RICARDO VARGAS

DETERMINING THE MATHEMATICAL ROI OF A PROJECT MANAGEMENT IMPLEMENTATION

Accepted for publication at

PMI Global Congress 2013 – North America
New Orleans – Louisiana – USA – 2013

PMO Summit Brazil
Rio de Janeiro – RJ – Brazil – 2012

Abstract

Related Podcasts

♫ Calculating the Return on Investment of the PMO – Part 1/2
http://rvarg.as/2u

♫ Calculating the Return on Investment of the PMO – Part 2/2
http://rvarg.as/2v

♫ *The Cost of Project Management*
http://rvarg.as/bg

♫ *The cost of Project Management and the PMO*
http://rvarg.as/bj

The objective of this paper is to present, discuss and apply a mathematical model based on the use of Monte Carlo simulation in conjunction with researches on project success/failure rates of projects to develop a 10 step model to calculate the mathematical return on investment (ROI) for the Project Office implementation.

The paper aims to provide guidance on how intangible results resulting from the project planning and control can be linked to potential savings in time and cost comparing with projects poorly managed (KWAK & IBBS, 2000). It is not the scope of this paper to demonstrate the positive impact of good project management practices. The main objective is to discuss possible ways of measuring results in order to have a more clear cost benefit analysis regarding the value of a PMO Setup (HUBBARD, 2010).

This paper also discusses the main challenges to quantify benefits considering cultural, social and value perception dimensions in order to translate benefits into clear and measurable numbers.

The Importance of Clear Benefit Measurement

Business improvement processes like the Project Management Office implementation are, most of the time, linked to indirect benefits achievement. In the past, program, project, or process success was measured by activity: number of people involved, money spent, days to complete. Little consideration was given to the benefits derived from these activities because they were considered impossible to be clearly measured (PHILIPS & PHILIPS, 2007).

The intention of clear measurement of benefits can be based in the following arguments:

- Price/money is a proxy for value.
- Measurable outcomes contribute to a better alignment and integration with financial systems performance.
- More tangible results support the identification of critical sources of value.
- Promotes communication and makes results quantitatively tangible.

Understand the clear impact on project results of the project management processes, tools and existing support and how this structure contributes to better project results became a key driver to understand the value of project management (EIU, 2009)

Model Overview

The proposed model is based on 10 (ten) processes that are organized into 6 (six) groups (Exhibit 01). Both the processes and the groups are interrelated in order to produce the needed steps to understand the real costs and benefits brought by the Project Management Implementation.

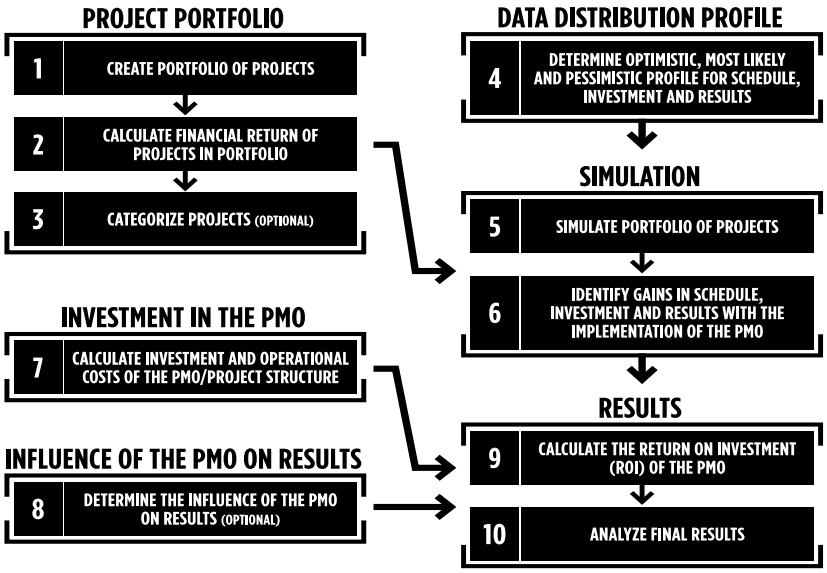


Exhibit 1 – 10 Processes to calculate the Return on Investment of a Project Management Office.

The processes are defined following the structure proposed by the PMBOK Guide (PMI, 2013) with Inputs, Tools and Techniques and Outputs.

Project Portfolio

The Project Portfolio group describes the process that should be in place to understand the scope of what should be managed by a potential Project Management Office (PMO). The intend is to make sure that the potential projects that will be supported by the project management office are identified and the cost, time frame and benefits (value) of these projects are calculated.

The Project Portfolio group is divided in the following processes

- Create the portfolio of projects
- Calculate financial return of projects in the portfolio
- Categorize projects

Create the Portfolio of Projects

This is process is responsible for the creation of the portfolio of projects. Based in working groups and the support of experts, it aims to create a list of the projects that will be managed by the PMO including some preliminary information like the Project objectives, estimated duration and budget (Exhibit 2).

1	CREATE PORTFOLIO OF PROJECTS	
INPUTS	**TOOLS AND TECHNIQUES**	**OUTPUTS**
1. Potential Projects	1. Working Groups 2. Expert Judgment	1. Project Portfolio 2. Preliminary Project Information (Objectives, Schedule and Budget)

Exhibit 2 – Create Portfolio of Projects

The Project Portfolio can be presented in different ways but the most suitable to support the upcoming process is a list with the name of the project, estimated duration and budget (Exhibit 3). If the Project Office will support all kinds of projects at the corporate level, the list of projects can include a very different set of initiatives.

ID	PROJECT	DURATION	BUDGET
1	Review of Product Mix	6	460,000
2	Zero Accidents	12	300,000
3	Internationalization of Production Units	23	6,350,000
4	Modernization of the Instrumentation System	8	2,420,000
5	E-commerce	4	350,000
6	Corporate Office Projects	7	450,000
7	New Markets	13	360,000
8	University Tiger Screws	7	350,000
9	New Line for the Oil Industry	18	2,850,000
10	New Distribution Center	19	3,600,000
11	Import Finished Products	22	2,080,000
12	Opening of Capital	24	1,200,000
13	Social Media	5	225,000
14	ERP System	9	1,240,000
15	New Maintenance Policy	17	680,000
	Total	**194**	**22,915,000**

Exhibit 3 – Example of basic project list

The preliminary project information can include all supporting information about the project, including main objectives, outputs, expected benefits and basic scope (Exhibit 4). This preliminary information can be also called Project Brief or Outline Business Case (UK CABINET OFFICE, 2011)

8 AREA | HUMAN RESOURCES

TIGER SCREWS

UNIVERSITY TIGER SCREWS

DESCRIPTION

It is a project for establishing an internal technical training center, aimed at qualifying workers for industrial jobs.

STRATEGIC MAP OBJECTIVES THAT ARE SUPPORTED BY THIS PROJECT

1. Improve customer service
2. Reduce lost-time accidents
3. Develop human resources

BASIC DATA

Begin	Mar-12
End	Sep-12
Duration	7 months
Budget ($)	350,000

WORK BREAKDOWN STRUCTURE - WBS

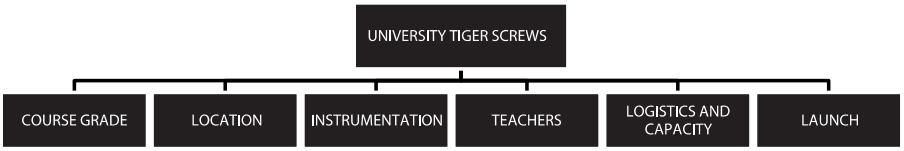


Exhibit 4 – Example of project preliminary information

Calculate Financial Return of Projects in the Portfolio

After identifying the potential portfolio of projects to be managed, it becomes important to calculate the benefits in terms of financial results of each project. This is one of the most challenging steps towards the calculation of the ROI of a Project office. Using the preliminary information, all proposed benefits will be measured in order to find clear outcomes (Exhibit 5).

2 CALCULATE FINANCIAL RETURN OF PROJECTS IN PORTFOLIO

INPUTS	TOOLS AND TECHNIQUES	OUTPUTS
1. Project Portfolio	1. Financial Calculations	1. Project Portfolio (Updated)
2. Preliminary Project Information (Objectives, Schedule and Budget)	2. Bayesian Estimate	2. Financial Results Calculated for Projects
	3. Analytic Hierarchy Process (AHP)	
	4. Expert Judgment	

Exhibit 5 – Calculate Financial Return of Projects in the Portfolio

In some cases, this is easily measurable in terms of increase in the production, market place, etc. In other projects, the intangible results must be converted into an estimated final outcome. As an example, one main outcome of the "University Tiger Screws" project is to develop new capabilities in the current staff in order to reduce the investments with additional hiring of personnel. A range of potential

savings is defined and through the pairwise comparison using the Analytic Hierarchy Process (SAATY, 1980, SAATY, 2009 and VARGAS, 2010), the Expected Value of the benefit could be estimated (Exhibit 6).

UNIVERSITY TIGER SCREWS — DATE: 19-ago-13

ANALYTICAL HIERARCHY PROCESS - INTAGIBLE BENEFITS CALCULATION

% Economy in the hiring process in the next 5 years	IMPACT		NAME OF THE GROUP TO BE EVALUATED				
			1 10% ECONOMY	2 7% ECONOMY	3 5% ECONOMY	4 2% ECONOMY	5 NO ECONOMY
10% ECONOMY	USD	871.670,43	1	is just as likely	is most likely	is much more likely	is much more likely
7% ECONOMY	USD	610.169,30	2		is just as likely	is most likely	is much more likely
5% ECONOMY	USD	435.835,22	3			is just as likely	is most likely
2% ECONOMY	USD	174.334,09	4				is just as likely
NO ECONOMY	USD	-	5				
			1 10% ECONOMY	2 7% ECONOMY	3 5% ECONOMY	4 2% ECONOMY	5 NO ECONOMY
	PROBABILITY		39,75%	28,43%	16,57%	9,16%	6,10%

EXPECTED VALUE: USD 608.110,28

INCONSISTENCY INDEX 5,4%

Exhibit 6 – Example of the use of AHP to estimate the Expected Value of the benefit of a project

The main output of this project is an updated list of projects including the estimated financial benefits.

Categorize Projects (Optional)

For organizations with a wide range of projects, the categorization of projects could add value in the analysis and stratification of efforts (Exhibit 7).

This optional process group the projects into different categories (Exhibit 8) like

- Departments
- Risk
- Value
- Sponsoring group
- Geographic location

3	CATEGORIZE PROJECTS (OPTIONAL)	
INPUTS	**TOOLS AND TECHNIQUES**	**OUTPUTS**
1. Project Portfolio	1. Description of the Categories 2. Working Groups 3. Expert Judgment	1. Projects Grouped in "Categories"

Exhibit 7 – Categorize Projects

ID	PROJECT	DURATION	BUDGET	FIN. RESUL. ($)	ROI	AREA	RISK	COMPLEXITY
1	Review of Product Mix	6	460,000	128,800	28%	Marketing and Sales	High	High
2	Zero Accidents	12	300,000	123,000	41%	Industrial	Low	Medium
3	Internationalization of Production Units	23	6,350,000	11,430,000	180%	Planning	Very High	High
4	Modernization of the Instrumentation System	8	2,420,000	1,573,000	65%	Industrial	Medium	Medium
5	E-commerce	4	350,000	126,000	36%	Information Technology	Medium	Medium
6	Corporate Office Projects	7	450,000	364,500	81%	Planning	Low	Low
7	New Markets	13	360,000	248,400	69%	Marketing and Sales	High	High
8	University Tiger Screws	7	350,000	258,110	74%	Human Resources	Low	Low
9	New Line for the Oil Industry	18	2,850,000	598,500	21%	Research and Development	High	High
10	New Distribution Center	19	3,600,000	2,124,000	59%	Logistics	Very High	High
11	Import Finished Products	22	2,080,000	4,430,400	213%	Marketing and Sales	Very High	High
12	Opening of Capital	24	1,200,000	660,000	55%	Financial	High	High
13	Social Media	5	225,000	41,116	18%	Marketing and Sales	Very Low	None
14	ERP System	9	1,240,000	347,200	28%	Information Technology	High	High
15	New Maintenance Policy	17	680,000	95,200	14%	Industrial	Medium	Medium
	Total	**194**	**22,915,000**	**22,548,226**				

Exhibit 8 – Example of a categorized list of projects with the calculated benefits highlighted

Data Distribution Profile

The Data Distribution Profile aims to determine the best "risk profile" of the portfolio to archive the benefits and it contains the process Determine Optimistic, Most Likely and Pessimistic Profile for Schedule, Investments and Results.

Using market research, historical information from previous projects and benchmarking, the objective of this process is to define the optimistic, pessimistic and most likely scenarios for the duration, costs and financial results of each project (Exhibit 9).

4	DETERMINE OPTIMISTIC, MOST LIKELY AND PESSIMISTIC PROFILE FOR SCHEDULE, INVESTMENT AND RESULTS	
INPUTS	**TOOLS AND TECHNIQUES**	**OUTPUTS**
1. Market Research 2. Benchmark of Project Results 3. Historical Information	1. Working Groups 2. Negotiation 3. Expert Judgment	1. Probabilistic Distribution Profile for Schedule, Investment and Results

Exhibit 9 – Determine Optimistic, Most Likely and Pessimistic Profile for Schedule, Investment and Results

Different external sources can be used to support the decision as follows

- Standish Group Chaos Manifesto (STG, 2013)
- The IPA Institute Database of Capital Projects (IPA, 2013)
- PMI Pulse Report (PMI, 2013)
- Reports and researches from management consulting companies

This process requires a lot of negotiation to set the right thresholds for the project without being biased by individuals with over optimistic or over pessimistic behaviors.

The determination of the profiles can be done considering that the project duration, costs and financial results follow the same distribution (Exhibit 10) or a different set of distributions for each element.

	Without PMO			With PMO		
COMPLEXITY	OPTIMISTIC	MOST LIKELY	PESSIMISTIC	OPTIMISTIC	MOST LIKELY	PESSIMISTIC
High Complexity	+25%	+50%	+75%	+0%	+5%	+15%
Medium Complexity	+25%	+50%	+75%	+0%	+5%	+15%
Low Complexity	+15%	+30%	+45%	+0%	+5%	+15%
No Complexity	+10%	+20%	+30%	+0%	+5%	+15%

Exhibit 10 – Example of probabilistic forecasting based on project complexity level. In this case, a high complexity project with a value of $1,000,000 will cost between $1,250,000 and 1,750,000 without PM support and $1,000,00 and 1,150,000 with proper PM support.

Simulation

The Simulation group describes the process associated with the Monte Carlo simulation of the duration of the projects in the portfolio, associated costs and financial results.

"Monte Carlo" was a nickname of a top-secret project related to the drawing and to the project of atomic weapons developed by the mathematician

John von Neumann (POUNDSTONE, 1993). He discovered that a simple model of random samples could solve certain mathematical problems which couldn't be solved up to that moment.

The simulation refers, however, to a method by which the distribution of possible results is produced from successive recalculations of project data, allowing the development of multiple scenarios. In each one of the calculations, new random data is used to represent a repetitive and interactive process. The combination of all these results creates a probabilistic distribution of the results (Exhibit 11).

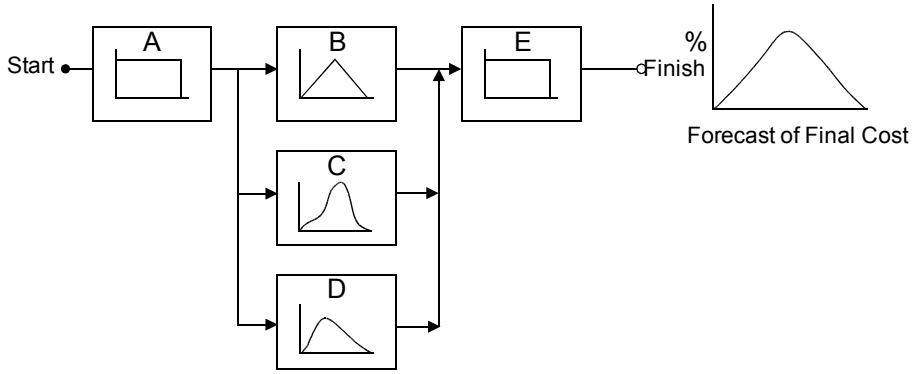


Exhibit 11 – Construction of model of distribution of costs and activities or work packages making up a final distribution from random data of the project (PRITCHARD, 2001).

The feasibility of outcoming distribution relies on the fact that, for a high number of repetitions, the model produced reflects the characteristics of the original distribution, transforming the distribution into a plausible result for analysis. The simulation can be applied in schedules, costs and other project indexes.

The Simulation group is divided in the following processes

- Simulate Portfolio of Projects
- Identify Gains in Schedule, Investment and Results with the Implementation of the PMO

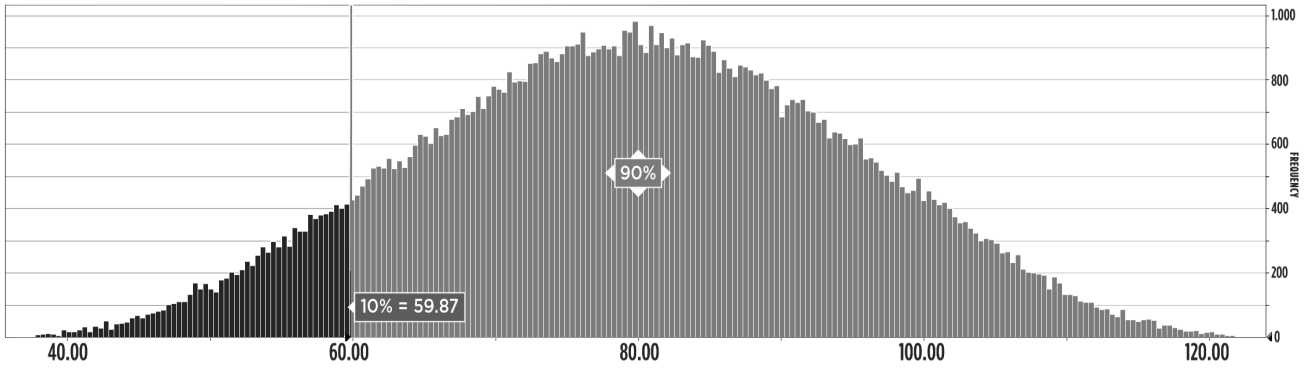
Simulate Portfolio of Projects

This is process is responsible for the simulation of the schedule gains, investment savings and improvements of financial results (Exhibit 12).

5	SIMULATE PORTFOLIO OF PROJECTS	
INPUTS	**TOOLS AND TECHNIQUES**	**OUTPUTS**
1. Projects Grouped in Categories	1. Monte Carlo Software Simulation	1. Probabilistic Distribution of Schedule Gains
2. Project Portfolio		2. Probabilistic Distribution of Investment Savings
3. Probabilistic Distribution Profile for Schedule, Investment and Results		3. Probabilistic Distribution of Improvements of Financial Results

Exhibit 12 – Simulate Portfolio of Projects

The simulation is produced using simulation software and the results are a range of improvements in duration, budget and financial results with their respective confidence level (Exhibit 13, 14 and 15).



STATISTICS

Trials	100,000
Mean	79.77
Median	79.78
Standard Deviation	15.02

PERCENTILE

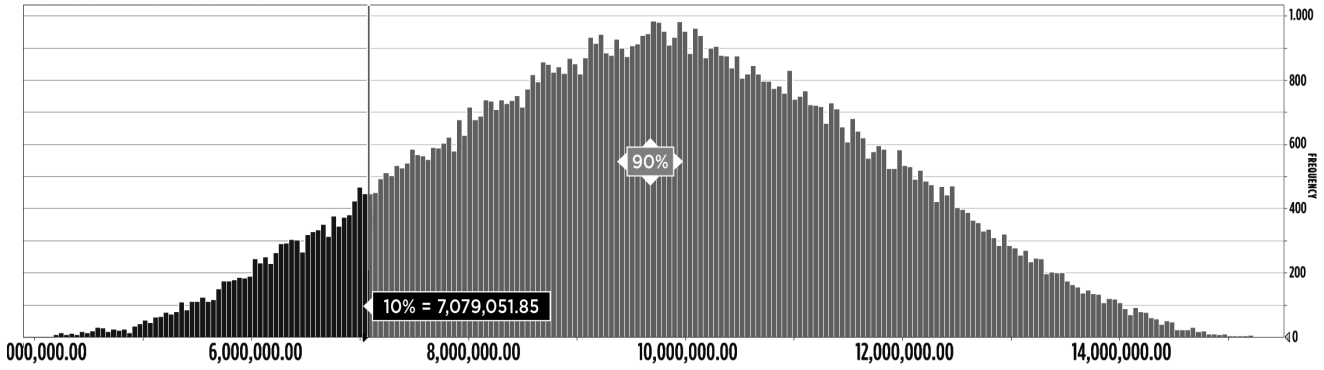
0%	31.29	**60%**	83.80
10%	**59.87**	**70%**	88.08
20%	66.53	**80%**	93.03
30%	71.52	**90%**	99.69
40%	75.77	**100%**	126.78
50%	79.78		

CONCLUSION

There is a 90% probability that the time gain using the PMO will be a minimum of **59.87 months**.

Please note that the objective of time gain is to evaluate the reduction in the projects' workload and not necessarily a faster completion of work.

Exhibit 13 – Example of simulation output for the savings in the total time of the projects for using the PMO. In this case there is a 90% confidence that the savings will be above 59,87 months.



STATISTICS

Trials	100,000
Mean	9,702,355.47
Median	9,710,732.45
Standard Deviation	1,974,491.61

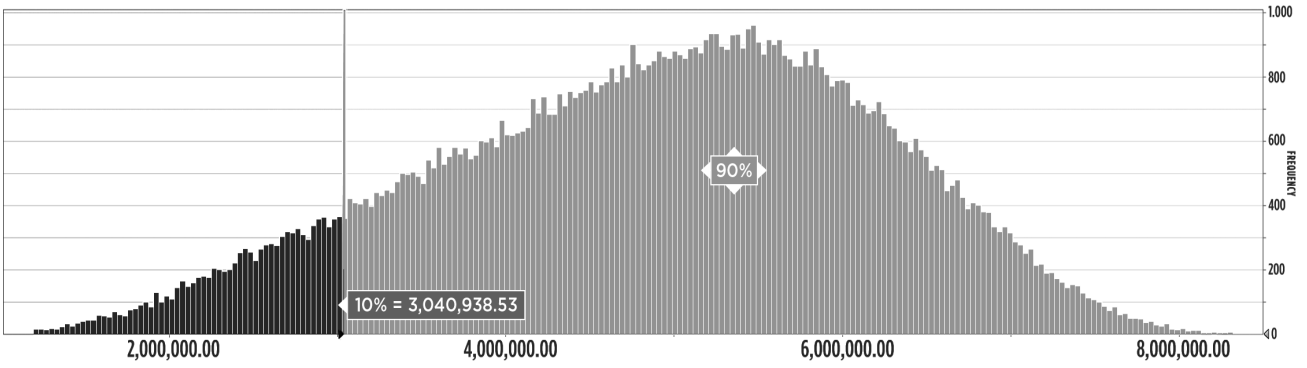
PERCENTILE

0%	3,606,978.10	**60%**	10,226,382.08
10%	**7,079,051.85**	**70%**	10,798,999.79
20%	7,949,33.15	**80%**	11,453,496.87
30%	8,615,088.26	**90%**	12,322,497.62
40%	9,182,361.04	**100%**	15,765,007.69
50%	9,710,723.29		

CONCLUSION

There is a 90% probability that **savings in financial investments** (budgets) using the PMO will be at least **$7,079,051.85**.

Exhibit 14 – Example of simulation output for the savings in the budget of the projects for using the PMO. In this case there is a 90% confidence that the savings will be at least 7,079,051.85 months.



STATISTICS

Trials	100,000
Mean	4,885,464.95
Median	4,990,530.57
Standard Deviation	1,318,293.80

PERCENTILE

0%	658,194.03	**60%**	5,338,818.99
10%	**3,040,938.53**	**70%**	5,679,229.44
20%	3,697,475.40	**80%**	6,058,075.00
30%	4,204,554.59	**90%**	6,544,955.20
40%	4,622,957.56	**100%**	8,315,454.74
50%	4,990,451.82		

CONCLUSION

There is a 90% probability that **the gains in financial results** with the use of the PMO will be at least **$3,040,938.53**.

Exhibit 15 – Example of simulation output for the gains in financial results of the projects for using the PMO. In this case there is a 90% confidence that the savings will be at least 3,040,938.53 months.

Identify Gains in Schedule, Investment and Results with the Implementation of the PMO

After the simulation is concluded, the results are collected for a predefined confidence level in order to identify the measurable improvements (Exhibit 16 and 17).

6	IDENTIFY GAINS IN SCHEDULE, INVESTMENT AND RESULTS WITH THE IMPLEMENTATION OF THE PMO	
INPUTS	**TOOLS AND TECHNIQUES**	**OUTPUTS**
1. Probabilistic Distribution of Schedule gains 2. Probabilistic Distribution of Investment saving 3. Probabilistic Distribution of Improvements of Financial Results 4. Organizational Tolerance Level	1. Negotiation 2. Expert Judgment	1. Schedule Gains 2. Savings on Investment 3. Improvement of Financial Results

Exhibit 16 – Identify Gains in Schedule, Investment and Results with the Implementation of the PMO

GAINS IN FINANCIAL RESULTS ($) Resulting from budget reduction and an improvement in the financial results.	10,119,990.38
FINANCIAL GAINS / PORTFOLIO VALUE (%)	44.16%
IMPROVEMENT IN TIME / EFFORT RELIABILITY OF 90%	59.87 months
IMPORTANCE OF THE PMO ON RESULTS (%)	52.20%
FINANCIAL GAINS ADJUSTED FOR IMPORTANCE OF THE PMO ON RESULTS ($)	5,282,634.98
PMO INVESTMENT ($)	2,770,390.83
PMO RETURN ON INVESTMENT ($)	**2,512,244.15**
PMO RETURN ON INVESTMENT (%)	**90.68%**

Exhibit 17 – Example of gains based on the simulation results (Exhibit 13, 15 and 15)

Investments in the PMO

The other aspect that must be considered when evaluating the ROI of a project implementation is to calculate the amount of costs the organization will incur to create and maintain the Project Office.

Different costs can be associated with the PMO (AUBRY, HOBBS, MÜLLER & BLOMQUIST, 2010). The most common elements are

- Personal cost
- Software and hardware
- Advisory services
- Training
- Others

7	CALCULATE INVESTMENT AND OPERATIONAL COSTS OF THE PMO/PROJECT STRUCTURE	
INPUTS	**TOOLS AND TECHNIQUES**	**OUTPUTS**
1. Direct Costs 2. Indirect Costs 3. Investment in Consultancy 4. Investment in Training 5. Procurement 6. Other Information on Costs and Investment	1. Financial Calculations 2. Budget Structure 3. Negotiation 4. Expert Judgment	1. Structure of Investment/ Cost of the PMO

Exhibit 18 – Calculate Investment and Operational Costs of the PMO/Project Structure

The main output of this process is the total cost of the PMO setup and operation for a predefined time frame (Exhibit 19).

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL	TOTAL PV
Infrastructure	50.000	50.00	20.000	30.000	50.000	200.000	161.368,16
Consulting	800.000					800.000	800.000,00
Personal	420.000	420.000	420.000	420.000	420.000	2.100.000	1.669.277,96
Equipment	100.000					100.000	100.000,00
Other	10.000	10.000	10.000	10.000	10.000	50.000	39.744,71
Total	**1.380.000**	**480.000**	**450.000**	**460.000**	**480.000**	**3.250.000**	**2.770.390,83**

Exhibit 19 – Example of a PMO Setup and operation cost in a 5 (five) year time frame. All values should be adjusted to Present Value

Influence of the PMO in the Results

Based on the studies discussed in the step 4 of the process, it is important to highlight that not all benefits and positive results exclusively stem from the very existence and operation of the PMO. Many other external factors can benefit from those results and are beyond the control of the project manager and his/her team.

Some examples of benefit / dis-benefit drivers not related to project management implementations are (UK CABINET OFFICE, 2011)

- External economic factors like currency exchange rate, interest rates
- Market changes
- Changes in the legislation
- Changes in the senior leadership
- Others

In this process (Exhibit 20), it is proposed the use of the Analytical Hierarchy Process (AHP) to compare the likelihood of benefits coming from the PMO, in comparison with other sources of benefits (SAATY, 1980 and VARGAS, 2010).

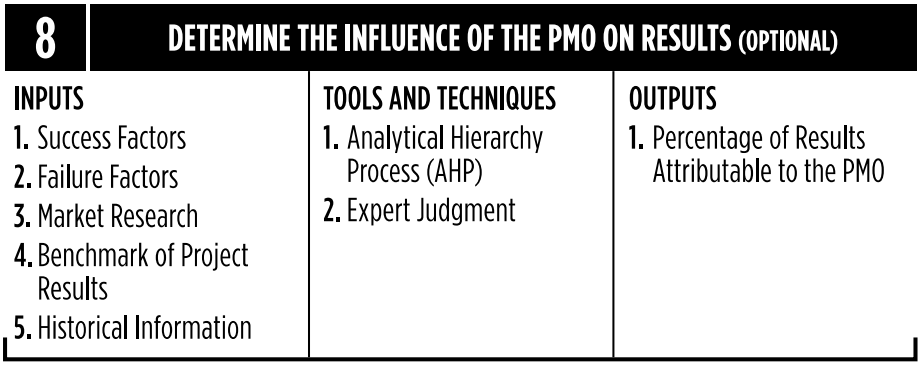


Exhibit 20 – Determine the Influence of the PMO on Results

The output of this process is the weight of the PMO in relationship with other sources of benefits (Exhibit 21).

		1	2	3	4	5	
		MARKET CHANGES	LEGISLATION	PROJECT MANAGEMENT (PMO)	LOW TECHNICAL SKILLS	OTHERS	
MARKET CHANGES	1		Likely	Less likely	Very likely	Likely	1
LEGISLATION	2			Very unlikely	Very likely	As likely as	2
PROJECT MANAGEMENT (PMO)	3				Highly likely	Very likely	3
LOW TECHNICAL SKILLS	4					Less likely	4
OTHERS	5						5
		1	2	3	4	5	
INCONSISTENCY INDEX: 6,8%		MARKET CHANGES	LEGISLATION	PROJECT MANAGEMENT (PMO)	LOW TECHNICAL SKILLS	OTHERS	
PROBABILITY		23,36%	11,61%	52,20%	3,63%	9,21%	

Exhibit 21 – Example of AHP comparing different sources of benefits with project management implementation. In this case, it is suggested that 52,2% of the benefits could be justified by the setup and operations of a PMO

Results

The final group of process intends to calculate the return on investment and also analyze and discuss the final results.

The Results group is divided in the following processes

- **Calculate the Return on Investment (ROI) of the PMO**
- **Analyze Final Results**

Calculate the Return on Investment (ROI) of the PMO

This process compare the results obtained in the simulation and compare them with the investments related to the PMO and the percentage of results attributable to the PMO (Exhibit 22).

9	CALCULATE THE RETURN ON INVESTMENT (ROI) OF THE PMO	
INPUTS	**TOOLS AND TECHNIQUES**	**OUTPUTS**
1. Schedule Gains 2. Savings on Investment 3. Improvement of Financial Results 4. Structure of Investment/ Cost of the PMO 5. Percentage of Results Attributable to the PMO	1. Financial Calculations	1. Return on Investment (ROI) of the PMO 2. Complementary Information 3. Calculation Report 4. Final ROI Report

Exhibit 22 – Calculate the Return on Investment (ROI) of the PMO

The output of this process is the calculated return on investment with complementary information (Exhibit 23).

GAINS IN FINANCIAL RESULTS ($) Resulting from budget reduction and an improvement in the financial results.	10,119,990.38
FINANCIAL GAINS / PORTFOLIO VALUE (%)	44.16%
IMPROVEMENT IN TIME / EFFORT RELIABILITY OF 90%	59.87 months
IMPORTANCE OF THE PMO ON RESULTS (%)	52.20%
FINANCIAL GAINS ADJUSTED FOR IMPORTANCE OF THE PMO ON RESULTS ($)	5,282,634.98
PMO INVESTMENT ($)	2,770,390.83
PMO RETURN ON INVESTMENT ($)	**2,512,244.15**
PMO RETURN ON INVESTMENT (%)	**90.68%**

Exhibit 23 – Example of financial calculation based on the simulation results and the cost / relevance of the PMO in the results.

Analyze Final Results

After receiving the final ROI Report, working groups and the PMO sponsoring group need to meet in order to analyze and discuss the results to make the final decision (Exhibit 24).

10	ANALYZE FINAL RESULTS	
INPUTS	**TOOLS AND TECHNIQUES**	**OUTPUTS**
1. Final ROI Report	1. Working Groups 2. Negotiation	1. Decision Making 2. Lessons Learned 3. Agreement on Results

Exhibit 24 – Analyze Final Results

Conclusions

The proposed model is a "master line" of the value calculation and can thus be customized and adapted to different scenarios. It is important to highlight that this model is a simplification of very complex environment, where different perceived values can provide different directions to different stakeholders.

In order to avoid resistance and criticism during the simulation of intangible results, it is important to do this work in teams to avoid personal biases in the process.

Finally, it important to understand the challenge of determining ROI without knowing which projects are selected and the strategy that supports them. A project office that takes care of several different multi million projects is a very different effort from a project office that has simple work packages to be controlled.

References

AUBRY, M., HOBBS, B., MÜLLER, R. & BLOMQUIST, T (2010). *Identifying Forces Driving PMO Changes.* Project Management Journal, Vol. 41, No. 4, pp. 30-45, 2010. Newtown Square: Project Management Institute.

EIU (2009). *Closing the Gap - The Link Between Project Management Excellence & Long-Term Success.* London: Economist Intelligence Unit.

HUBBARD, D. (2010). *How to Measure Anything: Second Edition.* Hoboken: John Wiley & Sons.

IPA (2013). *Research as a Foundation.* Ashburn: Independent Project Analysts. Available at http://ipainstitute.com/Home/About/Research

KWAK, Y.H. & IBBS, C.W. (2000). *Calculating Project Management's Return on Investment.* Newtown Square: Project Management Journal, Volume 31, Issue 2. Available at http://www.lamarheller.com/projectmgmt/calculatingpmroi.pdf

PHILIPS, J. J. & PHILIPS, P. P. (2007). *Show me the Money: How to Determine the ROI in People, Projects and Programs.* San Francisco: Berrett-Koehler Publishers.

PMI (2013). *Pulse Report of the Profession.* Newtown Square: Project Management Institute. Available at http://www.pmi.org/Knowledge-Center/Pulse.aspx

PMI (2013). *The Project Management Body of Knowledge: Fifth Edition.* Newtown Square: Project Management Institute.

POUNDSTONE, W (1993). *Prisoner's Dillema.* Flushing: Anchor Publishing Group.

PRITCHARD, C. L. (2001). *Risk Management: Concepts and Guidance.* 2ª Ed. Arlington: ESI International.

SAATY, T. L (1980). *The Analytic Hierarchy Process.* New York: McGraw-Hill International.

SAATY, T. L. (2009). *Extending the Measurement of Tangibles to Intangibles.* International Journal of Information Technology & Decision Making, Vol. 8, No. 1, pp. 7-27, 2009. Available at SSRN: http://ssrn.com/abstract=1483438.

STG (2013). *The Chaos Manifesto.* Boston: The Standish Group. Available at https://secure.standishgroup.com/reports/reports.php

UK CABINET OFFICE (2011). *Managing Successful Programmes: Forth Edition.* London: The Stationery Office.

VARGAS, R (2004). *Earned Value Probabilistic Forecasting Using Monte Carlo Simulation.* Washington: AACE - Association for Advancement of Cost Engineering 48th Annual Meeting.

VARGAS, R. V. (2010). *Using Analytical Hierarchy Process to Select and Prioritize Projects in Portfolio Management.* Dallas: PMI Global Congress North America. Available at http://www.ricardo-vargas.com/articles/analytic-hierarchy-process/