve the testing of new technologies. • Engage internal and/or external experts, as appropriate, to obtain a realistic understanding of any shortcomings and opportunities. • Encourage team members to share relevant intelligence from their personal knowledge. • Develop and implement a communications management plan to inform team members and other stakeholders of the current, updated approach. • Focus on a change management strategy that covers not only the technical but also the consequential impact on people's behaviors. • Provide to team members and stakeholders opportunities for training on future technologies that will be used. • Engage the sponsor and customer in regular discussions regarding constraints and contingency options. • Focus on iterative and parallel efforts to obtain quick lessons learned, avoid unnecessary threats, and exploit potential opportunities. • Rigorously monitor signs of emergent risks (threats as well as opportunities). • Conduct iterative SWOT analysis of the program or project environment and leverage potential technical opportunities. • Benchmark other organizations that are engaged in similar programs or projects using innovative technologies.
Complexity Scenario 5	The program or project team members are dispersed globally, and have cultural, language, and time zone challenges.	• Include in the scope the effort needed for the development of effective team processes and behavior norms. • Confirm that everyone understands and supports the goals and objectives of the program or project. • Develop, implement, and verify effective virtual team management methodologies, processes, tools, and systems (for example, effective decision-making processes). • Identify point-of-contact people in each location who have good language and translation skills in the agreed-upon common team language. • Learn how to actively resolve conflicts. • Establish and gain general agreement to a process for group decision making. • Set up a virtual site for the team to communicate and share ideas. • Nurture a collaborative team environment by encouraging a sense of community. • Provide cultural awareness training. • Pay attention to changes in team interactions such as reduced engagement or productivity. • Help team members to adjust to the diversity of the group and make teamwork an integral part of the program or project. • Assess existing cultural differences and work to facilitate synergy and leverage diversity. • Be sensitive to varying working hours and holidays. Schedule meetings that are convenient for the team (not only to the practitioner's geographic location). Ensure all communications are clear and concise. Follow up all interactions with written communications. Use simple words that cannot be misunderstood when translated into another language. Avoid the use of slang and acronyms. • Consider how to maximize value from "overlap" time between team members in different time zones. • Make sure that everyone has a voice and continually encourage information sharing. • Choose results-driven team members who can work independently.
Complexity Scenario 6	The program or project has numerous stakeholders, with disparate teams and sponsors from multiple organizations, each with their own methods and processes. There are also various third-party suppliers and the management structure and responsibilities are unclear.	• Ensure that the stakeholder management plan is the key focus throughout the program or project life cycle. • Ensure the scope of work includes adequate stakeholder engagement activities (for example, stakeholder assessment, buy-in, management strategies, and continuous monitoring or follow-up). • Pay attention to small communication nuances among various stakeholders that may have big impact on the future of the program or project. • Learn and understand the strategies or objectives of stakeholders to adapt the right communication techniques. • Create a glossary of commonly used terms to share across organizations or borders. • Include methodology, process, and solution integration in the program or project scope. • Apply mechanisms for delegation and federation of authority, accountability, and decision making in the project organization. • Scrutinize small parameter changes in risk analysis, as these could have great impact. • Actively engage in two-way communication with all stakeholders (for example, listening activities, inspiring people with the vision of the program or project). • Perform due diligence and continually monitor external stakeholders' organizational strategy and behaviors in order to partner with them effectively. • Consult and collaborate with stakeholders to ensure that everyone has a voice in the process. • Partner with suppliers and key stakeholders to establish plans for communication and develop other ground rules for aligning different processes. • Effectively integrate all of the key stakeholders' needs within the project management plan. • Create management systems, clear expectations, and a climate to encourage the desired behaviors among disparate stakeholders. • Provide conflict management and negotiation training to team members. • Create incentives to encourage team work and successful outcomes for the program or project. • Ensure risks are owned by stakeholders who are best placed to control them.

Scenario	Description	Suitable Actions for PM
Complexity Scenario 7	Requirements originate from a variety of sources with differing or conflicting objectives. In addition, regulatory or quality requirements may have overarching impact to the program or project.	• Balance and negotiate the requirements in order to align and obtain agreement on objectives. • Assess regulatory and/or quality requirements against the original program or project requirements and modify as necessary. • As each deliverable is completed, verify with the client whether the results meet the program or project approval requirements and/or functional test criteria, and obtain approval or sign-off. • Adopt a rigorous gate process throughout the life cycle of the program or project to obtain sign-off for key program or project milestones. • Communicate new regulatory requirements to the stakeholders for awareness and action as necessary. • Perform interim reviews of deliverables with key stakeholders to get buy-in before the effort has been expended to complete the deliverables. • Document nonconformance and corrective actions on a database to share with team members and relevant stakeholders. • Obtain agreement on the requirements and document this with stakeholders; share the overall strategy for the program or project. • Review with procurement third-party contracts in order to handle needed flexibility. • Work with suppliers to renegotiate the contracts to make them more flexible. • Consult with program or project managers and team members who are experienced in handling regulatory changes within the geographies potentially affected by the project. • Conduct program or project premortems to assess the impact of changing regulatory structures. • Ensure that adequate legal resources are involved on the program or project team to enable responses to legal/regulatory changes in the geographies in which the project or its outcomes are involved. • Ensure sufficient reserves to address the impact of regulatory changes.
Complexity Scenario 8	The program or project has encountered an increasing volume of change requests. People are no longer motivated to do their work. In addition, there are unresolved claims from the suppliers, customer, or contractor. Many of the key performance indicators and other metrics are pointing to the trend that the program or project is in trouble.	• Commission an external review of the status for the purpose of understanding the causes of the problems and the validity of the change requests. • Consult and engage with the organization's legal department and consider seeking advice from an external specialized consultant. • Establish a dialogue with the team to address the causes of low productivity. • Focus on team-building activities to reinforce teamwork and team expectations. • Meet with team members in person to discuss how change requests are impacting the work activities and take appropriate action to prioritize focus and resolve issues. • Along with interim lessons learned, document and review environmental changes and potential new emergent elements. • Implement stakeholder analysis as an ongoing activity, not just once at the beginning of the program or project. • Review and update stakeholder engagement strategies for the program or project. • Meet with the stakeholders to review the revised, baselined, and approved project objectives and requirements. Create a priority list of changes, documenting effort and planned delivery date. Maintain an open-door policy for all team members to bring forth issues, concerns, questions, or innovations. • Engage the sponsor and senior management in the review of the health of the program or project and consider whether the objectives of the program or project are still in alignment with the organizational strategies. • Review metrics for appropriateness and completeness. • Consider whether team members have enough latitude and appropriate motivation to make innovative contributions. • Consider whether team members' skills are appropriate for program or project success. • Document and take actions to enhance which key program or project team attributes contributed to success and resolve those attributes that caused issues. • Document and manage social-political factors that are permeated through the program or project. • Conduct a review of claims that have surfaced during the program or project with the organization's
Complexity Scenario 9	The project is unlikely to meet the agreed dates due to the numerous dependencies and relationships and lack of supplier or contractor commitment to the dates. This is compounded by the amount of change that the project is encountering.	assessed for impact and that all implications are understood before agreement. • Verify the validity of dependencies and relationships among the tasks, activities, and projects. • Examine the program or project network diagram and seek alternatives. Alternatives may include changed dependencies, refined work packages, or more discrete deliverables. • Seek advice and recommendations from subject matter experts on refined work packages and alternatives. • Communicate with work package owners and discuss and document roadblocks, constraints, risks, issues, and opportunities regarding the difficulty in completing the tasks or activities. Explore resolutions, preventive actions, and recovery options to get the overall project back on track to agreedupon completion dates. • Actively engage with the sponsors to determine the most effective way of communicating with them in order to achieve consensus. Communicate vigorously with all sponsors. • Review contracts with suppliers, contractors or customers. Identify contractual or legal obligations that may support getting back on track and seek advice from the legal department for the best course of action. • Seek out lessons learned from subject matter experts on similar projects. • Examine contract for financial penalties. • Notify the legal department or senior management of potential contractual issues. Apply rigorous claims management procedures. • Communicate with other appropriate stakeholders regarding changes to deliverables and due dates. • Engage with stakeholders to make sure they have provided input to the documented requirements, including criteria for success or completion. • Conduct more frequent stand-up (or remote) meetings to address risks, issues, and opportunities that impact the agreed-upon dates for the project. • Work with the suppliers to gain commitments to the necessary dates. Explore the roadblocks, constraints, risks, alternatives, and opportunities and determine the resolutions and remedies. • Evaluate and document the severity of the impact of the supplier's lack of commitment to the program or project.

Scenario	Description	Suitable Actions for PM
Complexity Scenario 10	The degree of complexity encountered in the program or project is impeding efforts at performance assessment and reporting.	• Determine and document the necessary data and information needed to understand progress on the program or project. Verify that work packages, deliverables, and corresponding metrics are defined adequately to determine progress. • Determine and document the roadblocks, constraints, risks, issues, and opportunities regarding the difficulty in providing assessments and reporting of progress on the program or project. • Conduct more frequent mandatory stand-up (or remote) meetings with people responsible for tasks or activities due in the near term to report on, discuss, and assess project status. The meetings can be reduced in frequency once an agreed-upon assessment and reporting process is in place and functioning adequately. • Communicate results of the daily stand-up meeting to all stakeholders. • Conduct deliverable assessments with the team to ensure completeness and acceptability. • Provide appropriate stakeholders with information on the difficulty in reporting and assessing progress on the program or project and seek their help in remedying the situation. • Follow up with stakeholders on the success or failure of remedies and seek additional help as needed. • Evaluate and document the project impact for absence of progress reporting and assessment. • Focus on lessons learned to establish stakeholder alignment and scope acceptance earlier in the process in order to reduce risk. • Develop, implement, and monitor an action plan for improving program or project metrics and reporting. • Conduct program or project peer reviews to obtain insight into ways to improve reporting. • Assess the skill level of the program or project manager and team to pinpoint weaknesses and strengths and to take appropriate action.
Complexity Scenario 11	The project is funded from various sponsors and sources each with their own objectives and agendas.	• Analyze and define the project scope, negotiating the boundaries and deliverables between sponsors. Obtain and document sponsor acceptance. • Develop and document the approach with sponsors in order to obtain agreement on the scope changes. • Actively engage with the sponsors to determine the most effective way of communicating with them in order to achieve consensus. • Mediate between the sponsors and work toward a mutual understanding of all points of view. • Conduct regular sponsor meetings to discuss the program or project issues, risks, and progress. This becomes even more critical with increasing budget constraints and schedule demands. • Be ever vigilant for changes in stakeholder attitudes and actions. • Pay close attention to changes in relationships among the various key stakeholders and the potential effects of those changing relationships on the program or project, its deliverables, and its team members. • Monitor shifts in power and influence among the sponsors. Work toward finding ways to balance the program or project goals among the sponsors.
Complexity Scenario 12	The program or project manager is having difficulty applying and acquiring organizational resources for the program or project activities. In addition, the functional group's objectives are not in alignment with the goals and objectives of the program or project.	• Revisit the scope and resource gap analysis to ensure that it documents the incremental work necessary to resource the program or project adequately. • Consider alternative approaches to produce the desired outcomes. • Investigate the availability, costs, and schedule implications of acquiring external resources. • Ensure that the program or project objectives align with organizational strategy. • Ask the executive sponsor to relay the importance of the program or project to the organization. • Enhance the lines of communication to functional managers who control the needed resources. • Establish regularly scheduled meetings with the sponsor and functional managers to ensure an adequate supply of resources for the program or project. • Meet with the sponsors to validate the priority of the program or project in the organization's portfolio. • Create a team-building activity and include the functional managers. • Provide incentives to the functional managers for meeting the resource requirements. • Evaluate alternative plans to address the resource issues. • Set aside additional contingency reserves for acquiring external resources.

Figure 40 Annex - PMI actions for Complexity Scenarios

9.4 Complexity in IT projects survey

All the questions of the "Complexity on IT survey" can be found on this section of the document. As the survey was build done on English and Spanish then this is the reason to gather both versions.

9.4.1 English Version

Survey - Complexity on IT Projects

1. Overview

This survey aims to provide a context to evaluate complex projects and the performance of their managers. This survey will help on building a framework more focused on information technology projects.

Many thanks for your participation, as you are helping to build knowledge.

Note: It will not take more than 10 mins for you to finish the survey

Image from http://www.arraspeople.co.uk/camel-blog/projectmanagement/qa-project-management-careers-large-project-experience/

1. Please advise to which industry sector you belong to: (*)

- ✓ Select
- Technology
- Aerospace, defence & security
- Asset management
- Automotive
- Banking & capital markets
- Capital projects and infrastructure
- Chemicals
- Communications
- Energy, utilities & mining
- Engineering & construction
- Entertainment & media
- Financial services
- Forest, paper & packaging
- Government and public services
- Healthcare
- Hospitality & leisure
- Industrial manufacturing
- Insurance
- Metals
- Pharmaceuticals & life sciences
- Private equity
- Retail & consumer
- Sovereign wealth funds
- Transportation & logistics
- Other

2. Years of experience on IT projects: (*)

0 years	1-5 years	5-10 years	10-15 years	> 15 years
○	○	○	○	○

3. IT profile (*)

- ✓ Select
- Chief Information Officer
- Chief Technology Officer
- Director
- Manager
- Portfolio Manager
- Program manager
- Project manager
- IT Specialist
- Subject Matter Expert
- Business Specialist
- Project Sponsor
- End User
- Other

Survey - Complexity on IT Projects

2. Complexity groups questions on project management

From your experience, please answer the below questions:

4. In relation with IT project management, please order the below complexity groups. Please locate the one adding more complexity on TOP, to the least on the bottom. (*)

- Technology
- Interested Parties, Integration
- Objectives, Requirements, Expectations
- Cultural and social context
- Degree of innovation, general conditions
- Project structure, demand for coordination
- Project organisation
- Leadership, teamwork, decisions
- Resources incl. finance
- Risk and opportunities
- PM methods, tools and techniques

5. Please rank 1-5 the importance of the below project aspects for IT projects.
1 being least important and 5 most important: (*)

	1	2	3	4	5
Objectives, Requirements, Expectations	◯	◯	◯	◯	◯
Interested Parties, Integration	◯	◯	◯	◯	◯
Cultural and social context	◯	◯	◯	◯	◯
Degree of innovation, general conditions	◯	◯	◯	◯	◯
Project structure, demand for coordination	◯	◯	◯	◯	◯
Project organisation	◯	◯	◯	◯	◯
Leadership, teamwork, decisions	◯	◯	◯	◯	◯
Resources incl. finance	◯	◯	◯	◯	◯
Risk and opportunities	◯	◯	◯	◯	◯
PM methods, tools and techniques	◯	◯	◯	◯	◯
Technology	◯	◯	◯	◯	◯

3. Complexity group: Objectives, Requirements, Expectations

Find out IT factors on complex projects

6. Please rank from 1 (least complex factor) to 5 (most complex factor) impacting IT projects. please mark "Does not apply" if you think that factor it is not applicable to IT projects (*)

	1	2	3	4	5	Does not apply
Uncertain and changing regulatory Requirements	◯	◯	◯	◯	◯	◯
Unclear requirements	◯	◯	◯	◯	◯	◯
Strategic Objectives (organizational) uncertain, vague	◯	◯	◯	◯	◯	◯
Large number of objectives and multidimensional assessment of results	◯	◯	◯	◯	◯	◯
Many conflicting objectives	◯	◯	◯	◯	◯	◯
Expectations unlikely to be achieved	◯	◯	◯	◯	◯	◯
Hidden mandate and objectives	◯	◯	◯	◯	◯	◯
Very interdependent objectives	◯	◯	◯	◯	◯	◯
Mandate and objective uncertain, vague	◯	◯	◯	◯	◯	◯

4. Complexity group: Interested Parties, Integration

7. Please rank from 1 (least complex factor) to 5 (most complex factor) impacting IT projects. please mark "Does not apply" if you think that factor it is not applicable to IT projects (*)

	1	2	3	4	5	Does not apply
Numerous interested parties and lobbies	○	○	○	○	○	○
Unknown stakeholders interrelations	○	○	○	○	○	○
Divergent interest of involved parties	○	○	○	○	○	○
Sponsor uncommitted with project methodology	○	○	○	○	○	○
Many different categories of stakeholders	○	○	○	○	○	○
Executive management uncommitted with the project	○	○	○	○	○	○
User uncommitted with the project	○	○	○	○	○	○

5. Complexity Group: Leadership, teamwork, decisions

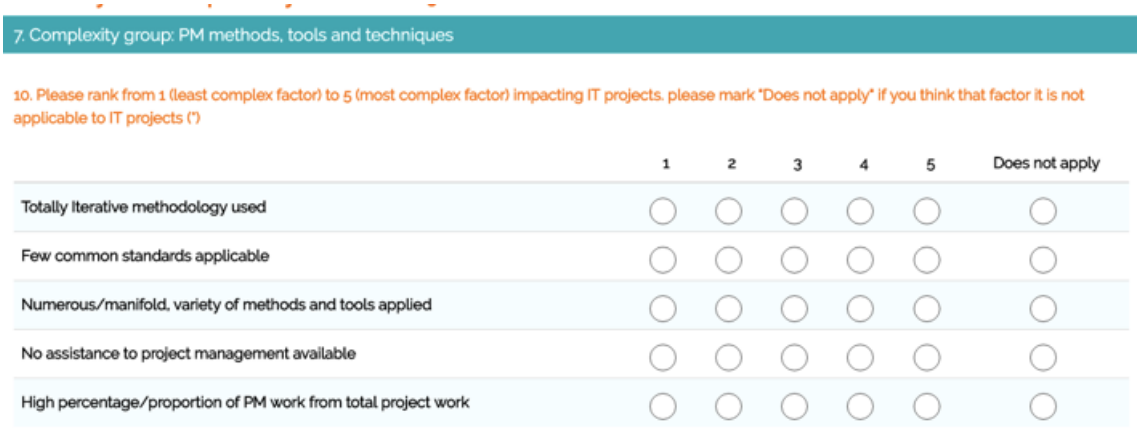
8. Please rank from 1 (least complex factor) to 5 (most complex factor) impacting IT projects. please mark "Does not apply" if you think that factor it is not applicable to IT projects (*)

	1	2	3	4	5	Does not apply
Many sub-ordinates, large control span	○	○	○	○	○	○
Little motivation of the project team	○	○	○	○	○	○
Adaptive and variable leadership style	○	○	○	○	○	○
Offshore / Near shore teams are NOT familiar with technical and business aspects of project	○	○	○	○	○	○
Dynamic team structure	○	○	○	○	○	○
Many important decisions in place	○	○	○	○	○	○
Dispersed team, not focused	○	○	○	○	○	○
Offshore teams/Near shore teams involved	○	○	○	○	○	○

6. Complexity group: Technology

9. Please rank from 1 (least complex factor) to 5 (most complex factor) impacting IT projects. please mark "Does not apply" if you think that factor it is not applicable to IT projects (*)

	1	2	3	4	5	Does not apply
Many Infrastructure, Telecommunication Constraints	○	○	○	○	○	○
Stakeholders technology illiteracy	○	○	○	○	○	○
No IT management support	○	○	○	○	○	○
Incompetence on using / applying Technology	○	○	○	○	○	○
Too many new technologies in place	○	○	○	○	○	○



7. Complexity group: PM methods, tools and techniques

10. Please rank from 1 (least complex factor) to 5 (most complex factor) impacting IT projects. please mark "Does not apply" if you think that factor it is not applicable to IT projects (*)

	1	2	3	4	5	Does not apply
Totally Iterative methodology used	○	○	○	○	○	○
Few common standards applicable	○	○	○	○	○	○
Numerous/manifold, variety of methods and tools applied	○	○	○	○	○	○
No assistance to project management available	○	○	○	○	○	○
High percentage/proportion of PM work from total project work	○	○	○	○	○	○

Figure 41 Annex - Survey English Version

9.4.2 Spanish Version

1. Vista general

Esta encuenta busca crear un contexto para evaluar proyectos complejos y el comportamiento de sus directores. Esta encuesta ayudará a crear un marco de referencia sobre la complejidad en proyectos de tecnologías de la información.

Muchas gracias por partifipar ya que usted está ayudando a construir conocimiento

Nota: No le tomará más de 10 minutos terminar la encuesta

Imagen de *http://www.arraspeople.co.uk/camel-blog/projectmanagement/qa-project-management-careers-large-project-experience/*

1. Por favor seleccione el sector de IT al que pertenece: (*)

- ✓ Seleccione
- Tecnología
- Aerospacial, defensa y seguridad
- Gestión de Activos
- Automotor
- Banca y mercados financieros
- Proyectos Inversión e infraestructura
- Química
- Comunicaciones
- Energía, agua, minería, etc.
- Ingenieria y construcción
- Entretenimiento y medios
- Servicios financieros
- Logística y empaquetado
- Gobierno y servicios públicos
- Asistencia médica
- Hotelero, y esparcimiento
- Industria manufacturera
- Seguros
- Metales
- Farmacéutico y ciencias de la vida
- Empresas de Inversión
- Retail
- Fondos Soberanos
- Transporte y logística
- Otro

2. Años de experiencia en proyectos de IT: (*)

0 años	1-5 años	5-10 años	10-15 años	> 15 años
○	○	○	○	○

3. Indique su perfil trabajando en proyectos TI (*)

- ✓ Seleccione
- Gerente General
- Gerente Tecnológico
- Director
- Manager
- Director de Cartera
- Director de Programa
- Director de Proyecto
- Especialista de IT
- Experto en la materia
- Especialista de Negocio
- Patrocinador de proyecto
- Usuario final
- Otros

2. Preguntas sobre los grupos de factores de complejidad en project management

4. En relación con la gestión de proyectos TI, ordene los siguientes grupos de complejidad. Por favor asigne el factor que añade más complejidad arriba y el que añade menos abajo.
(*)

- Tecnología
- Partes interesadas e integración del proyecto
- Objetivos, Requerimientos y Expectativas
- Contexto Cultural y social
- Grado de Innovación, condiciones generales
- Estructura del proyecto, necesidad de coordinación
- Organización del proyecto
- Liderazgo, trabajo en equipo, decisiones
- Recursos, incluidos los financieros
- Riesgos y oportunidades
- Project Management métodos, herramientas y técnicas

5. Por favor asigne un valor en el rango de 1 a 5 que represente la importancia de los siguientes aspectos en los proyectos de IT.
Siendo 1 poco importante y 5 muy importante: (*)

	1	2	3	4	5
Objetivos, Requerimientos y Expectativas	○	○	○	○	○
Partes interesadas e integración del proyecto	○	○	○	○	○
Contexto Cultural y social	○	○	○	○	○
Grado de Innovación, condiciones generales	○	○	○	○	○
Estructura del proyecto, necesidad de coordinación	○	○	○	○	○
Organización del proyecto	○	○	○	○	○
Liderazgo, trabajo en equipo, decisiones	○	○	○	○	○
Recursos, incluidos los financieros	○	○	○	○	○
Riesgos y oportunidades	○	○	○	○	○
Project Management métodos, herramientas y técnicas	○	○	○	○	○
Tecnología	○	○	○	○	○

3. Grupos de factores de complejidad: Objetivos, requerimientos y expectativas

6. Por favor asigne un valor en el rango de 1 (factor menos complejo) a 5 (factor más complejo) impactando proyectos TI (IT), marque "No aplica" si usted piensa que el factor no es aplicable a proyectos de tecnologías de la información: (*)

	1	2	3	4	5	No aplica
Mandato y objetivo incierto, vago	◯	◯	◯	◯	◯	◯
Muchos objetivos conflictivos	◯	◯	◯	◯	◯	◯
Objetivos estratégicos (organización), inciertos y vagos	◯	◯	◯	◯	◯	◯
Mandato y objetivos escondidos	◯	◯	◯	◯	◯	◯
Expectativas difícilmente alcanzables	◯	◯	◯	◯	◯	◯
Requerimientos poco claros	◯	◯	◯	◯	◯	◯
Requerimientos regulatorios, inciertos y cambiantes	◯	◯	◯	◯	◯	◯
Mucha interdependencia entre los objetivos	◯	◯	◯	◯	◯	◯
Gran número de objetivos y una evaluación de resultados multidimensional	◯	◯	◯	◯	◯	◯

4. Grupos de factores de complejidad: Partes interesadas, integración

7. Por favor asigne un valor en el rango de 1 (factor menos complejo) a 5 (factor más complejo) impactando proyectos TI (IT), marque "No aplica" si usted piensa que el factor no es aplicable a proyectos de tecnologías de la información: (*)

	1	2	3	4	5	No aplica
Numerosos partidos y grupos de presión interesados	◯	◯	◯	◯	◯	◯
Muchas categorías de stakeholders	◯	◯	◯	◯	◯	◯
Intereses divergentes de las partes interesadas	◯	◯	◯	◯	◯	◯
Usuario no comprometido con el proyecto	◯	◯	◯	◯	◯	◯
Interrelaciones de los stakeholders desconocidas	◯	◯	◯	◯	◯	◯
Patrocinador no comprometido con la metodología del proyecto	◯	◯	◯	◯	◯	◯
Gestión Ejecutiva no comprometida con el proyecto	◯	◯	◯	◯	◯	◯

5. Grupos de factores de complejidad: Liderazgo, trabajo en equipo, decisiones

8. Por favor asigne un valor en el rango de 1 (factor menos complejo) a 5 (factor más complejo) impactando proyectos TI (IT), marque "No aplica" si usted piensa que el factor no es aplicable a proyectos de tecnologías de la información: (*)

	1	2	3	4	5	No aplica
Equipo disperso y desenfocado	◯	◯	◯	◯	◯	◯
Estilo de dirección adaptativo y variable	◯	◯	◯	◯	◯	◯
Equipos Offshore (otros países) involucrados	◯	◯	◯	◯	◯	◯
Gran número de subordinados y ámbito de control amplio	◯	◯	◯	◯	◯	◯
Estructura de equipo dinámica	◯	◯	◯	◯	◯	◯
Poca motivación del equipo de proyecto	◯	◯	◯	◯	◯	◯
Equipos Offshore (otros países) NO familiarizados con la parte técnica y de negocio del proyecto	◯	◯	◯	◯	◯	◯
Muchas decisiones de proyecto importantes	◯	◯	◯	◯	◯	◯

6. Grupos de factores de complejidad: Tecnología

9. Por favor asigne un valor en el rango de 1 (factor menos complejo) a 5 (factor más complejo) impactando proyectos TI (IT), marque "No aplica" si usted piensa que el factor no es aplicable a proyectos de tecnologías de la información: (*)

	1	2	3	4	5	No aplica
Incompetencia en el uso y aplicación de la tecnología	◯	◯	◯	◯	◯	◯
Sin soporte del la gerencia de TI (IT)	◯	◯	◯	◯	◯	◯
Partes interesadas sin conocimiento sobre tecnologías	◯	◯	◯	◯	◯	◯
Muchas y muy variadas nuevas tecnologías aplicadas	◯	◯	◯	◯	◯	◯
Muchas restricciones en infraestructura y telecomunicaciones	◯	◯	◯	◯	◯	◯

7. Grupos de factores de complejidad: Métodos, herramientas y técnicas de gestión

10. Por favor asigne un valor en el rango de 1 (factor menos complejo) a 5 (factor más complejo) impactando proyectos TI (IT), marque "No aplica" si usted piensa que el factor no es aplicable a proyectos de tecnologías de la información: (*)

	1	2	3	4	5	No aplica
No hay disponible asistencia al project management	◯	◯	◯	◯	◯	◯
Pocos estándares aplicables	◯	◯	◯	◯	◯	◯
Usar métodos totalmente iterativos	◯	◯	◯	◯	◯	◯
Numerosos/variados métodos y herramientas de project management utilizadas	◯	◯	◯	◯	◯	◯
Gran porcentaje de trabajo director del proyecto sobre el total horas del proyecto	◯	◯	◯	◯	◯	◯

Figure 42 Annex - Survey Spanish Version

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