Which Contract Management technique can help make a project successful in the construction industry? [1, 2]

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ABSTRACT

Construction Industry represents a huge part on the worldwide economy; as years passed projects are increasing, both contractors and owners fail to reach their objectives. However, the management of projects require to respect many criteria to be successful. This paper will identify and explain how a project fails; then bring and show some alternatives on how to solve this issue. Different analysis will be shown such as qualitative and quantitative methods. The results obtained from this paper will show and explain why contractors and owners should select the CM Agency Method In the construction industry.

Key words: Construction, Failure, Contract Management, Project Management, Project Success Factors, Incentive Contracting, Risks

INTRODUCTION

The industry of construction is huge industry and one of the main industries in all over the world. "The global construction industry is expected to reach an estimated $10.5 trillion by 2023, and it is forecast to grow at a CAGR of 4.2% from 2018 to 2023."[3] This huge growth can lead to different can of failure during time.

[1] Editor's note: Student papers are authored by graduate or undergraduate students based on coursework at accredited universities or training programs. This paper was prepared for the course "International Contract Management" facilitated by Dr Paul D. Giammalvo of PT Mitratata Citragraha, Jakarta, Indonesia as an Adjunct Professor under contract to SKEMA Business School for the program Master of Science in Project and Programme Management and Business Development. http://www.skema.edu/programmes/masters-of-science. For more information on this global program (Lille and Paris in France; Belo Horizonte in Brazil), contact Dr Paul Gardiner, Global Programme Director, at paul.gardiner@skema.edu.

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[3] Markets, R. (2018). Growth Opportunities for the Global Construction Industry 2018-2023 - A Potential $10.5 Trillion Market. [online] Prnewswire. Available at: https://www.prnewswire.com/news-releases/growth-opportunities-for-the-global-construction-industry-2018-2023---a-potential-105-trillion-market-300578103.html [Accessed 23 Nov. 2018].

What's a project? Project is defined to be "an investment that requires a set of logically linked and coordinated activities performed over a finite period of time in order to accomplish a unique result in support of a desired outcome"[4]. On another hand, according to the Guild of project controls compendium projects are means to an end to "acquire, create, update, maintain, expand and eventually dispose" of organizational assets"[5] .

The table below will explain project, program, portfolio of assets and portfolio of projects; and with a real-life example for each one in the construction industry.

	DEFINITION	EXAMPLE (in Construction Industry)
Project	an investment that requires a set of logically linked and coordinated activities performed over a finite period of time in order to accomplish a unique result in support of a desired outcome[6]	Make a contract project
Program	**Strategic program**: deliver assets and benefits that are directly linked to attaining the sponsoring organization's future state[7]	Opening an office in a foreign country. Purchase a local contractor
	Operational program: deliver assets and benefits that are critical to the sponsoring organization's day to day operations[8]	Controlling daily the machines and maintain all equipment.
	Multi-Project Program: achieve synergies from projects with common traits such as shared resources, similar clients or product technology.[9]	Owners and Contractors should be doing more than one project (same owner at the same time)
	Mega-Project: deliver a specific asset to the sponsoring organization.[10]	Jubail II in Saudia Arabia, Dubai land in Dubai, Beijing Airport in China

[4] Harris, P., Kriel, J., LeServe, M., Riaz, Y., Giammalvo, D. P. D., Illingworth, S., … Weaver, P. (n.d.). 01.1.2. In *Guild of project controls compendium and reference (car)*. Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls?fbclid=IwAR28qfz7FcD6qA60EI1dtZs03w9m7QRPXKd5q1b1dTVNm98qRvAE-0tf0HA

[5] Guild of Project Controls Compendium (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)

[6] Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)

7 Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)

[8] Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)

9 Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)

[10] Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)

Portfolio of assets	**Information Assets**: controlled by functional groups like IT, engineering.[11]	Software for simulations of engineers, engineers for maintaining machines, Cost estimating Databases, Productivity and pay rates
	Human assets: controlled by HR [12]	Product manager, shipping team, delivery team, customer service, workers, engineers
	Physical Assets: controlled by either operations ("plant manager") or other functional entities such as "heavy equipment shop"[13]	Equipment and machines, Buildings
	Financial Assets: controlled by accounting or finance [14]	Payments and transactions
	Intangible assets: Difference between a company's book value and market capitalization value. [15]	Company's value, Brand Image
Portfolio of projects	Fact of minimizing of the risk and maximizing the return. Any organization, be it owner or contractor has a portfolio of assets available to dedicate to projects, with the objective being to develop the best "mix" of projects which will generate the most favorable return on those "assets".[16]	Using the available resources to respect the schedule and the quality asked in the construction's project

Figure1- Definitions and examples of key words[17]

The hardest part in project management is to give an appropriate definition of success. Success for one part can be a failure for another. "There are two elements to "success". One is the success or failure of the PROJECT which is where project control professionals who are assigned to the execution phase of the project play a role and the other is the "success" or "failure" of whatever product, service, asset, change or business result the project was undertaken to achieve."[18]

[11] Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)
12 Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)
13 Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)
14 Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)
15 Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)
16 Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from (http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls)
[17] By Author
[18] Guild of project controls compendium and reference (car). (2015, November 2). Retrieved November 16, 2018, from http://www.planningplanet.com/guild/gpccar/identifying-engaging-stakeholders

As it is hard to define success project can vary from environment to another one; depending on the size of the project. More the size is bigger the more parties are involved from suppliers, contractors, outsourcers etc. Additional actions should be taken in the exact time and place. Communication, teamwork and cooperation are the most important key to lead a project successfully to its goals. Contract management is an important tool in project management; since contracts play a decisive role in making project successful. The five most common reasons for contractors' failure are as follow: poor project management, poor leadership, poor performance, poor accounting and poor scheduling and planning. [19]

A successful project needs to go through an important process; to be called successful and needs to respect all the agreed parts with the owner to be called so. If a project is successful we need first to know if it does answer to the 7th questions. [20]

1. ***Outcomes agreed on have been respected?***
2. ***Does the client's issue solved?***
3. ***Does the project's budget and schedule have been respected?***
4. ***Does the relationship between the parties is positive?***
5. ***Do the clients know how to solve future problems by themselves?***
6. ***If the client want to hire you again?***
7. ***Get paid on time***

Moreover, to complete those questions there are some project success criteria[21] for both owners and contractors' perspective. For the owner perspective, his project success is determined by the project fulfils and business objectives, owner fulfils and satisfies contractual obligations. In the other hand, the contractors' perspective is determined by if the project is profitable, contractor fulfils and satisfies contractual obligations.

If a project does answer to all this question, so it means that the project was successfully realized. However, as it is mentioned in the first question Do all the outcomes agreed have been respected? There is a contract signed before, where all parties involved in the projects agreed and make conditions; to protect everyone. It is also called *incentive contracting[22];* where all the

[19] Top Five Reasons for Contractor Failure. (2017, July 11). Retrieved November 3, 2018, from http://constructionexec.com/article/top-five-reasons-for-contractor-failure
[20] McNamara, C. (2006). Field guide to consulting and organizational development: A collaborative and systems approach to performance, change and learning. Minneapolis, MN: Authenticity Consulting.
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[2222] Bower, D., Ashby, G., Gerald, K., & Smyk, W. (2002). Incentive Mechanisms for Project Success. *Journal of Management in Engineering*,*18*(1), 37-43. doi:10.1061/(asce)0742-597x(2002)18:1(37)

needs of all parts are stated correctly and the risks are all stated; and allow the client to have a part on the project for the well-being of the project.

""Risk management" refers to the management of threats – risk with potential negative effects on objectives while "opportunity management" refers to events or conditions which could have a positive effect on project objectives"[23]. "The risk/opportunity management process is not complex nor difficult, however based on the documented failure rates of both projects and the products created using project management as the delivery system of choice"[24]

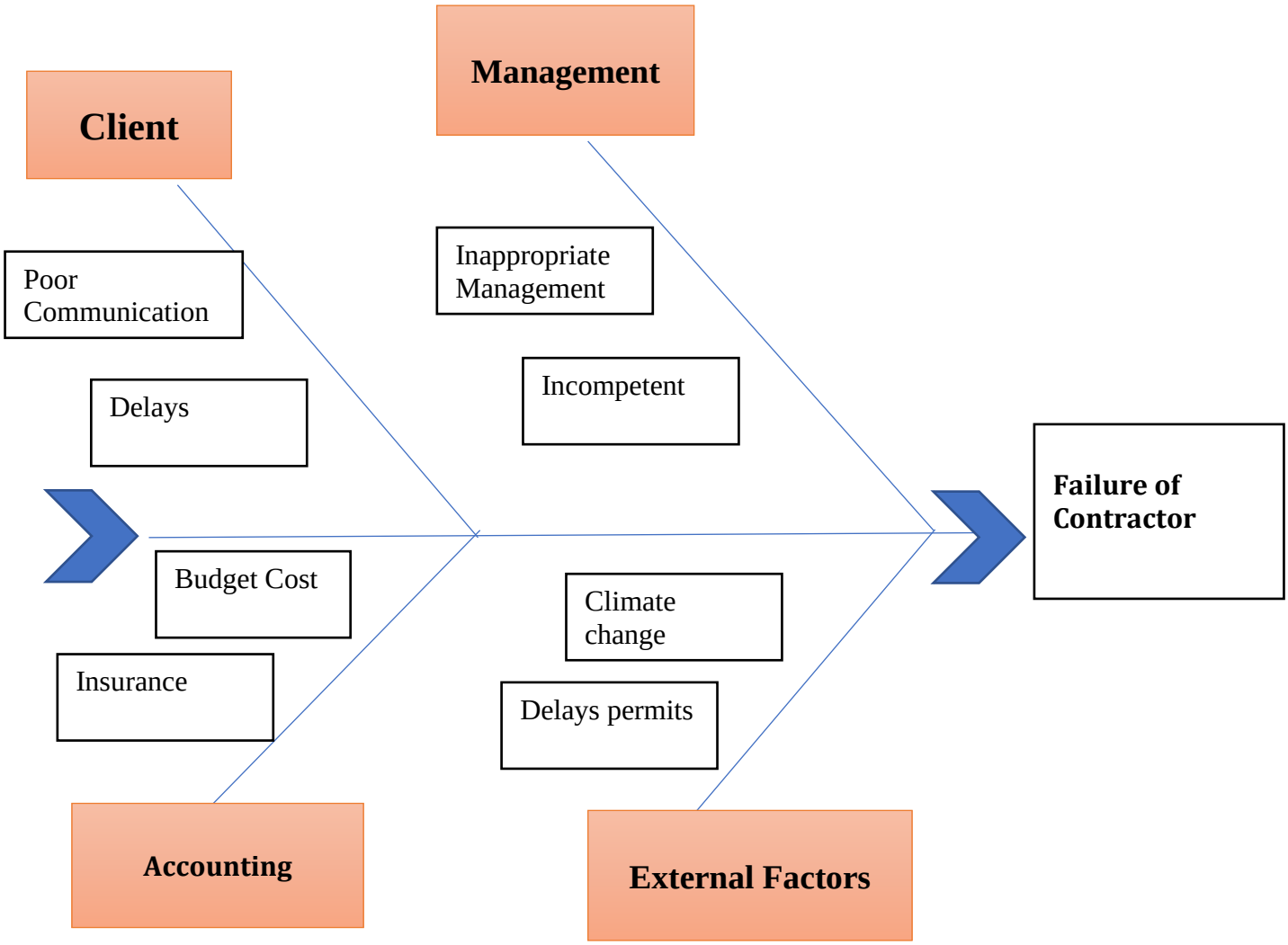

Figure 2- Fishbone Diagram for failure of contractors[25]

[23] Kriel, J., Rawlings, P., Aboul-Fo, M., LeServe, M., Regan, S., Wideman, R., . . . Williams, J. (2015). WHAT IS THE PURPOSE OF MANAGING RISK & OPPORTUNITY. Retrieved November 18, 2018, from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-risk-and-opportunity
[24] Kriel, J., Rawlings, P., Aboul-Fo, M., LeServe, M., Regan, S., Wideman, R., . . . Williams, J. (2015). WHAT IS THE PURPOSE OF MANAGING RISK & OPPORTUNITY. Retrieved November 18, 2018, from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-risk-and-opportunity
[25] By Author

This fishbone explains the reasons why contractors fail to achieve their objectives. It is mainly due to the lack of project planning and management that has a direct impact on the company. Secondly, the external factors that can hold and stop the whole projects if the contractors do not plan for it. Thirdly, the client which needs a strong communication to maintain and control potential risk coming from them. Finally, the accounting department who should plan and support the project.

Moreover, constructions projects can be showed and symbolized as system which can be divided into subsystems. "the system can be defined as portfolio of assets and can be classified into 5 major types of assets as inferred"[26]

- Human Assets
- Physical Assets
- Financial Assets
- Intangible Assets
- Information Assets

Methodology

Step1 - Problem Statement:

This paper problematic will be as follow:

- ✓ ***In the construction industry, what are the causes that lead to the failure of contractors?***
- ✓ How contractors can avoid them?

Step2 - Feasible Alternatives and Attributes:

In this paper, we will analyse different techniques that makes a contractor succeed more precisely seven methods[27]:

1. Design Bid Build Method
2. Engineer, Procure Construct Method
3. Bridging Design Build Method

[26] Planningplanet.com. (2018). GUILD OF PROJECT CONTROLS COMPENDIUM http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls

[27] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2015, November). Retrieved from http://www.planningplanet.com/guild/gpccar/managing-contracts-select-project-delivery-method-contract-type

4. Construction Management
5. Bridging CM
6. CM Agency
7. Integrated Project Delivery

Those methods enable to understand when and where the contractors and owners are at risk; when and where the risks are shared; when and where each party assumes the risks.

Step3 - Development of Feasible Alternatives:

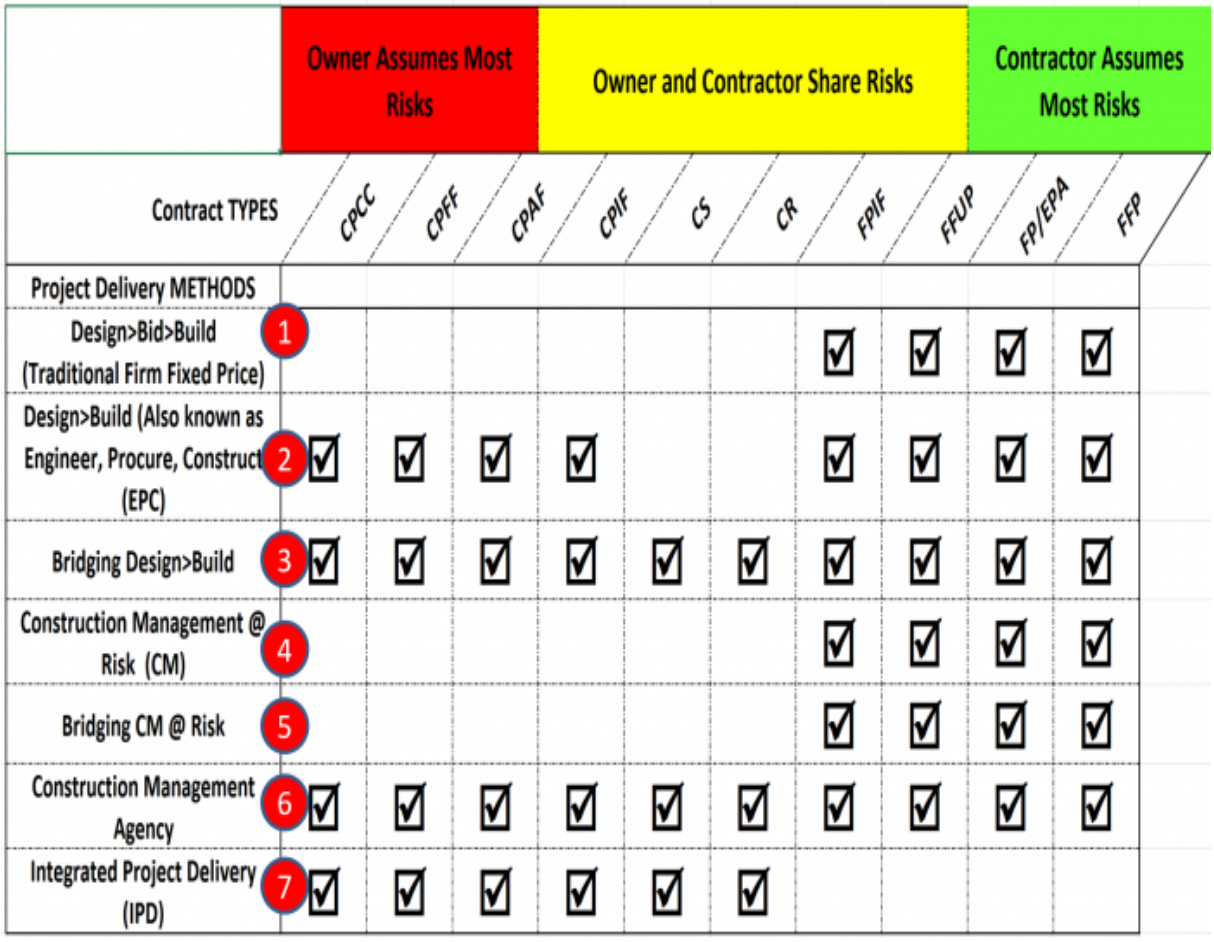

Figure 3- Project Delivery METHODS and Contract TYPES Compared[28]

1. Design Bid Build Method: "This method is known as a traditional one. Preferred by many owners; the Design-Bid-Build Method rallies of the requirements set between the

[28] Planningplanet.com. (2018). *GUILD OF PROJECT CONTROLS COMPENDIUM*: http://www.planningplanet.com/guild/gpccar/managing-contracts-select-project-delivery-method-contract-type

parties; and makes the owner and contractor free of conflicts. This method permits to the owner to have a direct connection with the architect and engineer of the project."[29]

2. Engineer, Procure Construct Method: "In this methodology, the owner makes only one contract with the Design-Build Contractor; the lines of reporting comes directly to PM. This method was used for many years for several projects and the results were appropriate. This method enable the firm in charge reduce their costs by decreasing the number of change orders"[30]

3. Bridging Design Build Method: "For the bridging method; it reduces the risks and exposure for the owner. The contractor makes the changes orders, and take care of the risks for delays etc. The owners and its consultant have the right design and change the quality for the construction".[31]

4. Construction Management Method: "This methodology able the owner to manage the design and construction for the project; and he's related directly to the procurement department. The owner can select first the consultant and architect; then agree on a CM. In other hand, he can select first a CM; then the architect. Furthermore, the owner can select a PM to assist him in the creation of contracts for all parties." [32]

5. Bridging CM Method: "This technique is still a new one, used to protect owners from the lack of enforceability of a Guaranteed Maximum Price[33]. This methodology able the owner to have an early selection of the contractor and architect & engineers."[34]

6. Construction Management Agency Method: "Used since the end of the WW2; this methodology makes all the lines of reporting directly coming to the owner from the CM and Architect & Engineers." [35]

[29] Planningplanet.com. (2018). *GUILD OF PROJECT CONTROLS COMPENDIUM*: http://www.planningplanet.com/guild/gpccar/managing-contracts-select-project-delivery-method-contract-type
[30] Planningplanet.com. (2018). *GUILD OF PROJECT CONTROLS COMPENDIUM*: http://www.planningplanet.com/guild/gpccar/managing-contracts-select-project-delivery-method-contract-type
[31] Planningplanet.com. (2018). *GUILD OF PROJECT CONTROLS COMPENDIUM*: http://www.planningplanet.com/guild/gpccar/managing-contracts-select-project-delivery-method-contract-type
[32] Planningplanet.com. (2018). *GUILD OF PROJECT CONTROLS COMPENDIUM*: http://www.planningplanet.com/guild/gpccar/managing-contracts-select-project-delivery-method-contract-type
[33] Planningplanet.com. (2018). *GUILD OF PROJECT CONTROLS COMPENDIUM*: http://www.planningplanet.com/guild/gpccar/managing-contracts-select-project-delivery-method-contract-type
[34] Planningplanet.com. (2018). *GUILD OF PROJECT CONTROLS COMPENDIUM*: http://www.planningplanet.com/guild/gpccar/managing-contracts-select-project-delivery-method-contract-type
[35] Planningplanet.com. (2018). *GUILD OF PROJECT CONTROLS COMPENDIUM*: http://www.planningplanet.com/guild/gpccar/managing-contracts-select-project-delivery-method-contract-type

7. Integrated Project Delivery Method: This method makes the project secured by deleting and reducing all the costs wasted and ameliorating the communication in all the project's design and building. Moreover, it gives to the owner a fully reliable cost and schedule of the project.[36]

Step 4 - Selection of criteria:

Thus, to analyze our seven alternatives solution already chosen above; and to be able to determine which alternative is the best and adequate to solve our main problem. We will use the MADM (*Multi-Attribute Decision Making*), in order to know which alternatives are the poorest ones.

The criteria provided by WASET[37] and by DBIA[38]chosen and seemed the most adequate to this situation to determine the effectiveness of each alternatives are:

A. ***Owner Risk:*** Percentage of risk for each methodology regarding the owner.
B. ***Owner Control on the Project:*** Power and percentage of control of the owner on parts of the projects.
C. ***Contractor Risk:*** Percentage of risk for each methodology regarding the owner
D. ***Contractor Control on the Project:*** Power and percentage of control of the contractors on the projects
E. ***Communication Management:*** Lines of reporting toward all parties involved and with the owner.
F. ***Project Budget:*** Do the methods respect the budget agreed at the beginning.
G. ***Project Schedule:*** Do the methods respect the schedule set at the beginning?
H. ***Project Category:*** Construction method, complexity of the design and project scale.
I. ***Human Category:*** Level and skill and working overtime, labor motivation.
J. ***Management Category:*** How the tasks will be done, and coordination between subcontractors and level of planning.
K. ***Materials and Tools Category:*** Level of supply of materials, shortages of equipment and performance of work during the project.

Each attribute will be graded as follow:

[36] Planningplanet.com. (2018). *GUILD OF PROJECT CONTROLS COMPENDIUM*: http://www.planningplanet.com/guild/gpccar/managing-contracts-select-project-delivery-method-contract-type
[37] (Robles G. et al., 2014)
[38] Dbia.org. (2018). https://dbia.org/wp-content/uploads/2018/05/Primers-Choosing-Delivery-Method.pdf

- Red Color → 0 point → Worse
- Yellow Color → 1 points → Equal
- Green Color → 2 point → Better

After grading all the seven alternatives we will select only four best ones, so three alternatives will be rejected.

	Alternative1-DBB	Alternative2-EPC	Alternative3-Bridging DB	Alternative4-CM-Risk	Alternative5-Bridging CM	Alternative6-CM Agency	Alternative7-IPD
Owner Risk	**Better**	Worse	Equal	Worse	Worse	Better	Equal
Owner Control	**Better**	**Better**	Worse	Worse	Equal	**Better**	Equal
Contractor Risk	**Better**	Equal	Equal	**Equal**	**Worse**	Equal	Worse
Contractor Control	**Better**	Equal	**Better**	**Equal**	Equal	**Better**	Equal
Com. Mgt	Equal	Worse	Worse	**Better**	Equal	Equal	**Better**
Project Budget	Worse	**Better**	Equal	Equal	Equal	Equal	Equal
Project Schedule	Equal	Equal	Equal	Equal	Equal	**Better**	Equal
Project Category	Equal	Equal	Equal	Worse	Worse	**Better**	**Better**
Human Category	**Better**	**Better**	Equal	Equal	Equal	**Better**	Equal
Mgt Category	Equal	Worse	Worse	**Better**	Equal	Equal	**Better**
Materials and Tools	**Equal**	Equal	Equal	Equal	Equal	**Better**	Equal
Total	*15**	*11**	*9*	*10*	*8*	*18**	*13 **

Figure 4- Qualitative analysis – Multi-Attribute Decision Making table[39]

[39] By Author

From our MADM table, we've ranked the *Construction Management Agency* the highest ranking, and *Bridging Design Build* the lowest ranking. As mentioned before, we will select only the best four alternatives which are as follow:

1. Construction Management Agency Method → 18
2. Design Bid Build Method → 15
3. Integrated Project Delivery Method → 13
4. Engineer, Procure Construct Method → 11

Therefore, the three other alternatives will be rejected which are: *Bridging Design and Build Method, Construction Management Method and Bridging Construction Management Method.*

Findings:

Step 5: Analysis and comparison of the alternatives

After the Qualitative Analysis, the second step will be a quantitative analysis by using the relative weighted methods that will enable us to compare which are the best alternatives to keep.

The score will be:

- Excellent: 2
- Equal: 1
- Worse: 0

	Alternative1-DBB	Alternative2 - EPC	Alternative3 - Bridging DB	Alternative4 - CM-Risk	Alternative5-Bridging CM	Alternative6-CM Agency	Alternative7-IPD
Owner Risk	2	0	1	0	0	2	1
Owner Control	2	2	0	0	1	2	1
Contractor Risk	2	1	1	1	0	1	0
Contractor Control	2	1	2	1	1	2	1
Com. Mgt	1	0	0	2	1	1	2
Proj. Budget	0	2	1	1	1	1	1
Project Schedule	1	1	1	1	1	2	1
Project Category	1	1	1	0	0	2	2
Human Category	2	2	1	1	1	2	1
Mgt Category	1	0	0	2	1	1	2
Materials and Tools Cat.	1	1	1	1	1	2	1
Total	*15**	*11**	*9*	*10*	*8*	*18**	*13 **

Figure 5- Quantitative Analysis[40]

As mentioned before, we will select only the best four alternatives which are as follow:

1. Construction Management Agency Method → 18

[40] By Author

2. Design Bid Build Method → 15
3. Integrated Project Delivery Method → 13
4. Engineer, Procure Construct Method → 11

Therefore, the three other alternatives will be rejected which are: *Bridging Design and Build Method, Construction Management Method and Bridging Construction Management Method.*

After the Quantitative Analysis table, we will use the *Additive Weighting Technique.* The first step for this method is to rank each attribute from the most important to the less important.

Attributes	(Step 1)	Step 2		
	Relative Ranking	Normalized weight (A)		
Owner Risk	1	1/66	=	0,015
Owner Control	6	6/66	=	0,091
Contractor Risk	2	2/66	=	0,03
Contractor Control	5	5/66	=	0,076
Com. Mgt	7	7/66	=	0,11
Proj. Budget	3	3/66	=	0,045
Project Schedule	4	4/66		0,06
Project Category	8	8/66		0,12
Human Category	11	11/66		0,17
Mgt Category	9	9/66		0,14
Materials and Tool Cat.	10	10/66	=	0,143
SUM	**66**		SUM	1

Figure 6- Additive Weighting Technique Analysis[41]

[41] By Author

DBB Method	
(B)	(A)x(B)
2	0,03
2	0,182
2	0,06
2	0,152
1	0,11
0	0
1	0,06
1	0,12
2	0,34
1	0,14
1	0,143
SUM	**1,337**

Figure 7- Additive Weighting Technique[42]

EPC Method	
(C)	(A)x(B)
0	0
2	0,182
1	0,03
1	0,076
0	0
2	0,09
1	0,06
1	0,12
2	0,34
0	0
1	0,143
SUM	**1,041**

Figure 8- Additive Weighting Technique[43]

CM Agency Method	
(G)	(A)x(B)
2	0,03
2	0,182
1	0,03
2	0,152
1	0,11
1	0,045
2	0,12
2	0,24
2	0,34
1	0,14
2	0,286
SUM	**1,675**

Figure 9- Additive Weighting Technique[44]

IPD Method	
(H)	(A)x(B)
1	0,015
1	0,091
0	0
1	0,076
2	0,22
1	0,045
1	0,06
2	0,24
1	0,17
2	0,28
1	0,143
SUM	**1,34**

Figure 10- Additive Weighting Technique[45]

[42] By Author
[43] By Author
[44] By Author
[45] By Author

Step 6: Selection of the preferred alternative:

From the previous tables; we can conclude that the best alternative is "***CM Agency Method".*** To be able to be sure if it is the right and best alternative; we can use the ratio scale to prove our result.

18/15= 1,2*100= 120%

→ As result, the alternative *G* is 120% better than the alternative *B.* Therefore, the best alternative is *CM Agency Method.*

Step 7: Performance monitoring and post-evaluation of results:

From the best-chosen alternatives CM Agency Method, the best ways to monitor the performance would be the following:

- Check the following criteria for *Contractor Risk, Communication Management, Project Budget and Management Category.*
- Select the Engineers and Architect at the beginning of the project
- Owner's representative need to be selected too to keep the owner updated

CONCLUSION

The construction industry represents a huge part of the economy in all over the world; as the number of projects is increasing, and project management is developing and improving from years to years. However, still many projects fail due to its management. This paper focussed on the contractors' failures in the construction industry. How could they avoid these failures? What are the best methodologies to use for both owners and contractors to make a project successful?

As result, after looking and seeking for different methods by applying and using numerous attributes and criteria, we came up with one result and one methodology which is the *Construction Management Agency Method.* Therefore, this paper concludes and helps give clarity to how contractors and owners should deal in the construction industry to avoid failure.

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