

## **Controlling constructions risks in energy projects**

السيطره على مخاطر البناء في مشاريع الطاقة

by

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## DECLARATION

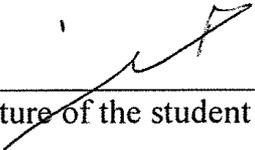
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## **Abstract**

A risk is a natural phenomenon present in all construction projects. The challenge lies in dealing with such risks. Construction in energy projects is more challenging and demanding, risks present are not only more severe in terms of consequences, but they require tremendous amount of effort and analysis to deal with. The paper provides insight to the energy construction industry, the risks that are associated with it, and how such risks are being identified, classified, mitigated and sometimes avoided. Energy projects can be found in oil and gas, renewable and nuclear energy projects. Examples from the UAE, Europe and China were taken into the study and further emphasis on the risk aspects and nature have been identified and explained. The paper offers a variety of risks associated with the energy industry with a special emphasis on the construction phase. The course of paper involves the identification, management, control and mitigations of risks. Methods used and applied on the management of risks are also discussed, which offers a transient interchange and exchange of experiences between the different sub sectors of the energy construction industry.

## ملخص

الخطر هو ظاهرة طبيعية موجودة في جميع مشاريع البناء ويكمن التحدي في التعامل مع هذه المخاطر. البناء في مشاريع الطاقة هو أكثر صعوبة ومطلباً، والمخاطر الحالية ليست فقط أكثر حدة من حيث النتائج، ولكنها تتطلب قدراً هائلاً من الجهد والتحليل للتعامل معها. وتقدم الورقة نظرة ثاقبة لصناعة البناء في مجالات الطاقة، والمخاطر المرتبطة بها، وكيف يتم تحديد هذه المخاطر وتصنيفها وتخفيفها وتجنبها في بعض الأحيان. وننضم مشاريع الطاقة مشاريع النفط والغاز والطاقة المتجددة والطاقة النووية. البحث يقدم أمثلة من الإمارات العربية المتحدة وأوروبا والصين، وتم التركيز على جوانب المخاطر وطبيعتها وشرحها. تقدم الورقة مجموعة متنوعة من المخاطر المرتبطة بصناعة الطاقة مع التركيز بشكل خاص على مرحلة البناء. وينطوي مسار الورقة على تحديد المخاطر وإدارتها ومراقبتها والتخفيف من حدتها. وتناقش أيضاً الطرق المستخدمة وتطبيقها في إدارة المخاطر، مما يتيح تبادلًا عابراً وتبادل الخبرات بين مختلف القطاعات الفرعية لصناعة البناء في مجالات الطاقة.

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## Chapter 1 - Introduction

Construction Risks are present in almost all kinds of projects; it's a fact more than just a thought. And being present in the construction stage, such risks are more likely to have a greater impact on the cost and time of a project more than any other types of risks.

Of course projects also differ in terms of their scope of works, nature, and purpose. Sometimes construction risks are more complicated in some projects more than others, due to the complexity of such projects. In addition to complexity the cost of the project itself plays a significant role in the impact of the risk, the higher the cost of the project, the higher the cost of its risks impact. There is no doubt that energy projects are considered one of the most costly and complex projects, therefore construction risks associated within such kind of projects are known to be critical.

Energy projects include Oil and gas, nuclear and renewable energy projects. Having said that, each has its own characteristics and scope.

Based on statistics gathered for the past decades in the fields of construction law and international arbitration, a conclusion is made which states that construction projects are very sensitive to risks and because of that such projects share the following risks between each other no matter how complex a project is:

- Seasonal natural hazards such as sandstorms, rainfalls, tsunamis, ice storms, high and low temperatures, etc..

- Man power, in terms of supply and management
- Act of God (Earthquakes, Hurricanes...)
- Political status
- Governmental regulations
- Unforeseen conditions
- The construction of some projects in difficult hard terrains and conditions (Remote areas)
- The use of complex technology and materials that are not fully researched and proven.
- Interface and coordination between different stakeholders and parties.

It is very important to understand construction risks and define them properly to find a mean of mitigation and complete projects smoothly.

Health and safety departments in different entities around the world started to give more attention to construction risks, thus imposing different rules in construction projects to account for the risks arising from construction. Among the requirements imposed in those organizations is the carry out of risk assessment for different planned activities that usually starts with identifying and listing the risks,

followed by defining the risk and the mean to mitigate it, and finally the controls put into the plan to control the risks.

The paper discusses deeply risks associated with construction in energy projects. Listing similarities and differences between different types and proposing a mean of mitigation or control for construction risks that could be shared among energy projects.

## **Chapter 2 Synopsis and Methodology**

The risks will be defined, analyzed and provided a mean of control up to what the market practice is and if there is a chance to apply more modified measures of control for such risks.

Energy projects will be divided into:

- Oil and Gas projects
- Renewable energy projects
- Nuclear projects

The research will be supported by Real time data, cases, and interviews present in journals, in addition to technical surveys present in surveys that are referenced.

The paper is lightly domestic based on what is present in the UAE and other areas of the world.

However, the information present in the paper from abroad to modify the controls of risk is as applicable to the region, and to suggest best practices.

Construction risks that will be discussed include but not limited to

- Cost overruns
- Non-completion, and Completion delay
- Project Specifications / Quality
- Force Majeure
- Land Availability
- Etc.

The paper will provide awareness and knowledge of controlling construction risks that may face parties associated within a construction contract in the mentioned fields.

Resources are obtainable through books, journals and the market itself.

## **Chapter 3 - Risks in construction projects**

Certain construction risks are unavoidable, being said such risks are always being present between most projects, and hence they are projects that will be analyzed and classified.

Risks include<sup>1</sup>:

- Physical works (Ground conditions, obstructions, test, samples, defective materials, inadequacy of staff)

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<sup>1</sup> Hughes W, Champion R and Murdoch J, *Construction contracts: law and management*

- Delay and disputes (possession of site, layout issues, delay due to reasons outside parties control, delay in supplying information, inefficient work execution)
- Direction and supervision (incompetency, inefficiency, partiality, poor communication, defective designs, errors in documents, ambiguous requirements, compliance with requirements, changes in scope)
- Damage and injury to persons and property (breach of warranty, un insured matters, consequential losses, gaps in insurance)
- External factors (Government policies, laws, financial constraints, approvals, energy restraints, industrial disputes, political status)
- Payment (delay in settlement of claims, delay in payment, insolvency, funding limitations, exchange rate, inflation, payment process and approvals)
- Law and arbitration (Time consuming disputes, uncertainty due to poor documentations and reports, unclear contract, cost of getting decision, enforcement, statutory changes, applicable laws)

Furthermore, Looking through different construction projects the following risks have been identified below:

### ***Section 3.1 - Cost related risks<sup>2</sup>:***

- Tight project schedule
- Design variations
- Variations by the client
- Unsuitable construction program planning
- Occurrence of dispute
- Price inflation of construction materials
- Excessive approval procedures in administrative government departments
- Incomplete approval and other documents

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<sup>2</sup> Hughes W, Champion R and Murdoch J, *Construction contracts: law and management*

- Incomplete or inaccurate cost estimate
- Inadequate program scheduling

Usually companies, clients and organizations have risk management strategies, such strategies focus on risk owners, risk exposure and risk transfer.

There is no perfect design, or perfect site conditions, change is always present and variations in projects always arise. However applying risk management systems can reduce the harsh effects of risks arising from such reasons.

Benefit of risk management in construction projects include<sup>3</sup>:

- Project issues are assumed and predicted and accounted for from the start of construction phase.
- Decisions to be made are analyzed properly and effects of such decisions are overseen.
- The project is monitored all the way through construction
- Clear understanding of risks associated within construction
- Using previous database of lesson learned and risk management systems

In construction projects, cost, time and quality will always be subjected to risks.

Due to the unique features of the construction industry, there are always more risks to be found in this area.

Such features include but not limited to the following<sup>4</sup>:

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<sup>3</sup> Smith NJ, Jobling P and Merna T, *Managing risk in construction projects*

<sup>4</sup> Smith NJ, Jobling P and Merna T, *Managing risk in construction projects*

- Long Duration
- Sophisticated processes
- Uncertainties
- Financial pressure
- Dynamic nature of projects (management of change, additional scope etc...)

Therefore in order for projects to achieve success there should be some techniques and measures that can be used to control and manage such risks to accomplish project delivery.

According to a case study on the west rail project of Hong Kong, after all factors involved in the project were analyzed by Shen (1997), it was found out that the most significant risks were, the increase of prices of materials, accuracy of cost budgeting , and the default of contractor. Together with other researchers Shen (1997) concluded factors that contributed to such risks that related directly to poor training, awareness and operation (execution of work). The survey included project managers and members of top management.<sup>5</sup>

In risk management it is very essential to classify risks, as it provides a structural figure of risks that affect a construction project

There are no defined ways to classify risks in a construction project; many approaches are being adopted by professionals in this field of practice.

Perry and Hayes (1985) classified risks from different resources, which were divided in respect of risks endured by the different parties of a construction project. Shen (2001) had them categorized based on the nature of the risk itself as the following: “financial, legal, management, market, policy and political, as well as technical risks”. In other words depending on the objective of the research, researchers chose

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<sup>5</sup> Zou, Patrick. X.W. and Guomin Zhang. "Managing Risks In Construction Projects: Life Cycle And Stakeholder Perspectives"

the most appropriate method of classification.<sup>6</sup>

Given the nature and the objective of my research, I tried to include all the major key risks **that** can affect a construction project and they are below<sup>7</sup>:

- Tight project duration
- Variations in design
- Tremendous amount of governmental / administrative approvals
- Inefficient scheduling of activities
- Inadequate construction planning
- Variations during construction phase
- Poor management of subcontractors
- Client variations
- Delay in approvals and other documents
- Poor accuracy in cost estimation
- Poor interfaces between project stakeholders and lack of proper communication
- Insufficient number of professionals and managers
- Insufficient number of skilled manpower
- Unavailability of sufficient site information geotechnical and topographical survey reports
- Arising of disputes between parties
- Price escalation due to inflation and other factors in the project

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<sup>6</sup> Zou, Patrick. X.W. and Guomin Zhang. "Managing Risks In Construction Projects: Life Cycle And Stakeholder Perspectives"

<sup>7</sup> Smith NJ, Jobling P and Merna T, *Managing risk in construction projects*

- Noise pollution

### ***Section 3.2 - Clients Risks***

Between all the risks related to clients, tight project schedule was ranked as the highest risk anticipated by parties. Project schedule is an output of both activities and time, in which the result would be the start and the end date of a given project.

Preparing a tentative “realistic “and a practical schedule in the concept and the feasibility stage of the project will always help achieve good results, especially if there was enough room to accommodate uncertainties and ambiguities about the project scope of works. Since there is a clear relation between time and cost, a long schedule will have a negative impact on the project cost benefit and vice versa. Variations that are caused by a client can lead to the change in planning, design and construction packages. Usually such variations are caused because of two common reasons, the first is the changes made by the client during the course of the project and the second is the misinterpretation of the client needs in the project scope in which there are lot of ambiguous areas in there. For the both reasons, the client will be responsible for risks. To avoid such causes, the client should have a dedicated task force from the very beginning of the project to make sure that all requirements are clear in the scope and highlighted in the right manner. The same team should also have a close monitoring during all stages of the project to make sure the contractor is aligned with such scope. Quality assurance reviews with all meant stakeholders can always add up to smooth execution of the project and should always be considered. Such team should also be responsible and fully aware of regulatory execution strategies and how to gain the required governmental permits. Documentations should also not be neglected and always kept in an efficient and effective way.<sup>8</sup>

### ***Section 3.3- Designers Risks***

Some risks that are related to designers include design variations that arise during the design phase, most probably coming from the client that requires certain changes or

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<sup>8</sup> Zou, Patrick. X.W. and Guomin Zhang. "Managing Risks In Construction Projects: Life Cycle And Stakeholder Perspectives"

the other reason where the designer did not understand the scope fully due to lack of communication or technical skills.

Because uncertainty surrounds the construction phase all the time, the design phase is effected in such a manner where scheduling is not made realistically. To tackle such issue, experienced designers that have knowledge in construction are to be hired to make the most realistic program schedule. Inaccurate cost estimation is another risk related to designers especially if the consultant is lacking experience in certain specialized works. Involving the contractor in early stages could eliminate such discrepancies. Cost estimation can also be affected by the poor miscalculation of certain activities such as earthworks. One very common reason for this issue is the unavailability of sufficient soil investigation and topographical survey reports.<sup>9</sup>

In which it can affect the progress of other disciplines ( like mechanical and piping )

Insufficient information related to geotechnical investigation and topographical survey can delay the progress of earthwork activities such as excavation , backfilling and grading. Hence, construction will be delayed in such manner.

### ***Section 3.4 - Contractors risks***

Construction program planning can be a very common challenge to contractors especially when it is unsuitable to the project due to sophisticated designs and in proper construction programs.

To tackle such issues , certain assurance studies should be conducted during the design phase to ensure a successful construction phase. Constructability study is conducted usually when the design reaches 50-70% to make sure that the design can be executed and constructed in the right manner. The 3D model reviews can always enhance the process of construction, where usually its attended by all meant parties and it's a right tool to visualize what the project will be like in 3 phases of the design based on incremental percentages (30%, 60% , 90%). More importantly Interface meetings with different stakeholders of the project are also beneficial and can resolve unforeseen dispute arising during the construction phase. Safety is a very important aspect in construction and especially when it comes to energy projects because any slight negligence to safety aspects during construction can lead to a catastrophic incident. Thus, appropriate safety studies will go through impact on Health, Safety

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<sup>9</sup> Smith NJ, Jobling P and Merna T, *Managing risk in construction projects*

and Environment (HSE) and make sure that all parties abide with the guidelines.

### ***Section 3.5 - Subcontractors risks***

When it comes to subcontractors it always about managing them. Unlike the main contractor, a subcontractor usually allocates manpower to specific project while running other projects as well in which managing his resources can be a bit tricky if the main contractor was unable to guide the subcontractor and manage him.

### ***Section 3.6 - Authorities risks***

Such risks are considered to be one of the most critical, because in some occasions it can be a showstopper. In energy projects, complications and tremendous amount of approval procedures are always present. Clients and contractors especially foreign should always investigate the guidelines, procedures and required approvals in administrative government departments.

Maintaining good relation and a healthy environment with governmental agencies and officers is one of the main keys to tackle such an issue.

### ***Section 3.7 - External risks***

Under such risk, fall a number of risks that are a result of external conflicts or issues.

Take the example of the price escalation of construction materials or the sudden drop of oil prices...Etc.

Such risks are mainly unavoidable but its usually catered for in the construction contracts under a number of clauses that transfer the risks to either parties. A contingency premium can maintain the position of the contractor.

## **Chapter 4 - Managing risks in Energy projects**

Due to the high complexity of energy projects, most of them fall under the international construction projects. In the UAE, all three energy sectors discussed in this paper (Oil and gas, renewable and nuclear) are being handled if not fully

partially through international contractors or regional consultants. The complexity does not end here, foreign participants face greater risk in addition to the usual risk faced by every other domestic project during international construction projects.

The report by Kerur and Marshall was carried to identify, Assess and mitigate the authority risks, by analyzing the present literature, assessment tools for international risks and by utilizing the 150 years of experience in advising the construction projects in Middle East, Far East, and Eastern Europe and in India since the past four years.<sup>10</sup>

While talking about international projects, we usually refer to those projects, which involve at least one of the foreign nationalities among the contractor, employer and lead consultant, who works outside his country origin. In the case of foreign contractors or the main contractor's affiliation with a foreign subsidiary or division, the government acquired project is also referred as an international project. It is obvious that the major projects involve various international companies due its complexity. Therefore, the employer or purchaser is usually local, the foreign company as the main contractor, also the suppliers and subcontractors belongs to another country, while the other suppliers and contractors are the blend of local and international companies, International banks as financiers, and in addition to the expert consultancy that is addressed as a foreigner in a jurisdiction. The blend of diverse nationalities and languages in every team of each organization, especially in the emerging markets or regions like the Middle East is very common. In private projects also there are international components involved, with further probability of foreign organization as the developer or procurer. It is pretty evident that there are many factors that classify a project as international. This classification makes the construction of the project integrally risky. The most probable risk factors are prolonged construction, environmental factors, and the complexity of operations, financial strength and diverse organizational structure. Projects commonly face 2 main categories of risks, risk while project delivery and Jurisdiction risks. All the

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<sup>10</sup> - Kerur Sachin, Marshall William, "Identifying and managing risk in international construction projects"

projects face both types of risks, however, it is less likely that domestic projects get affected by jurisdiction risk, either these are lessened by the fundamentals of the projects or are not examined because domestic projects treat these risk as common business risks and resolve these with their corporate strategies. Projects delivery risks are referred to the particular projects, their financing, and construction with regard to an asset. Issues such as rival party risk, construction site, land condition risks, financial restraints in the projects, contractual issues, and increase in material prices comes under project delivery risks. Jurisdiction risk is referred to the laws involved in the projects that are impaled on the delivery and construction of the assets. These risk factors are not directed to a particular project however its consequences have the significant impact on the project. It involves the obligations such as establishing the legal body, getting license, constancy in political and social factors, the risk of exchange rates, currency, and the establishment of the forums to resolve the disputes and for enforcement. Construction risks are faced by every project and only few faces jurisdiction risk; however, the domestic construction projects face very fewer consequences as compared to the international projects.<sup>1112</sup>

Jurisdiction risks become very less or are likely to be mitigated if the construction project parties are addressed same as the project jurisdiction, and the project payment and currency used are same, in which the corporate strategies and actions become the part of the system to mitigate these risks.

It becomes more tricky for international projects while facing jurisdiction risks such as economic restrictions while entering into a market, differences in taxes and rates, currency issues, insurance problems, problems due to nationality, unfavorable political and social factors, association with the present government, infeasible customs of religion, business and society, problems while resolving disputes and enforcement choices, strict laws, insufficiency of the foreign infrastructure, permit problems, import issues, payment problems, security obligations and practices, visa

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<sup>11</sup> E. Gould, Nancy E. Joyce , *Construction project management*

<sup>12</sup> Kerur Sachin, Marshall William, "Identifying and managing risk in international construction projects"

problems for labors or recruiting local labor. All above-mentioned limitations or risks are very significant if one looks at the performance of the foreign country projects. Whilst these can also occur in domestic projects, but being familiar with the laws and the market standing of the business along with designed strategies to resolve such jurisdictional risk mitigates these risks for domestic projects. For instance, during the initial stage of business establishment, actions are taken to overcome economic barriers or the company fails to operate. Prices and taxes are already well understood and adjusted into the business plan for home jurisdiction. Currency is not an issue for domestic projects whereas insurance and availability is encompassed in the practices. However, this does not imply that domestic projects are not liable or do not face laws but there is a designed system with strategies which easily mitigates the risk factors, it unleashes the comforting ground for domestic projects.<sup>13</sup>

While evaluating the international projects for construction, it is essential to identify the delivery risks and jurisdictional risks separately. The proficiency skill in project delivery risk identification, analysis, and modification can be transferred to the project and jurisdiction [24]. Additionally, the nature of jurisdiction varies from country to another. It is not necessary that the professional advising on the project delivery risk will give an effective advice for the international project. Likely, the tools used for project delivery risk identification and analysis may not be transferred for analysis and identification of jurisdictional risks. The importance lies in recognizing the presence of project delivery risk and jurisdiction risk and the difference among them to effectively identify, analyze and mitigate the risk. However, it is very vital to take the second step in applying the appropriate strategies in order to make the risk approach effective.<sup>14</sup>

The recognition is very important as the project delivery risk aspect change with regard to project jurisdiction. To identify and mitigate the risk factors for project

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<sup>13</sup> Frank Beckers, Nicola Chiara ,Adam Flesch, Jiri Maly,Eber Silva and Uwe Stegemann, *A risk-management approach to a successful infrastructure project*

<sup>14</sup> Kerur Sachin, Marshall William, "Identifying and managing risk in international construction projects"

delivery in home jurisdiction there are strategies, there may be a need to alter these strategies before applying these on international projects.

Usually, every project faces cost related issues, however, there are different consequences with regard to their variable in project type and location. Based on what was analyzed so far, there is an apparent shift in the market position of the construction project risk due to changing risks during project delivery within the jurisdiction. The most common contract related issues that varies among different markets includes, unanticipated project condition and site situation, prolonging projects due to delay, significant impact on liquidated damage due to delay, consecutive subcontracts and payment clauses like pay-when-paid, time constraints, processes for documentation and temporary or provisional payments, prior payment and security obligations, issue related to the performance and retention, reporting problem, legal obligations like 'decennial liability', rectifying faults and the privileges and responsibilities of the working personnel, engineers, representative etc. there is possibility that international contractors or their subcontractors already had the designed strategies or approaches to deal with the above-mentioned risk factors, it is also true that these approaches and strategies may not work if the new jurisdiction does not place the issue on same market position. Thus, the major contractor's professional teams may possess the necessary skills needed for the project delivery risk identification, analysis, and mitigation; it is probable to use the domestic skills for modification and evaluation and accurately applied on international project's new jurisdiction.

### ***Section 4.1 - Jurisdictional Risks***

Jurisdictional risks both new and old can be found through the difficulties and ambiguities faced by participants of international construction projects. The variable factors affecting the local, national or regional market or industry for construction projects can be divided into three sections, economic or financial risks, and political and social risks. In order to identify, analyze and mitigate, there are twenty general risks with regard to the jurisdiction that can turn into the disaster for international projects if failed to manage.

The following table encompasses construction industry literature, in summary of the experiences analyzed<sup>1516</sup>

<b>Risk</b>	<b>Consequences</b>
<b>Business Case and the Economic Practicality</b>	Financial model with adequate details with regard to the needed investments, costs, sales, profits, or the after tax profit. Legal or economic obligations in the analysis must be attained to enter. The assistance from local experts for consultancy while analyzing, specifically for economic or legal obligations to entering, prior any investment in a new market or even yielding the project tender in the foreign country.

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<sup>15</sup> Gibson Edward G , Walewski “Risks of International Projects: Reward or Folly? “

<sup>16</sup> Kerur Sachin , Marshall William , “Identifying and managing risk in international construction projects”

<p style="text-align: center;"><b>Tax</b></p>	<p>While analyzing the business case, that country's local tax rules and penalties in the home jurisdiction must be considered, but there is professional help needed for other contrary taxations to analyze and identify. Always Consider the risk of the changing or new taxes implementation due to new laws.</p>
<p style="text-align: center;"><b>Currency</b></p>	<p>It is very important to review the currency hedging availability, utility, and cost, also the local unit. The GCC's fixed currency or pegged or the possible euro dissolution etc. it may lessen the few risks but it will not end the need of currency hedging. There is also the possibility of restructuring in the currency, where it may be recreated, thus it must also be taken into consideration.</p>

<p style="text-align: center;"><b>Practices, Trends And Environments In Market</b></p>	<p>Business cases likely consider the practices, trends and market environment for its assessment, however, it worth separate analysis. Market saturation and ongoing trends are the essential issues to look into, also the construction quality of the project, the accessible professional help, subcontractors, suppliers and others for high quality project results. Consider the temporary payments and unpopular or new member in the local market but are international participants as a standard view.</p>
<p style="text-align: center;"><b>Insurance</b></p>	<p>Usually, all markets require the project insurance for project specification that must be insured by only local insurance entities. It is also a potential risk for the organizations with global reach and global strategies, or in the case where home jurisdiction is at advantage than the foreign jurisdiction.</p>

<b>Legal entity establishment</b>	<p>The establishment of a legal entity that is covered by laws triggers the apparent jurisdiction risks. For instance, UAE permits international organizations to open branches, though the branch is not considered as an individual entity thus it unveils potential liabilities for the mother company as a branch, which creates taxation problems in the home country.</p> <p>UAE demands 51% shareholders to be Emirati for establishing an individual legal entity. Thereby it is necessary to consider all the aspects such as entity choice, structure, documentation, and negotiation before entering the UAE market.</p>
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<p><b>Expropriation</b></p>	<p>Markets which do not have applicable rules or who does not enforce the laws and people directly seize the land or property (direct expropriate), it is a very important risk in jurisdiction. Indirect expropriation is also possible due to prejudice taxes implementation, import or export permission application being refused, and alteration in the governmental landscape that impacts the international endeavor's chances of business in the foreign country.</p>
<p><b>Employment of Nationals</b></p>	<p>Local terms of contract or laws of Few markets require that a certain percentage of locals to be hired by the international organization operating in their country. Also, privileged treatment is demanded for the supplier and subcontractors (only locals). Moreover, the forced employment of locals or nationals may disturb the cost base for international contractors, also there may be cost and quality risk due to the imposed local agreements with local subcontractors and suppliers.</p>

<p style="text-align: center;"><b>Political Constancy</b></p>	<p>Developing markets might face the problems due to political uncertainty. Public-private partnership (PPP)</p> <p><b>Projects</b> are the example of the projects, which face political instability due to prolonged and periodic revenue generation by the government; moreover, the alteration in government requirements may also impact the market and eventually the international projects.</p>
<p style="text-align: center;"><b>Social constancy</b></p>	<p>The social constancy of a project is strongly connected to the political constancy, as social inconstancy like conflicts and violence triggers the big risk for few projects in terms of jurisdiction. The one well-known example of social conflict is that of 'Arab spring', where international funders and investors were reluctant to finance the project in 2011, and such consequences are potential risks.</p>

<p><b>Government relationships</b></p>	<p>Regardless of the project being public or private, not being on good terms with current government creates substantial risk in terms of jurisdiction. Obviously, the involvement of the government, the sensitivity of project with regard to political and social instability, may trigger the possible array of consequences in the project.</p>
<p><b>Regional Customs and Business Practices</b></p>	<p>Not being able to identify and adapt to the local practices of the market immensely impacts the international project's success, and this thing does not need a statement. Such issues arise when the team is flown to the project country from the home country and they do not have any regional know-how thus the foreign business application may be considered inappropriate with regard to the new jurisdiction and might have the opposing consequences that can create relationship issues and negative impact on the project.</p>

<p><b>Cultural and Religious Issues</b></p>	<p>Cultural and legal issues are connected to the regional practices and customs and the international projects who fail to identify and develop the sensitivity towards these practices, may face the consequences and trigger the legal obligations. For instance, During Ramadan, middle eastern countries alter the working hours and give Eid holidays as their cultural and religious practice, moreover, the knowledge about their prayer timings and another religious practice is an essential issue. The benefits of face to face meeting and recognition and understanding of cultural norm is important.</p>
<p><b>Governing law</b></p>	<p>Usually, the international participants in foreign jurisdiction think that they will negotiate the governing law issues. However few markets have the governing laws to enforce certain customs and practices. Government or local procurers demand the enforcement of the governing laws on the international projects, which reels the international projects under unacquainted legal government.</p>

<p style="text-align: center;"><b>Dispute resolution and enforcement</b></p>	<p>Few foreign participants incorporate their dispute resolution strategies in the contract with an expectation to enforce it to resolve conflicts. Whereas these practices are negotiable but the local practices and enforcements do affect their mechanism. For instance, international federation of consulting engineers (FIDIC) removed the dispute settlement boards and it is very corporate in UAE. Especially negotiation on the grounds of</p> <p>Dubai International Arbitration Centre (DIAC), as its Rubric is generally used to officially resolve the conflicts. However, the judgment enforcement and negotiation can develop the prerogative risks in new jurisdiction.</p>
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<p style="text-align: center;"><b>Regional Forms of Contract</b></p>	<p>New investors or participants must acknowledge the dominating regional contract forms for specific projects and the customary risk that an exceptional project will have to encounter. For instance, middle east enforces the FIDIC Red Book 1999 for all civil construction projects but the adjustments after negotiation are unpredictable that may result in considerable negotiation or disgraceful actions. Novel participants can exploit the FIDC form as an opportunity to enter the civil construction market in middle east. Likewise, many projects of East Engineering Procurement and Construction (EPC) in middle are either carried out following the FIDIC book or the most well known projects use FIDIC form.</p>
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<p><b>Health and safety</b></p>	<p>Developed and developing markets have the evident differences in terms of health and safety issues understanding. This defined difference may create problems for the designed and authored governing policies of international construction organizations for health and safety. The discrepancies in awareness of health and safety issues in developing marketing regarding the laborers or site teams can trigger the possible risk for international companies, such as catastrophic situation at the site. However, these risks are manageable, by educating and designing the appropriate policies, though the process could be slow and inadequate.</p>
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<p style="text-align: center;"><b>Subcontractor and Quality Of Supply Chain</b></p>	<p>The good relationship with proficient subcontractors and suppliers is the core reason of success for domestic construction projects. However, these relationships are developed on trial and error and over a long run. On the contrary, there is a very significant risk of taking on board the new subcontractors and suppliers who do not have the regional know-how, there may not be any choice for an international contractor. There is not just the risk of selecting the inexperienced subcontractor and suppliers but there is the possibility of opting the insufficient professional local subcontractor in the jurisdiction. Which will impact on the quality of the project and increase the international contractor's project delivery risk. Informal strategic association with the local subcontractor that help assure the project quality by providing the supply chain knowledge may help mitigate these risks, but unfortunately, this strategy requires long period of time.</p>
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<p style="text-align: center;"><b>Importation, Customs And Visa Issues</b></p>	<p>Potential schedule risk in case of the fatality to attain the construction plant's customs clearance and the estimated increased cost due to the procurement of local plant. Likewise, time and cost expense may incur due to the delay in visa obligation fulfillment for top management as well as the lower staff or laborers.</p>
<p style="text-align: center;"><b>Climate</b></p>	<p>However, climate is not a risk factor in the jurisdiction but it deserves the consideration as a project necessity. For instance, heat and dampness in UAE climate during summer effects the labor efficiency and work productivity and eventually the quality of project depreciates. Which incurs the risk of mid-day breaks, similarly countries with monsoon weather and other seasonal issues require the significant climate assessment for scheduling the work accordingly.</p>

There are various examples of learning the process of international companies for project delivery in a novel jurisdiction in order to convey the high quality, immensely

complex and highly valued projects. These considerations are not just for the financial purpose but for sustainable reputation risk recognition, too.

The reputation of an international participant can be at stake if failed to carry out a successful high profile project for the influential procurer and impact of lessons learned during the first project on the following projects. If the first project failed to deliver the expected quality, the regional reputation gets affected adversely, and it may also become difficult for the international organization to cover the damages on their other projects.

Lastly, the international companies should opt few assessment tools like International Project Risk Assessment (IPRA) for general and formal identification of risk, which is designed by Construction Industry Institute for risk identification. While being careful to not enable any assessment process for risk without considering the support from local professionals, especially related to the taxes and legal obligations. The IPRA assessment tool is recommended for international projects that will help classify the risks. It is a generic tool for risk assessment in case of reliable and local information unavailability or accessibility, which may identify and minimize the potential risks in the project.<sup>17</sup>

### ***Section 4.2 - Ranking and assessing risks***

IPTA tool by the Construction Industry Institute has a designed baseline to assess and rank the identified risk. This baseline assesses the international participant who has very less local information and limited options to increase the information they have, The IPRA will assist in the process of ranking and assessing the project risks, as discussed above in addition to considering a professional support with generic assessment tools for identification.

Risk assessment is a cloaked art which is referred as a science and due to the characteristics of risks, estimating the correct prioritization of the events is very difficult as every project circumstances vary and so does its importance in a particular project. Although having more experience and descriptive information regarding local market will enhance the chances right process selection, however, the exactness of the risk assessment and ranking cannot be guaranteed. Thus, it is reasoned to use the generic assessment tools and the integration of the management, risk assessment and

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<sup>17</sup> Gibson Edward G , Walewski “Risks of International Projects: Reward or Folly? “

ranking, both local and international teams, site teams and professionals for external risk analysis. The set of opinions may sound like a backbreaking process, but the blend of all opinions collected around the company will more likely mitigate the prejudice due to individualism and may also direct the processes in right direction.

### ***Section 4.3 - Risk mitigation general issues***

The objective is to opt the right and efficient risk management strategy through identification, assessment, and ranking. It is the most appealing proverb that risk rely on the party that can manage such risk, but it is hardly been practiced. Frequently, the supply chain is enforced with risk as a function to proportionate bargaining power, precisely to make the subcontractors and suppliers more attentive and strategic in order to design strategies for the identification, assessment, and mitigation of risk. Obviously, it is not efficient for the contractor to dodge or remove the risks from the project, it implies that the application of mitigation strategy is not a piece of cake, it is very critical to identify, assess and rank.

Project risk can be dealt with in three different ways, transferal through contract, through attaining insurance or hedging for protection, and by retained risk's attentive management and justification of the retained risk with satisfactory price. Contract to transfer risk is applicable in case of another party's willingness and ability to undertake the risk. Usually, transferred risks are attained by the subcontractors but this strategy only saves the main contraction and only if the subcontractor is financially strong and has the ability to bear the main constructor's obligations. Another clause in the strategy is the ability of the main contractor to secure his standing by permitting the subcontractor the complete 'flow down' to manage the risk on his behalf. However, it is very unlikely that the local subcontractors would not recognize the risks beforehand and apply their mitigation strategy, which is a very sincere risk. International contractor can have the rights over subcontractors, when finally consequences and risks are passed on, the risk of bad reputation if failed to deliver the successful project and it became viable to sue the subcontractors, also may

unleash the possible financial experiences if the contractor opt for the small company as subcontractor that give satisfactory judgment.<sup>18</sup>

In a subcontracting among the designer and main contractor for a design and construct project, there is huge risk transfer from the main contractor to the designer but on a condition that designer must have strong financial ground to handle the risk 'flow down' for the main contractor.

It is also important to mention that it is very rare that the main contractor secures himself by easily transferring the probable project risk to its subcontractor, mainly because project delivery risk is accepted by the main contractor only, whilst only some percentage of the risk is transferred to the subcontractor. The example of Liquidated damages and the associated cap is a good illustration to explain the scenario where the main contractor faces the debt due to the work delay by his subcontractor under the main contract. Variation in rates of liquidated damages significantly exposes the main contractor. Likewise, the main contractor is also exposed, due to the security of performance value dispensed by the subcontractor for the main contractor and the security of performance value dispensed by the main contractor for the employer. Therefore mitigation of the risk should not entirely rely on the risk transfer strategy but it should be accommodated with the appropriate and proactive risk management strategy.<sup>19</sup>

Insurance is used as an effective tool worldwide for risk mitigation and it's essential for industries like construction. There is always a requirement of international projects to insure the construction project domestically, in addition to considering the other strategies themselves. An insurance strategy as decennial liability is highlighted in the jurisdiction for the contractors and architects, along with its legislative exposure of decennial liability insurance, although it is among the policies whose cost is exorbitant. Perhaps, the political risk insurance is the most opted and right insurance strategy in unstable countries. Risks like terrorism, political ferocity, currency exchange and expropriation are generally covered by political risk

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<sup>18</sup> Kerur Sachin , Marshall William , “Identifying and managing risk in international construction projects”

<sup>19</sup> Kerur Sachin , Marshall William , “Identifying and managing risk in international construction projects”

insurance. For a hard estimated risk, currency hedging offers international participants with an option to lessen the risk however providing the potential to minimize the project margin. Profitable hedging's feasibility is measured on the basis of particular project only, however, several projects may demand marketable 'middle ground' in case of partial hedging, or short coverage period, to mitigate the probability of currency escalation but not considering the hedging cost. The two reachable strategies for risk mitigation are the attentive management and the price estimation of retained risks; however, these are also areas that usually be the reason for the failure of international construction projects.<sup>20</sup>

In order to manage the retained risk, it is vital to vigilant subcontractors and supply chain with supervision, efficient operational management, time to time notices of submissions and contract updates, maintaining the detailed documents and management processes, ample resources for contract management staff and teams at site. Maintaining the friendly and cooperative relationship may create the informal behavior and averseness towards formal updating procedures regarding claims and reporting to employer and engineers of the project and that is a very substantial risk. It is important to keep in mind that decision taken at the time of friendly relationship cannot be revised when it gradually turns bad and the reporting of the simultaneous and corresponding events cannot be done afterward.

It is not healthy for international participants to rely on a particular confrontational construction contract administration, instead, opt for a 'continuous disclosure' strategy that allows engineers and employer to be updated regarding any project issue. Such administration strategies are more likely to satisfy the notification obligation, in exchange for the contract's right security, nonetheless providing the significant project disclosure to all the involved parties.<sup>21</sup>

International participants use their lawyer's advice on international project's jurisdiction and delivery risks and adequately accommodate the listed risks it into the submitted tenders so that the risk can be estimated. Although, commercial clauses on new international entrants are not enforced to support the domestic company to win and it is not necessary that the commercial clauses will always be feasible. It should be borne into the head that buying out the jobs can be riskier than compromising with

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<sup>20</sup> Bunni, Nael G. *Risk And Insurance In Construction*

<sup>21</sup> Kerur Sachin , Marshall William , "Identifying and managing risk in international construction projects"

the fewer profit margins. Some job's nature is to clutch supply chain, in order to make it increase its productivity to incur the money invested in the project. Restrained cost can be negative if the site and management team are inadequate resources to perform and not taking professional help to increase the value. These factors are more likely to affect the project badly; as it will impact the productivity of the administration and probably unleash the risks whilst delivering the project for the contractor. During the project, international contractors gradually face the risks of delay, cost issues, and price aggressiveness, which trigger the discomfort, and less margin of profit.

Regardless of the project being a joint venture of international and local companies or only international project nor does the size of project, small or major matter. While taking the first step in new jurisdiction, whatever procedures, practices and strategies management and site team are learning on a continuous learning curve will become beneficial for next projects in the given jurisdiction in the case if the market is new.<sup>22</sup>

It's the consolidation of the initial lesson learned that can help international company to achieve success in foreign countries in which similar short falls have been already faced in previous projects. In the scenarios where the international company has a reliable local team employed then they may require any formal reporting and project update policy but it is evident that the developed market's staff turnover is lower than the developing market, also it's more likely that local teams vary from project to project. Except, if there is a consolidation among the organization and lesson learned system from the previous projects, otherwise there is a very significant risk of losing the reliable local teams to a different jurisdiction.

Nevertheless, there are a countless number of strategies that can help create the consolidation among lessons learned and foreign jurisdiction, from interrogatory informal sessions to complete out shoring, because of meticulous behaviors. it is recommended to appoint an individual at least that monitor the project processes and behavior and formulate a detailed report listing the ten most common or frequent project risk factors that impact the project performance, what initiatives or strategies were applied to resolve these risk factors, to what extent those strategies were successful and what are suggested alternatives, what are the structures or procedures that may need redesigning or alteration in subsequent projects. It is also recommended that the person/individual appointed to analyze the project must not be a site or management team member that may prejudice the project risk analysis politically or otherwise. Also, confidentially distributing the questionnaires for the

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<sup>22</sup> Bunni, Nael G. *Risk And Insurance In Construction*

purpose of all onboard teams in projects to have the consolidated input from various sources with honest project disclosure is also beneficial.<sup>23</sup>

it is likely that the 'lesson learned' report will benefit the international organizations over time to understand the new markets, as the report will encompass the factors that require improvement and the keys to successful project delivery. This will redirect the resource allocation for effectiveness and efficiency, the exactness in the price estimation and it will also reassure the implementation of the right mitigation strategy. This strategy or report of lessons learned will determine the investment worth in comparative jurisdiction.

## **Chapter 5 - Construction risks in Oil and gas projects**

Middle East's energy reserves are known to represent more than half of established oil reserves of the world, it's attracting regional security and safety demand as the biggest security solution provider in the region, G4S. The integral risk in the gulf involves the withdrawal, transference, and handling of the valuable natural possessions. This risk is the reason for increased security and safety demand, which includes solutions for fire alarm structure feasibility to thermal fire, radioactivity, and dangerous chemical exposure.

Throughout the years, there was an observed significant increase in constructing and operating oil and gas services due to the drastic increase in oil field products and services demand including costs of fuel and labor. Simultaneously, the size of oil and gas construction projects has increased and so does their level of complexity. Optimized project delivery and performance monitoring were never this acute.

### ***Section 5.1- Accounting for risk***

Developing the contingency plans for risk management has been a customary practice since a long time. Contingency plans highlight the risk in a more descriptive manner and design mitigation strategies on the basis of a past event. Economically speaking the designed contingency plans are essential to be used when faced with the risk, however, mostly the procedure become obsolete till then. Conventionally, contingency budget worth is determined based on a static project budget proportion.

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<sup>23</sup> Kerur Sachin , Marshall William , "Identifying and managing risk in international construction projects"

Nonetheless, this procedure is immovable and withholds numerous funds for the project throughout its period without any reason.<sup>24</sup>

With the latest management tools and models, solution for integrated and seamless contingency planning can incorporate and monitor the change in the system. The transaction of risks from being estimated to actual that affects the financial budgets require the permits, design a few contingency plans and in the end, implement the right changes in estimation and actual budgets. On the other hand, if the estimated risk becomes void, the constancy funds are given back to the organization, which can utilize the funds in a more proficient way.

### ***Section 5.2 - Mitigating risk through visibility***

The amount of data provided to track may mislead the oil and gas project managers. Alongside all the operations and the variety of stakeholders, including all the departments of finance, who monitor the project via c-suite and the external contractors, usually, the problem is same, isolated data and deficiency in the clarity.

Generally, the manual processes are used for collecting and reporting the data, and the project management cost relies on it, the speed and authenticity of the delivered information rely on it. Delay in the report formation or analysis may not allow or gives time act upon the corrective measures. The single data source with the integrated system that can be accessed instantly to report the performance of the project, specifically, dashboards with designated roles, feasible cost reports, and all in a spontaneous virtual view.<sup>25</sup>

Solution to cost marginal over runs can be achieved through project cost management system, which allows the monitoring of progress of the project and the estimation of possible risks before facing marginal overrun. It is achievable using integrated data through instant access. In the cost management system, “what-if” scenarios may be created by the project-monitoring analyst to understand and analyze the worst scenarios and make the contingency plan on the basis of realistic scenarios.

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<sup>24</sup> Sloninsky Javier, “MITIGATING RISK FOR OIL & GAS COMPANIES WITH PROJECT COST CONTROLS”

<sup>25</sup> E. Gould, Nancy E. Joyce , *Construction project management*

Earned Value Management (EVM) method can be used if the single system grants cost and schedule data access for scenario analysis. EVM is a project-monitoring tool that can be used to measure the difference between the plan performance and actual performance of the project. Cost and Schedule Performance Indices is an example of the basic value earned metrics that inevitably computes the independent estimates on the basis of true performance trends for the objective view of total project cost forecast. The capability or means of predicting the possible results before completion of the project and monitoring the project effectively is the variance between on time and within budget project delivery and apparent massive overruns after months or weeks of project expenditure payment. Organization can operate more efficiently by using the past data and instantly accessible present data, projects will more likely be sorted and well constructed to operate.<sup>26</sup>

### **Choice of projects: A risky business**

As most projects have the innate risk factor that should be controlled and operated, systems that monitor the project lifecycle can rectify the possible project risk at the initial stage and also provide the mitigation strategy whilst opting for the project.

### ***Section 5.3 - Risks due to site ground conditions***

The risk mitigations of such disputes are very challenging and costly, arising due to subsurface (ground) conditions, thus the parties contracting in the construction project must make sure through proper analysis the possible risk allocation and its appropriation pre award and during tendering phase.

Specifically in the Middle East, where, within region majority of the countries' civil codes provide for the joint liability of architects and contractors in case of building collapse or fixed work expenses partially or completely, for a period of ten years, regardless if the collapse was due to soil conditions.

### **The risk**

Usually, contractors do not focus much on investigation of the subsoil or seabed before constructing or signing the construction contract. Whilst this may not be a requirement for all projects but surely it is for some, price of the project work, design

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<sup>26</sup> - Sloninsky Javier, "MITIGATING RISK FOR OIL & GAS COMPANIES WITH PROJECT COST CONTROLS"

and risk cannot be finalized without investigating all the potential risk factors involved in a project.

Every project owner, whose responsibility is only construction, would want a thorough investigation to avoid any time or cost-related risks. Tangible situations which are either unpredictable or hidden may demand the alteration in construction methods and means, restructuring in case of drastic change. Mostly the wrong geological information delivered by the employer misleads the contractor, who solely relies on provided information than investigating himself, which leads to project delays and claims. This same problem occurred during a project, the project was to construct a railway linking between Hong Kong and Guangzhou, which got 2 years delayed because of unpredictable geological risks under Hong Kong's urban area. It is expected that this delay will cost billions of dollars.<sup>27</sup>

It is quite evident that the projects where a party with appropriate and efficient risk management takes responsibility are more likely to produce the finest results. However, mostly this factor is neglected and the employer only asks for price and project completion assurance, in such cases, it is more likely that contractor is given the responsibility of all risks management.

### **Is local law relevant?**

It is important to take into consideration the local laws whilst negotiating and drafting the site requirements. Nonetheless, every Middle Eastern country has individual laws but the following are some common key considerations in all countries:<sup>28</sup>

- Freedom to regulate the contractual provisions for unpredictable tangible situations by all the parties.
- All the parties are supposed to operate with regard to their agreement (following the same methodology which fulfills the contractual responsibilities in good faith) thus it is important to draft very carefully and ensuring that all the project aspects are covered.
- Project requirements, which contradict the necessary requirements enforced by law, are not enforceable, for instance, risk transfer in order to restrict engineer or contractors' decennial liability.

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<sup>27</sup> Clancy Niall, "Shifting Sands: 'Negotiating Risk For Ground Conditions'", (

<sup>28</sup> Clancy Niall, "Shifting Sands: 'Negotiating Risk For Ground Conditions'"

- Disclaimer drafting must be prudent (for example, which signifies the relation of the lapse or fault to the geotechnical report) that are usually imposed by the court, however, the wrong presentation (quoting the half information or any kind of manipulation) is not untrue or uncivilized.
- Not acknowledging decennial liability or other laws, for instance, some contracts in the UAE do not signify the procedure to allocate the risk related to ground conditions in a given contract. However, the court withholds the right to cancel the entire project or part of it, in order to send back the parties to the positions prior the contract.
- Any clause, such as time extension rights, alteration in order, superior power, insurance, security or description or detailing requirement may be the unpredictable risk or consequence of ground situations.

### ***Section 5.4 - Risk in standard form contracts***

The FIDIC red book with construction contract conditions highlights the tangible risks allocation for employers that are not reasonably predictable for any proficient contractor till the tender submission date.

The key limitation in this clause from employer's point of view is that he may lessen the motivation to investigate and reason the risk triggered by the ground conditions.

The tangible situations of every case rely on particular circumstances that it can be predicted or not and mostly this process is continuous, therefore it is expensive. It is not necessary that passable negotiation and drafting will resolve the conflicts but it surely can be narrowed down through précised and clear drafting.

It must be clearly mentioned in the contract, if the contractor is to rely on the personal investigations or reports and will not rely on the provided information. Also, proper referencing must be done for all necessary reports and investigations, except all the risks are assumed by a given party.

The yellow book of FIDIC for constructing and designing plant contract contains approximately similar risk provisions like that of the red FIDIC book. Apparently, not many employers follow this book as the red one.

To be exact, the silver book of FIDIC that illustrates the various EPC/Turnkey project contract circumstances that obliges the main contractor to fetch all essential

information with regard to the tangible situations and employer's liability is denied for the information accuracy, adequacy and authenticity provided by him to the contractors. However the notion depicted the silver book allows the contractors to undertake individual investigation; they are given an opportunity to exploit. In the real time, mostly FIDC contracts are revised in order to redirect or alter the risk allocation among the parties. Whilst revising any previous standards in the contract, it is very essential to keep in mind the tangible situations of different provisions (for instance, clauses to operate the time disparity and delay) are acknowledged and dealt to avoid any further uncertainties or inconsistency in the contract that may need amends again. <sup>2930</sup>

### **Final Observation**

Disagreements due to the unpredictable ground situation are quite challenging and costly, thus the risk allocation within the contract is needed to be dealt very cautiously and equally so it does not disturb the project course. Regardless of all the reports and paper work being reliable or not, the risk distinction must be evident. The chances of further disputes and arguments should be mitigated by these warranties, insurances or issue.

Before performing the contract it is essential to ponder on the contract nature that is suitable for the project.

Undergo both subsoil and sea surface (grounds) testing and sampling independently if possible. In addition, a rumination on the possible implementation of local laws on the contractor's liability of provision allocation on the information delivered by the employer to make sure if there is any need to revise the contract in order to check the sufficient risk allocation consideration.

A well-informed and sharp construction industry stakeholder shall always ensure a timely project completion and control over profit margins that are very crucial to forecast the cost throughout the project lifecycle. Mostly the properly forecasted projects tend to be more successful than others and the ones who don't forecast tend to suffer to reach the breakeven point. In the construction industry, stakeholders are

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<sup>29</sup> Bunni, Nael G. *Risk And Insurance In Construction*

<sup>30</sup> Clancy Niall , "Shifting Sands: 'Negotiating Risk For Ground Conditions'"

stressed to forecast the project costs accurately, which is leading to the disagreements in the industry and it is referred as “sign of the time” by some.

Now, the main problem that stakeholders and the advisors are facing during the construction is how to equally balance construction costs arise due to challenging interests of the industry. Another factor that makes accurate forecasting difficult is that currently UAE official bodies are not responsible for controlling the labor wage rate and lately there have been no authorized indices to estimate the cost of material requirements in construction projects.<sup>31</sup>

Therefore, the present market is persuading the construction parties to work together for early project stage or procurement stage to develop a mutual cost mechanism for the construction projects.

While balancing between the core protagonists is tough, but shouldn't be indefinable.

### ***Section 5.5 - Inflationary pressures***

Following the local conditions in the UAE, the prime reason of increased project cost is due to price inflation impact on procurement material like steel and concrete back in the period from 2012, however, it is more likely to the rising trend in the construction industry than being a problem. Even though prices went down a bit from last year due to low oil prices, prices of Cement and Steel did not decrease much.

### ***Section 5.6 - Effect on procurement***

On one hand there is absurd inflation trend inkling in the procurement market and on another hand, two stage tendering is gaining the popularity in reference to procurement, moreover, the period of tendering is also becoming smaller to benefit from the market prices. Additionally, there is swapping among the cost appreciation methods and provision fluctuations. The price hedging is becoming a norm for essential materials in giant projects. Particularly, the projects with extended ‘lead in’ periods to be précised.

The reliance of employers is more on quantity inspectors than tender inspectors and quantity bill mainly and individual lawyers to help the appropriate drafting mechanism for the contract that manages the raising material cost risk in the project.

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<sup>31</sup> Al Saadoon Omar, “Controlling Construction Costs”

### **Fixed Price Contract & Fluctuations (typical scenario)**

During the project lifecycle, it is quite predictable that the cost of labor and material will vary. The global market conditions presently decree that they will keep rising. It is more likely in the case of fixed price contract being silent that all the risk will plunge on the project contractor. Typically, the main contractors try to shield themselves by exaggerating the price of tender to combat any anonymous and immeasurable risk in project lifecycle. In past, the provision for fluctuation used to be encompassed in contracts for any defects. Nevertheless the inappropriateness of provisions for fluctuations in the past, contractors are trying to increase the cost after sensing the need of increasing cost in order to distinct their applications. However, there is not much enticement for contractors to exploit the cost, mainly in case the employer is inclined towards the contract that permits lump sum payment. Chiefly, employer pursues such type of contracts for additional comfort that guarantees the premium price mechanism.<sup>32</sup>

### **Reasonable agreement**

Ultimately, it benefits the employer and contractor of the project, as well as it offers some certainty in order to recover the costs, to consider involving contractual mechanism or selecting the procurement mechanism through partnership, which will recover few or all the increased cost factors before the actual work commencement and during the project with regard to cost inflation instead of quoting high the price in the beginning.

The two general and most used procurement and contractual approaches for the reduction of increasing cost include, "pain share" and "gain share" cost approach and the cost 'escalation mechanism' or the blend of two approaches to decrease the costs.

### ***Section 5.7 - Pain-Gain Share concept***

This approach suggests that if the project acquisition cost is higher than that of the targeted cost (inclusive of profit and overhead cost but not acquisition cost of site), then the employer and contractor both bear the disadvantage, as the employer will be

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<sup>32</sup> Al Saadoon Omar, "Controlling Construction Costs"

liable to pay extra cost and the contractor will not get full reimbursement, share in profit or overhead.

On the other hand, if they keep the savings at the beginning of the project in order to decrease the acquisition cost than targeted than both the parties will attain the advantage. The employer will not be liable to pay extra for the targeted costs and contractor will get the full payment with agreed overhead and profit share.

Also, it is very common that parties decide the mutual provisions, which allow more cost elasticity in case the cost plunges above or below the set range in the targeted costs then there is no pain or gain to pay.

All contractual arrangements or construction projects cannot apply this approach and an appropriate guidance is required for its application (ideally, prior signing the contract).

### ***Section 5.8- Costs escalation***

Renowned approaches are mostly opted for construction contracts, which can be applicable on monthly basis for work performance assessment. The main date is decided at very early stage (tender stage) and possible alterations are also computed with the help of indices (the last arrangement that was successful in UAE) and base index referencing that is either published or contractual. However, it is essential to note that that all the alterations cannot be accommodated in one variation clause. In case there is the delay that can be attained but the increased cost cannot be recovered then it is validated and is generally added to the contractor's claim for extra payment. Preferably during the project lifecycle, both the parties should estimate the predicted cost escalation with respect to tender curriculum (presuming the curriculum existence) or the project date landmarks in the case of delay. Later, an assessment must be carried out in order to differentiate the actual growth and monthly cost incurred on the work done according to anticipated growth and also the worth of work in relation to the tender curriculum and landmark dates. This approach presumes that the material supply and subcontracts alteration can be done on fixed case, nonetheless, it is essential to assess the paid wage rate at various intervals. It is essential to note that lately, Abu Dhabi authorities have officially launched an enterprise via Abu Dhabi Department of Planning and Economy; it has established price index for material to fight speculation and mitigate the conflicts over costs. The material index has stake up to 90% construction elements, which involves 22

fundamental materials. As this approach provides more project certainty in the industry, it is more likely to be perceived favorably by all the stakeholders.<sup>33</sup>

### ***Section 5.9 - Two stage tendering***

There are two stages in this procurement method; the first involves the partial designing to appoint the contractors following the competitive approach. The contractors rely on the profit and overhead added cost and approximate quantity's introduction. The contractor's suggestion at initial stages helps achieve the credible or possible project factors like completion date, design credibility, structure and endurance.

During this process, employers tend to be acute to amend the work packages prices for concrete and steel reinforcement and MEP in relation to the quality criteria and curriculum.

Less essential packages in the curriculum must be accommodated while construction to enable price flexibility, mainly in case of the strong relationship of the contractor with supplier for roofing material etc.

### ***Section 5.10 - Fluctuations remedy under FIDIC conditions of contract***

Both the 1987 and 1999 FIDIC, contain provisions, which manage the alterations with regard to material, labor cost or other construction material costs. Provisions also serve the cost fluctuations triggered due to local law alteration. Mostly in similar scenarios, engineers look up to their employer and contractor while assessing the cost increase or decrease. After being determined the extra cost is communicated to the contractor and employer by engineers.

There are provisions in the FIDIC contract to serve the other parties in the contract that wish to qualify its standard individually while managing the project fluctuations to support the contractor to reduce the related risks.

Price escalation mechanism is used in few FIDIC contracts in order to modify the cost changes. This price mechanism is equally complex and as it involves the data

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<sup>33</sup> Al Saadoon Omar, "Controlling Construction Costs"

modification. However, this mechanism is more suitable for prolonged projects that are procured on PPP arrangement projects but more likely the employer faces extra cost, wherever this mechanism is opted.

### **Economical trends**

The usage of steel and cement is exceeding its limit which generally goes up to 45% of total construction costs, although it is reported that 13.2 million tons cement is produced every year by UAE alone, steel as a construction material is still rising. Unfortunately the negative image of construction cost is increasing, this is mainly due to certain reasons like shortage of cement supply and shortage of labor which causes the construction project delay, also due to lack of profitability, the small or average range projects are being annulled or negated. The good news is that the UAE government is considering the construction cost speculation as a serious threat, to such extent that in 2015, it signed a contract with cement industry to produce more cement and increase the cap limits. Most likely the Dubai authorities will be under quite a pressure due to the Abu Dhabi's initiative of constructing the material price index, mainly because GCC probable projects that worth around USD\$1 trillion are to be employed in UAE, which is envisioned as the highest number of projects by GCC. Proactive employers are focusing more in the procurement development areas of the project and such employers try to add on board the contractors at the early procurement stages in order to oversee the processes related to supply chain, as most costs are related to it, e.g. long lead items. <sup>34</sup>

### **Final note**

Increasing construction cost is the threat for private and public sectors, both. Private as well as public sectors are looking for administrative and legal solutions to suppress and resolve the rising issues in construction projects.

Recently, in UAE, the negative impact on the construction cost is the debatable decreasing pace of construction projects and the procurement of small and middle range projects.

Reducing the increasing construction cost might not be impossible if all the parties work together but with sustainable transparency from the very early stage of

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<sup>34</sup> Al Saadoon Omar, "Controlling Construction Costs"

procurement and exploit the local authorities provided incentives. Moreover, it is recommended to the employer's team to be more attentive while articulating and drafting the construction cost, cost escalation negotiations, and opting the pain and gain mechanism in contract to make sure that everything concerning the parties is fair and attainable.

However, in the construction industry the future trend shows that it indicates that partnership contracts might somehow replace the FIDIC in the public sector.

## **Chapter 6 - Construction risks in Renewable energy projects**

### **Green developments in the Middle East**

Several Gulf countries have announced the principles and instructions for the green building to manage the structure and functions of the newly constructed buildings. As Dubai Government's investment arm, Dubai World has embraced the US LEED Green Building Certification structure as an obligation for all types of developments.

Furthermore, Emirates Green Building Council is about to develop a particular LEED type for UAE for future developments. On the positive side other countries like Bahrain, Qatar, and Oman are also stirring towards standards of green building.

After Middle East's initiative of environmental strategies and regulations, a number of international organizations are opting for green initiatives in the region. For instance, in UAE, Grand Hyatt and HSBC have implemented the green initiatives. Other organizations like TECOM Investments and Zabeel Properties are following their footsteps, so are the other domestic and international that is more likely to trail in near future.

As Arabian Peninsula desert climate is harsh, taking green initiatives in the Middle East is been questioned by several experts, however, there is significant growth in investment for the region. As presently there is a city constructed in Abu Dhabi named Masdar City that is the first zero-waste and carbon neutral city in the world by

utilizing only green or related energies to construct the buildings and also during the complete infrastructure. <sup>35</sup>

### **New green buildings, but what about the old ones?**

Construction in Middle Eastern countries is moving towards green buildings as a government initiative towards preserving energy, but also its worth to mention that transforming the old buildings into new green technology is quite challenging. Whilst, the ideal organizations like New York's Empire State Building are going green, it is a challenge for the Middle East, it is to see if it will take the challenge to transform its old building like empire state, to a greener, hygienic and fresh building. However, the installation of efficient and renewable technologies to transform new buildings will increase the expenditure as well as the challenges to operate the technical operations, though the potential reward will outweigh the technology expense.

Presently the owners and developers in the economic environment are grasping the advantage that green buildings are good investments. Mostly it is supposed that there is significantly high value associated with the green buildings as these are less costly and the maintenance is pretty efficient. Moreover, in favor of owner, there will be more occupancy.<sup>36</sup>

The fact is: Due to increasing demand in both, private and public sectors of Middle Eastern countries for green building, there is a lot of pressure on owners and landlords to sell and lease the properties following green approach.

### **Impact on businesses**

These green initiatives are very beneficial for businesses in the region to sell products for green buildings, consultancy services, and technologies. For instance, the Masdar City offers the businesses and green technology companies a well-advanced platform

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<sup>35</sup> Frank Beckers, Nicola Chiara ,Adam Flesch, Jiri Maly,Eber Silva and Uwe Stegemann, *A risk-management approach to a successful infrastructure project*

<sup>36</sup> the Economist Intelligence Unit , "Managing the risk in renewable energy"

for their products and expertise in the region to sell the green energy idea. It also supports the brand and corporate image of existing businesses to improve and adopt the new green initiative. For instance, the building owners in UAE are encrusting Estidama (designing structure for sustainability) in Abu Dhabi and progression legislation is compulsory in Dubai, which implies that going green will soon be the crucial business strategy. Moreover, several Middle Eastern countries employers for health and safety concerns to make sure risk free and safe working environment for their employees is provided. Numerous big organizations are also asking for green building offices for commercial purpose, and it is believed that greenery increases the productivity level of employees too. It is also more likely to reduce the legal obligations of the employers in case of health problems caused due to buildings.

### ***Section 6.1 - Avoiding Legal Risks***

Green buildings face countless legal obligations in order to flourish in healthy environment, such as:

- Acquiring appropriate local building permits;
- Retain the green building enhancement among tenants and landlords;
- Safe financing
- Negotiating the insurance and financial clauses.
- Sort all the issues that are being obstacles while attaining the energy conservation objective.

All these challenges can be dealt with by seeking the legal guidance at the beginning of the building project. For instance, the contractor, developer, and architecture must allocate the responsibilities while signing the contract in order to

achieve the certification, also landlords should add the clauses in leasing contract for tenants to maintain the greenery and each must do their part for the sustainability.<sup>37</sup>

If not dealt appropriately, these issues can lead to prolonged and costly legal proceedings. As a consequence, Real Estate Regulatory Agency (RERA) as a regulatory authority in Dubai monitors the growing breach of contracts with regard to Green Environment. Regardless of all the potential advantages, real estate markets are blending the green building approach, mainly due to not having enough information on the approach, how essential this approach is for the energy saving and environmental sustainability. Moreover, Due to unstable economic conditions, people in the industry – some developers and tenants are ignoring are the approach, as it will be an added expense.

Regardless of the apparent challenges, Green building approach in the Middle East has a promising future. As the growing economy will present the new opportunities to elicit the new green technology market and perhaps stimulate few additional green buildings in the region.

Below are examples of green energy applications around the world:

### ***Section 6.2 - Sener Project (Spain)***

SENER's star project was the Gemasolar Solar plant, after an extensive research and development on solar technology and it was Almeria Solar Platform (or PSA, its Spanish acronym) former experiment, SENER decided to make a challenging commercial plan in 2009 that would encompass a breakthrough feature. With association with Torresol energy, SENER possessed 60% of the project; project finance prototype was used for the funding of the project. Procurement and Construction Division (DPC) of SENER were accountable for constructing the turkey

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<sup>37</sup> the Economist Intelligence Unit , "Managing the risk in renewable energy"

of this exclusive plant, as this project is the unique and foremost with regard to its technology.<sup>38</sup>

### **A construction project that served as a model for innovation**

SENER team was aware from the beginning that it is only one among its kind yet and attentive about their responsibilities for constructing the plant. The acquired experience in order to develop a breakthrough technology, like Zabalgarbi plant depicted the potential impact of Gemasolar may have globally, in sectors and in societies as the whole. In the beginning, the same standards of distinction were maintained by DPC as were decided in its conception.

José Olaso, explained the *challenge of Gemasolar*, earlier he was the project manager and presently he is the DPC, general manager. Olaso explained that Because of the pioneering technological elements, the new scenario was tremendously demanding, as they were to develop, purchase, form, direct and start, and optimize in very short period of time and with the fixed budget. The thing is it is nothing like developing or designing the one heliostat and testing it on a pilot plant, it is to incorporate 2,650 different heliostats with an exclusively new feature and also incorporate the aerospace application with very high accuracy motor system, moreover all on time and within the budget. SENER needed to successfully build, direct and operate all the systems for Gemasolar and the features that were exclusive, never used before for a solar plant, moreover, the system must guarantee the 25 years of the durability of the plant and at the very modest price possible. SENER designed the heliostat and almost its everything, including the panels, mirror attaching system, its mortar system, piling of heliostat, directing it to the receiver in a tough territory according to the rigidity requirements, building 80km or more internal roads at lowest cost; installing the salt pumping system towards the receiver, which initially transferred molten salt 140 m

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<sup>38</sup> SENER, "Sener" (Gemasolar plant, pioneer also in its construction ~ Noticias SENER)

high and it was cooperatively planned by the suppliers and the SENER; the train that generates steam, exceptional for its resources, the thermal slopes that it uses to work, the conditions and liquids involved in the process, tank to heat the molten salt at 565 °C temperature that also without any precedence; the control system of solar field that permitted every heliostat to travel independently but with regard to the radiations and the need of the production, wholly designed by SENER; the internal association of the tower and its cloistered external lining; as its design, manufacturing, integration and SENER-patented receiver installation which required the aerospace technology; and lastly the security procedures required for the project of this magnitude. all beneath the vigilance of this attentive world: the project was thoroughly followed by the solar thermal industry, similarly by the politicians around the world and the worldwide media of course, as they visited the construction site regularly in order to achieve the first hand information regarding its progress. SENER even focused on the plant's aesthetics, it worked on the design and construction in association with the company's architects, who helped design the core elements like the towers shape and other visual essentials. The opted tower shape was cylindrical, which was meek and less costly, as it got the more votes due to varying diameters. Moreover, for components of the plant, précised color palette was chosen. The company ensured that quality and aesthetic of the volumes, appearance and the design of the building is with regard to the particular criteria. Criteria that will distinguish the plant afterward. Gemasolar project was an accomplishment with regard to construction, design, direction and commercial operations, as it received a number of awards and credits since the Inauguration. Moreover, it has stimulated its importance across the world, everybody including the schools, technological institutes, politicians, artists and various brands are interested in it. Numerous companies are trying to develop a plant with similar central tower design and systems, since its inauguration in the year 2011, however, no one has succeeded as yet.<sup>39</sup>

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<sup>39</sup> SENER, "Sener" (Gemasolar plant, pioneer also in its construction ~ Noticias SENER)

## **Innovation management in the construction industry**

SENER's responsibility in the construction project management included fundamental tasks of the project, such as procurement of material and equipment, subcontract for installing the mechanical and electrical equipment, also civil engineering and more, inclusive of the faculty start up. Coordination and monitoring of all these tasks in order to ensure project's accomplishment with safety, excellence and attain the promised value within budget and on time. These tasks of management are related to organization's R&D&i processes:<sup>40</sup>

- **Innovation** entails the knowledge, which helps to choose the most suitable method for the present market and implementing it on the projects individually.
- **Development** is basically the management capability enhancement in a construction project, which optimizes safety, excellence, and revenues. These principles are decoded into the company specific methods and strategies. Promptly, in innovative projects SENER is known to develop the regulatory and constructive processes, just like heliostats assembly line at Gemasolar and the critical executions for regulating the risk in the Earth Pressure Balance Shield Tunnel Boring Machines operations.
- **Research** is the basic need, which helps to identify the finest suppliers or subcontractors for different products or projects in different countries. It also escorts the engineering facility when it requires the information on its procurement, building or start up extent.

## **People Training**

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<sup>40</sup> SENER, "Sener" (Gemasolar plant, pioneer also in its construction ~ Noticias SENER)

DPC knows the worth of construction techniques theoretical and applied information and also the importance of training the teams. Except for the précised courses, the additional learning comes from on the job knowledgeable engineers, who tend to train the less knowledgeable or new team members.

Moreover, the training opportunity that SENER provides while construction is like no one else, as it trains throughout the project, where designs become the reality and it is where the knowledgeable engineers show their credibility by transforming their experience into solid results.

### ***Section 6.3- A Building Site 20km out To Sea (UK)***

Building a wind farm offshore is a very big challenge, and London array is no different. Moreover, the farness from the shore, the height of the wind and irregular sea conditions makes the construction process very tough to execute. The foremost 177 foundations were installed in March 2011 along with the advanced technology and equipment in order to assure project safety and quick turbine installation in the year 2012. The hype of the project is that it had 1000 people and 60 containers to work on the project, in total the London array project consumed 5.5 m hours to complete.<sup>41</sup>

#### **The Key Components Of The Offshore Wind Farm Are<sup>42</sup>:**

- The basics to protect the wind turbines at the bottom of the sea.
- The wind turbines
- In order to attach the set of turbines together and with the foreign substations the array cables were needed.

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<sup>41</sup> "Offshore Construction" (London Array)

<sup>42</sup> "Offshore Construction" (London Array)

- Before sending to shore, the offshore substation increases the voltage of electricity.
- The external cables beneath the sea linking all the substations, offshore and onshore.
- The construction of offshore activities was monitored by a provisional construction base at Ramsgate's port. Almost 120 staff operated by it till today.

### **Laying the foundation**

London array was obligatory to be created for one hundred and seventy-seven monopile grounds individually. Among which two were for offshore substations and other 175 were for the turbines, every base required an individual design stipulation that only relies on the position on the site. Monopile grounds are basically long rod-shaped tubes made of steel, which is nailed under the seabed. The height of each tube is 68m long and 5.7m wide and it weighs almost 650 tons. An evolution piece, which is almost 28m long and weighs up to 245 to 345 tons, was attached on the highest pile. Ladder and platforms are placed and painted yellow in order to maintain the access and visibility. The depth of water ranged from the littoral to 25m, the bi purpose constructed vessels were utilized in order to install the ground: underwater MPI Adventure was used, where the sea workers coated the lower areas. The four enlargeable legs elevate the deck's legs out of the water in order to develop an even platform to nail the piles in. another vessel to connect the numerous small grounds in a very complex site, its name was HLV Svanen vessel. Normally it takes one or two days to connect/install each grounds, while work was done between 2011 march to 2012 October. <sup>43</sup>

### **Installing the turbines**

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<sup>43</sup> "Offshore Construction" (London Array)

The turbines transported from Esbjerg in Denmark to the United Kingdom by barge were Siemens Wind Power's manufacturing. The vessels used to install the grounds were again used to elevate the turbines individually at their positions. If the turbine was attached to the evolution piece, the nacelle and hub can be installed. One of the core housing key components is the nacelle, like gearbox, panels, and generator. At last, in total three turbine blades were equestrian in the horizontal position and each at a time in the middle/hub, while each turbine weighed about 480 tons. In order to alert the ships and aircraft passing on few turbines to install the marking and navigation lights. To help save the minor boats, the slope of every turbine blade is supposed to be 22m over the highest sea level at the tallest tide, also at the bottom position. To assemble the power from the set of wind turbines prior making it essential for export cables at two offshore substations. Fabricom, Lemants and Geosea's joint venture named Future energy, designed, constructed and connected the cables using Siemens Transmission and Distribution Ltd electrical equipment. A professional floating crane named Rambiz elevated the substations into its place after their assembly on shore and transfer by boat at site. Array cables were used to link the turbines to one and other and also the foreign substations. Almost 650m to 3200m long and 200km array cables were used to specify the ROV (remotely operated vehicles) and vessels. The robot under the sea was monitored by an umbilical connection from the shore. <sup>44</sup>

### **Export Cables**

The export cables are linked by four offshore and onshore cables. Which were concealed in drains or troughs at the bottom of the sea by using the professional like barge and plough, Stemat Spirit for installing cables.

The export cables, about 220km, were used to install each of the four cables, which were almost 50km in length.

The swale's littoral zone to install every export cable begun. Because of it being the most crowded place for marine and transport purpose, we operated in the area with

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<sup>44</sup> "Offshore Construction" (London Array)

the help of the local community and sea operators to decrease the disturbance while executing the planned activities. Before installing the export cables, the debris routes needed to be cleared. In order to achieve that, a vessel was used to drag the grapnel hook or the modified anchor beside the seabed.

### **Cable installation sequence**

The CLV (cable laying vessel) was fixed in the Swale, about 1.5-1.8km offshore. At the onshore substation site, a crank was installed in order to pull the wire from CLV, while under the sea wall, the ductwork was installed. A buoyancy system was used to float the cables above the mudflats. Troughs were dug to use the amphibious excavators in the mudflats. Internally the cables were placed and backed by a minor vessel with the help of a displacement burial instrument. About 2.5km cables were used at offshore substations and at the same time burying the cables by positioning the plough at the bottom of sea.

### **Connecting the export cables**

At Cleve Hill, the onshore substation and export cables were connected through piercing of seawall. It was called as the most modest cable installing method. However, the Horizontal Directional Drilling (HDD) tubes were obligatory, thus it required an onsite professional plant or machinery that permits the continuation of work. Holes were drilled, then installed ducking for cables and at last shut the holes till we were prepared to tweak each cable out. For the record, it was the end of 2011 when the installation of the first export cable took place and then second in the beginning of 2012 and other two were also installed in the same year. The vessels that were exported and installed the base, turbines, and substations and even for London array cabling were a collection of professional vessels. Construction teams offshore who were on site during wind farm construction, some of these vessels were used in order to accommodate those. The Stemat Spirit was launched in 2010 march and instantly the export cables were installed at the wind farm. The Stemat Spirit was constructed by the Stemat, a chief company who offers maritime services. Whereas the spirit is a unique DP2 workboat service which has the capability to lodge 60 crew

and its speed is approximately 10 knots. To place the array cables at wind farm that opted for ROV (remotely operated vehicles) and other various vessels.<sup>45</sup>

The above were examples of successful execution of mega projects in the renewable energy construction sector, where risks were identified and addressed in the right manner and proper strategy to control such risks was implemented.

## Chapter 7 - Construction risks in nuclear projects

### ***Section 7.1 - Identification of General Risks***

The general risks are those, which are mutual among most of projects and also with the AP1000 power plant. For example, the defect safety feature in a project is also a general risk. Based on interviews conducted in China present in the paper “Managing construction risks of AP1000 nuclear power plants in China” for this project, Following are the general risks recorded in AP1000 project<sup>4647</sup>:

**Safety:** A very essential characteristic to accomplish a project within time. As an accident impacts the injured person and company expense equally, if any safety problem is not dealt with time it will impact very badly the project progress. For instance: the effect on the project performance can be mitigated if the company replaces the worker that got hurt during an accident. Nonetheless, in such situations, if these accidents are not dealt with timely by the project manager then it may also affect the other workers on the team emotionally. The lack of assurance among other members may affect the project performance and be an interruption for the project.

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<sup>45</sup> “Offshore Construction” (London Array)

<sup>46</sup> Wang S, Wahab MIM and Fang L, “Managing construction risks of AP1000 nuclear power plants in China”

<sup>47</sup> “Construction Risk In New Nuclear Power Projects | Nuclear Power”. *Scribd*.

**The complexity of the project:** Because of the AP1000 project construction complexity, there are numerous parties working together on the project like many suppliers, contractors, and external agencies. The increase in a number of parties likely increases the number of disputes. Thus, it becomes very problematic to resolve such unexpected issues among the different groups on the project and it increases the likelihood of risk due to disputes. For instance, a meeting is called to discuss the chances of substituting a particular sort of material in order to cover the equipment. Suppose there are only two teams, designers, and suppliers to discuss the issue, then it's more likely to be a technical issue that can be dealt without any serious conflict. If there is a third party like a representative of the owner in the meeting, then it will be slightly problematic issue to resolve, as it may involve the cost factor of the substituting material. Similarly, if another representative from Construction Company joins the meeting, then the complexity level will raise little more, as it may delay the material substitution process.

**General risks** because of: security, complex structure of the project, conditions of the site, inadequate resources and task completion delay. <sup>48</sup>

- Unique risks due to :
  - Technical risks: modularity of the project, lack of professionals, conflict between partners, inadequate operational skills and associated operations and time period.
  - Political risks: equipment procurement policy, technology importation and adaptation policy, and project execution policy.
  - Administrative risks: Strategies of various operations, strategy for bidding, risk managing attitude, and management consultants.

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<sup>48</sup> World nuclear association , “ Structuring Nuclear Projects for Success”

- Discrete Personnel risks: covering the new design, manual error, impact of political and cultural factors, and customary relations.
- Worksite conditions: it is very unlikely to estimate the practical worksite situations beforehand. As the AP1000 nuclear power plants have been introduced recently and there is no record to refer to. Thus, there is more probability of facing unpredictable issues that will just occur, along with the need to resolve those within the construction project. For instance, the definite cumulative tolerance system strays from its set settings during the building construction; the alteration can be done in order to accommodate the variant. For example, while the construction of the AP1000's containment vessel when the real cumulative tolerance system strays from its set settings, the alteration in order to fix the variant were not easy due to the modular structure of the technology, which led to the project completion delay.<sup>49</sup>
- Limited resources: there is three-year time constraint to complete the project by the contractors, whereas there are numerous potential challenges on the way due to increasing Chinese economy. In short, the contractors are supposed to complete the project on time while fulfilling all the necessary requirements for the construction of AP1000 nuclear power plant and also managing the other projects that they have started to exploit china's booming economy. The AP1000 plant is dependent on the advanced modular techniques of construction in order to decrease the project period to three years, in case any contractor is unable to commence the promised obligation of the project by reforming the scarce resources, then there is a threat of not accomplishing the project on time. Only two construction companies have reformed their resources yet, in order to be part of construction for Chinese nuclear power plant, and more companies will join in soon after reforming.
- Delay in the Task Completion: in the construction of AP1000 nuclear power

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<sup>49</sup> Wang S, Wahab MIM and Fang L, "Managing construction risks of AP1000 nuclear power plants in China"

plant, various components need to be constructed in factories. An essential factor of modularity in the construction of various components is in correspondence, in order to decrease the project completion period. If in any case, any component fails to satisfy the requirements or delay, it will increase the risk. For Instance, in AP1000 project of nuclear power plant, containment vessel's construction, and CA20 component, building construction and equipment installation takes place at a time. Thus, there will be the effect on overall project duration in case of delay in any project component.<sup>50</sup>

### **Proposed Risk Management Strategies for General Risks:**

- **Acceptance Strategy:** in this strategy, the risks are acknowledged by the company during undertaking a component of a project. However, acceptance does not imply that no actions to be taken for the risks. This infers to record the risk for future and supervising the risk throughout. If the circumstances linked with the risk change, the possibility of its influence and occurrence will also change. In this scenario, reliance on the probability and influence status, the equivalent management must be employed. For instance, flood at the impermanent warehouse at the site of the project may be risky and the project equipment may also get damaged due to the flood. But it is also very expensive if any effective measures used to prevent the risk. As the probability of the flood is very low and implementing the risk mitigation measures is not essential. Thus, the risk is considered as the best alternative. Though, the risk management must be attentive and take the necessary measures if the weather forecast reports the probability of heavy rainfall.
- **Minimization Strategy:** the company uses this strategy in order to minimize the risk, usually when the chances of happening an event are average and the effect is low. In case 4, regardless of risk effect being low, its normal occurrence on average might trigger complications for project development.

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<sup>50</sup> Wang S, Wahab MIM and Fang L, "Managing construction risks of AP1000 nuclear power plants in China"

Meetings should be held frequently so that all the parties discuss the conditions and development of the project and decrease the potential risk. Frequent meetings, tend to help take right actions and also suggests the best alternative to mitigate risk.<sup>51</sup>

- **Insurance Strategy:** a strategy which helps reallocate the potential risk to the insurance company, while taking the partial responsibility of the project. In case 3, it is more likely to be a catastrophic result due to the high effect and low chances of occurrence, which both, the company and project will endure. In such cases, it is recommended to opt for an insurance strategy to lessen the risk. For instance, it is very common for project equipment to get damaged while being exported to the site. The insurance can help save the cost of expensive equipment, if damaged.<sup>52</sup>
- **Transfer Strategy:** in this strategy, company transfer the expected risk to the third party by outsourcing some or one project operation to a subcontractor. However the risk sustains, but it shifts to the subcontractor who undertakes the particular operation responsibility. Furthermore, a company can enhance its performance by outsourcing or subcontracting the risk for resolving it. Whenever there is more probability of risk occurrence along with less effect, it is wise to on board a subcontractor to mitigate the risk. For instance, the construction of AP1000 nuclear power plant requires various component formations and the entire project plan will get to attain the equivalent construction benefit. The construction company that relies on the available equipment and technology, it must choose, either to construct the components in-house or outsource to the subcontractor.
- **Contingency Strategy:** this strategy acknowledges the potential risk and develops an equivalent contingency plan simultaneously. Whenever there is a chance of an event that may increase the risk, a contingency plan is used to

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<sup>51</sup> World nuclear association , “ Structuring Nuclear Projects for Success”

<sup>52</sup> Bunni, Nael G. *Risk And Insurance In Construction*

decrease the effect. The contingency strategy generally comprises of three sections: first is the emergency response, second is recovery and last is recommencement. It is suggested to use the contingency strategy in case 6 and 8. For Instance, assessing the equipment using a water cooling structure in order to avoid the risk due to water leakage. Also, a company must design a strategy to combat any mechanical or electrical risk they may arise because of unannounced water leakage.

- In case of the constant risks, the risks must be supervised thoroughly by the project management team to ensure it's manageable. And in case of inconstant risks, the management team must design various strategies with regard to its changing nature to manage risk.<sup>53</sup>
- **Abandonment Strategy:** it is the strategy where the company leaves the project. Though no organization likes to opt for abandonment strategy but at times it becomes an essential step for an organization to take. Mainly, one should evaluate all the existing resources thoroughly and the course of company development in the future. Then, predict the likelihood of project accomplishment, if the company opts for AP1000 nuclear power plant construction. It is very significant that any project that has a higher probability of risk and the effect of risk is also high, then such projects must not proceed. For instances, a company plans to build a nuclear power plant but not does have adequate resources, experts or the manpower to construct it, and it chooses AP1000 nuclear power as a project, then it is more likely to fail and the owner and partners to bear loss.

## ***Section 7.2 - Unique Risks***

Risk, only observed while constructing the AP1000 nuclear power plant are referred as the unique risks. For instance, AP1000 nuclear power plant implements the Top-

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<sup>53</sup> E. Gould, Nancy E. Joyce , *Construction project management*

open method of construction, which hardly any other project has implemented. In this construction method, equipment installation and building construction is done simultaneously. However, these two operations are usually never done at a time in other projects. Due to the different methods of construction and increased complexity of the AP1000 project, the construction risk is higher more than any other projects. In this part, the unique risk associated with the AP1000 nuclear power plant is been recognized and characterized in 4 groups: technical, political, administrative, and individual personnel<sup>54</sup>

➤ Technological Risks

There are many new technologies that AP1000 nuclear power plant uses. Thus, there are more chances of the issues in the construction due to numerous technology usage. For instance, AP1000 nuclear power plant in order to shorten the project duration period, it uses top-ten construction methods and also employs the modularization strategies. Despite the fact that these techniques reduce the amount of time and labor on site, the goal of shortened project duration may not be achieved unless the Chinese firms master these new technologies.

**Monitoring General Risks:**

While constructing the AP1000 nuclear power plant, it is possible that applying a risk management strategy may dissolve some risks. The level of risk remains constant in some projects while it varies with the nature of the project in few. The goal to complete the project on time and also reducing the labor on site cannot be achieved unless the Chinese market implements the new management technologies. Following risks are identified after accumulating the opinions about new technologies:

**Modularization:** it decreases the number of operations on site. Modularization shifts few operations to manufacturing phase, in factory, all the components are covered. Thus, it is recommended to launch a list of operations that must be followed on site

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<sup>54</sup> Wang S, Wahab MIM and Fang L, "Managing construction risks of AP1000 nuclear power plants in China"

and the operation that must be achieved in the manufacturing phase. However, it is not possible to correctly classify the operations in two categories before designing and its conformance. Thus, it is more likely to trigger the risks if construction is started before design conformance.

**Inadequate experienced experts:** Numerous new technologies used while constructing the AP1000 nuclear power plant demand adequately experienced experts in many areas Such as information technology, construction methods, construction aids and others. Chinese companies mostly face these risks because of inadequately skilled professionals.

**Disagreement between external and internal partners:** Growing uncertainty in AP1000 construction project, due to the employing new technologies may also trigger the disagreement between the internal and external participating companies. Since these disputes are very basic risks that a project faces, thus it is very vital to resolve these at an early stage.

**Inadequate Operational Skills:** there is need of proficient operators in order to mitigate the errors while using the new technologies for AP1000. For instance, reactor safety in AP1000 nuclear power plant is one of the core features. This safety feature is included in order to mitigate the operational human errors. Nonetheless, there is no firsthand experience of operating this technology in china. Thus, all the organizations that have opted for it to use in the AP1000 plant, need the adequate information to operate it. Hence, not having adequate operational skills is considered risky.<sup>55</sup>

**Associated Operations versus Period:** project period gets affected directly by numerous factors like construction procedure and other related operations to the project. The AP1000 nuclear power plant associated operations contain, précised-training programs, allocation of definite material and equipment required, reactor vessel procurement and vapor generator that have a very long lead-time for

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<sup>55</sup> Wang S, Wahab MIM and Fang L, "Managing construction risks of AP1000 nuclear power plants in China"

procurement. Although it is very challenging to actively start these associated operations, because of not having enough experience to construct the AP1000 nuclear power plant. That is why there is a risk of not accomplishing the project on promised time.

### ***Section 7.3 - Political Risk***

Technology in china is initiated by a very high tech project, which is the AP1000 nuclear power plant. Thus, any modification in the transportation policies of import and export may have the major effect on project performance. For instance, important resources or equipment delay can postpone the entire project. Following risks are identified after gathering the opinions regarding the political risk factors affecting the AP1000 nuclear power plant construction via interviews:

**Equipment procurement:** The model reactor cast for the foremost nuclear power plant –AP1000 in china was world’s first ever reactor prototype design. Therefore, it is very likely to face unanticipated risks because of the reactor. In order to mitigate these risks, only one report should be transported in the beginning by SNPTC. In real, SNPTC transports for reactors at a time. Thus, an expected cost is considered as expected risk.

**Technology Importation and Adaptation:** Government in China has planned to utilize the new designs and technologies used in AP1000 to modify its personal huge size nuclear power plants such as Xiaoliang 2007 and Zhang 2007a. As per the contract between SNPTC and Westinghouse, designers in china will design the detailed structure (Zhang 2007b), whereas Westinghouse will be responsible for providing the universal blueprint. Since this process offers the learning opportunity for designers in china, so they can add this learned experience to develop china’s personal huge size nuclear power plants in the future. Nevertheless, this process will also signify the associated risks like vague work scope, insufficient specifications, document disputes and regular alterations.<sup>56</sup>

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<sup>56</sup> Wang S, Wahab MIM and Fang L, “Managing construction risks of AP1000 nuclear power plants in China”

**Project Execution:** Because of the high tech nature and model of the project, thus, designers in china require extra time to fetch information and experience in order to structure the nuclear power plant. This causes complications for the present requirements while completing the project within three years' time period. Thus, designers do not have more time to structure and communicate the plant, because the project is supposed to be implemented with respect to government's provided schedule. It is likely to increase the cost of design amendments and the possibility of project delay also increases.

### ***Section 7.4- Organizational Risks***

As the AP1000 nuclear power plant is a very complex and big project, it involves many stakeholders and shareholders. It is also very likely that the conflicts among them will increase while working together because of their diverse working methods and internal philosophies. Moreover, if any company with the unsuitable set of skills for project may be the reason of project failure. Following risks are the possible organizational issue that may occur during AP1000 nuclear power plant construction:

**Operations strategy:** the opted organizational strategy while constructing the AP1000 nuclear power plant should be flexible enough to comply the project requirements. A company who wants to contribute in construction of AP1000 nuclear power plant must have an ability to feasibly make amendments in the operational strategy. For instance, the nuclear plant AP1000 design demands the top-open construction. Thus, an organization interested in being the part of AP1000 must modify its operations in order to meet the demand. Moreover, it has not been employed in china before, which is why the modification is very essential.

**Bidding Strategy:** in Chinese construction industry, constructing the AP1000 is a very competitive development. However, few construction companies who are contributing to the project do not have enough information or expertise for constructing AP1000 nuclear power plant. Due to increasing demand of contributing in the AP1000 project, it is likely that few companies may use false means to be its

part, thus there is more risk for these companies. For instance, there is no operative method for the AP1000 project owner to analyze the bidder, few companies can provide false data to contribute to the project regardless of the scarce resources. Eventually, the project will fail.

**Risk Managing Attitude:** there are few companies well known for their problem-solving ability but unfortunately they are reluctant to modify their management strategies. However, it is valuable to plan the risk management procedures or strategies, but these companies are normally habitual of resolving the issues when it inclining. Companies with such tendentious nature are more likely to be the reason of project failure, due to not proactively dealing with these risks.

**Management Consultant:** few managers avoid considering the employee contribution or input while designing the goal. Rather, they set the expectation bar very high all by themselves. For instance, a task that requires 32 months to complete but the manager expects an employee to complete it within 22 months, this goal setting will decrease the chances of project accomplishment. Such higher expectations of the project manager do not consider the opinion or input of employees.

**Individual Personnel Risks:** this nuclear plant construction requires personnel with the variety of skill and from various fields. The risks below are recognized in relation to individual personnel risk.

**Human Error:** it is standard the most frequent and dynamic source of risk is human beings. Practically speaking, most of the project fiascos lead to manual errors caused due to humans. As AP1000 is an International project, it has contributing people from around the world with diverse backgrounds to work with each other. These people come from various cultural upbringings, with different approaches, work practices, and morale. Thus, it is more likely that there will be conflicts and disagreement while working together that may impact the project performance badly.

**Concealing new design:** designers in china are reluctant to share their responsibilities with other countries to design the AP1000 nuclear power plant. That is why Chinese designers will make sure that they deliver the comprehensive and feasible design. Eventually, another design may from outside come up, which increase the cost, obstacles and disagreement between designers, contractors, and owners. Which may trigger multiple task delay.

**Cultural and political influence:** in case a manager is unable to accomplish the project on short period of time, it is more likely that company will substitute the manager due to political or cultural pressure. Hence, when multiple managers are given responsibility to manage the project, the one who brings along fresh strategies and procedures is the one that impacts the project performance.

**Cultural relationships:** the East Asian people encourage the cultural or habitual relationships within workplaces. However, this becomes an obstacle while identifying the risk origin. For instance, in case one participant does not play its part and other are reluctant to unveil it to the management, then it will cause a risk within project.

### **Projected Risk Management Strategies for Unique Risks**

Only identifying the unique risk is not enough, it is essential to project an effective strategy in order to manage the unique risks. To deal with the unique risks effectively, expected risks are mentioned under every category of unique risks recognized in table 7. An experimental project can be referred in order to gather the data and develop the suitable strategies of risk management in order to apply for the full range program in near future (Turner 2005). The core objective of this strategy is to recognize and present the risk management strategies, so the organizations contributing to the AP100 nuclear power plant's experiment project can take the foremost steps during the construction process in order to control risks. There are various unique risks as discussed in this research, such as the inadequate professionals, scarce resources, and lack of personnel in AP1000 project. Several strategies for big projects risk management have been recognized in the literature (e.g., Flyvbjerg et al. 2003). According to the interviews, literature and knowledge collected from numerous

projects by one of the writers, the strategies illustrated in the table 7 are described below.<sup>57</sup>

**Research strategy:** the organized collection, recording and examining of risk associated data is known as research strategy. There are various technical associated risk, because of the high-tech project. Unavailability of sufficient information on the project is the reason for many problems, if only more knowledge could be collected prior executing, many problems would have effectively resolved. Moreover, in case of inevitable problems, alternative solutions can be found by researching. For instance, whenever a problem arises, firstly, it is divided into subsections. For every subsection, the acquainted and unacquainted issues are identified by the team and in the end, each unacquainted issues is rectified in order to resolve it effectively. Even though, Research has the aptitude to resolve the problems associated with the latest technologies and advanced processes used. Breaking the norms and coming up with the new aids is human being's innate nature. Learning new technologies and aids may be the interest of few team participants on the project and thus they will contribute in exploring the new skills.

**Negotiation Strategy:** the most usual reason of risk management failure is the poor understanding. That is why interpersonal understanding can be improved by communication that increases the likelihood of project success. An essential communication technique is negotiation, thus most companies interested in a project possess it. It can be used for multiple objectives such as fixing the relationships among team participants to end the conflicts and resolve the issues in order to escape failure. Therefore, the risk triggered due to the cultural or political factors can be extraordinarily resolved using negotiation strategy. A better alternative can be recognized through negotiation in the earlier stages of the project to onboard the appropriate team for project accomplishment.

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<sup>57</sup> Wang S, Wahab MIM and Fang L, "Managing construction risks of AP1000 nuclear power plants in China"

**Monitoring Strategy:** Risk monitoring is very essential to evaluate the collected information and to take an effective and appropriate decision. While in earlier stages of project, the risk monitoring scheme is installed to alert the teams beforehand, so they do not face any catastrophic situation. For instance, few risks have little probability of occurring but have higher effect on the project. Moreover, latest and efficient monitoring scheme also impact.

1. Probable effect of risk on the project
2. the likelihood of risk arising
3. Fetching the information on time in order to appropriate action to combat the risk.

**Controlling Strategy:** Company in a steady environment with an effective strategy to control internal factors has usually very little risk exposure than a company with an ineffective strategy to control internal factors. An effective project accomplishment plan is the chief controlling strategy that mitigates the numerous project related issues. Additionally, the controlling strategies should only be applied to reduce the risk that has been recognized with respect to present evaluation and controlling of expected risks, also the contingency plan schedule. The likelihood of risk arising and the probability of accomplishing a successful project can be attained by an effective plan. Thus, the main concern of all team members is to outline the project operations, listing the associated operations and project planning. Recently, the strategy of work breakdown is opted by most of the teams to design the comprehensive project plan. The project could apply the controlling strategy to mitigate the expected risks.

## **Chapter 8 - Conclusion**

As discussed and observed, Construction risks are considered as a challenge in almost all energy projects whether projects were in the oil and gas, nuclear or renewable energy sectors. Such risks can delay a project and in some occasions it can even stop it. Dealing with such risks is becoming more and more crucial in the construction industry. During the research of paper as observed and analyzed thoroughly, Risks

can be very similar between energy projects and at the same time they can be unique specific for a single industry as well. Construction risks varies in nature and complexity as seen in energy projects , the way to handle risks is also different from one project to another.

Different systems and guidelines are being used in those projects to identify, list , control and eliminate construction risks. It is always beneficial for companies and organizations working in such fields to overlook risks from a high level aspect , understanding the risks and trying to implement successful experiences in managing construction risks. Systems are being developed every day in such industry and the success of any construction project lies in maintaining and controlling its risks.

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