

The Gulf of Mexico Oil Spill and Response: A Case Study on Project Failure and Success

The Gulf of Mexico oil spill and response was the headline story of the summer 2010 and was the biggest oil spill in US history [1]. The equivalent of 4 to 5 million barrels of oil were estimated to have flowed from the Macondo well in the weeks after the 20th of April when the drilling rig, Deepwater Horizon, exploded and sank claiming the lives of 11 rig workers, to the 15th of July when the well was successfully capped. And in actual fact the Macondo well was only declared completely shut in with the successful completion of well kill operations on the 19th of September, 5 months after the disaster [1, 2].

The Aim of this case study is to present the reader with an example of two projects. One in where a catalogue of errors and failings by project managers led to one of most talked about catastrophes in recent history. The other, demonstrating how a project involving large numbers of people and equipment is successfully managed to achieve its goal. It will outline the events leading up to the oil spill, focusing on the key findings of the BP investigation and, will give an overview of the response effort. A comparison will then be drawn with reference to the Iron triangle of project management, showing why one project failed and the other succeeded.

What Happened?

The Macondo well is situated in the Mississippi Canyon Block 252, just off the coast of Louisiana in the Gulf of Mexico. BP was the majority owner of the Macondo well and also owned the lease to drill for oil in the Macondo area. Deepwater Horizon was a deep water drilling rig owned by Transocean, who were contracted by BP to complete operations on the exploration well to prove that oil was present in rock beneath the sea bed. Deepwater Horizon construction was completed in 2001 and was designed to be capable of drilling in water depths up to 10,000ft. The Deepwater Horizon arrived on the Macondo well site in January 2010 completing drilling procedures successfully, reaching a total depth of over 18,000ft.



Deepwater Horizon Drilling Rig Courtesy of providingnews.com 9/11/10

On the afternoon of the 19th April the crew of Deepwater Horizon started its procedure of sealing in the well after completing drilling operations. This involved the pumping of cement down into the well through the *Blowout Preventer* or *BOP* (for all words in italics please see glossary of terms at end

of study) to the bottom of the *Well Casing*, with the intent to seal all hydrocarbons in the reservoir. The sequence of events which followed the commencement of sealing the well on the 19th April led to hydrocarbons being released on to the deck of Deepwater Horizon on the evening of the 20th April. It is perceived that hydrocarbons then migrated into the air intakes for the main generator engines causing them to over speed and explode. Measures were taken to emergency seal the well, however these also failed and the order to abandon ship was given. Deepwater Horizon sank 2 days later causing the largest oil spill and one of the largest response projects in US History.

The BP investigation into the disaster revealed 8 key events that culminated in the release of hydrocarbons on to the deck of Deepwater Horizon causing explosions and the subsequent failure of the crew and emergency equipment to seal the well. A detailed explanation of the key findings can be found in [3] and viewing the investigation 30 minute video presentation.

Two of the key findings of the investigation were related to the chemical make up of the cement. Halliburton (Cement Service Provider) were contracted by BP to provide cement suitable for this application in which BP was responsible for assuring the cement proposal. It was found, by independent analysis, that it was not suitable for the purpose of isolating the reservoir from the well and caused certain mechanical barriers to fail in there isolation procedures, hence allowing the influx hydrocarbons. A number of the key findings related to project managers and rig personnel misinterpretation of well test results and data. The well test assuring the well was sealed was incorrectly assumed successful although the test data should have warranted more investigation. The influx of hydrocarbons was not noticed until 40 minutes after the well test was accepted, even though live data from sensors in the well were intimating that there was an influx for the duration. The size of the influx was incorrectly estimated as normal procedures for well control for an influx of that size either failed or were not followed.

These failings led to hydrocarbons spilling onto the deck of the Deepwater Horizon and the subsequent two explosions. The final attempts of rig personnel to seal the well failed as it was deemed by the investigation the explosions damaged control cabling to the blowout preventer disconnecting communication. However, in the event of the cables being damaged the blowout preventer has a failsafe were 2 control pods on the side of the blowout preventer should activate to automatically seal well. It only required 1 of the 2 control pods to activate to seal the well however, the investigations final key finding was that one control pod had a dead battery and the other had a broken solenoid switch. Neither control pod could, therefore seal the well nor stop the flow of hydrocarbons into the Gulf of Mexico.

Information in this section is taken from the BP Internal Investigation, reference [3].

The Response

The response project is one of the largest projects ever undertaken by BP. At its height it involved over 45,000 people, approximately 7000 vessels and 120 aircraft. The sheer vastness of the project and the resources made available meant that it was split into 6 smaller projects areas to allow for better control. The areas were Well Sealing, Ocean Clean Up, Beach Clean Up, Wildlife, Environmental Restoration and Economic Investment. Much of the work is currently still ongoing as BP looks make right what happened in the Gulf and learn what it can from the incident [4].

In Sealing the well BP had two parallel operations running. The first was to drill a relief well to intercept the current Macondo well just above the reservoir, sealing it with cement to provide a permanent solution. However, this process takes a long time to complete and a temporary solution had to be developed. The second operation aimed to develop a temporary seal/cap on top of the blowout preventer to stop immediate flow of oil into the gulf as quickly as possible. Initial attempts to cap the well are unsuccessful however, with each attempt information is gathered about the reason for failures and contingency plans were put into action to design a cap that will seal the well. The rate at which engineers from both BP and Oceaneering developed the cap was astounding as conventional technologies for well capping would not be effective at this water depth. The cap developed was successfully implemented on the 15th July, stopping the flow of oil into the Gulf of Mexico. The relief well intercepted the Macondo well in early September and successfully completed a permanent seal on the 19th September [4,5].

The Ocean Clean and beach up was where the bulk of the man, vessel (some of which was local fishing boats and pleasure craft) and air power were focused. As previously stated around 4 to 5 million barrels of oil equivalent flowed into the Gulf between the 20th April and 15th July. On the ocean hundreds of miles of *protective boom* were laid; controlled burns were carried out on oil on the surface; dispersant spray was used to help break up the oil aiding natural evaporation and skimming was also undertaken to remove oil from the surface.



Rapid Response Teams [4] (11/11/10)

On the beaches rapid response teams were set up to scour for oil across the Gulf Coast. New innovations developed such as the Marsh Washer to aid process of removing any oil that made it to shore as safely and efficiently as possible [4].

In actual fact only a small majority of the oil that flowed to the gulf made it to shore. It was estimated that over 20% of oil was either skimmed

or burned off with additional 50% estimated to have been devoured, with the help of dispersant, by oil eating microbes and fungi that are present in the Gulf of Mexico [6].

The BP wildlife teams with the aid of Tri-State Bird and Rescue were responsible for finding birds, sea turtles and other wild life affected by the spill. Wild life once cleaned and treated were and are still being rehabilitated to areas now devoid of oil [4].

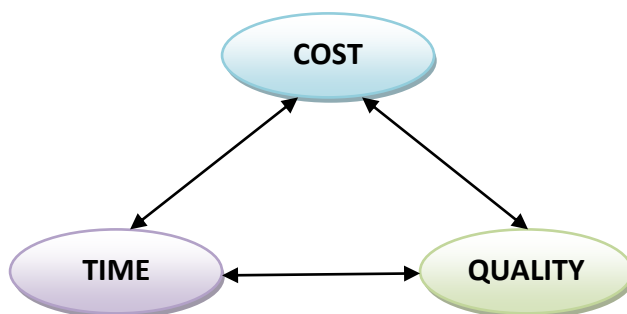


BP and Tri-State Bird and Rescue Teams [4]

The environmental restoration and economic investment are long term initiatives that have been set up by BP. \$500 million has been invested into the Gulf research institute so that a full understanding of the short and long term impact of the spill can be ascertained. The research is being carried out by independent experts from institutions in the Gulf coast states and will study the impact on public health and the environment. A \$20 billion claim fund was set up to aid local business's which have been affected by the spill and to aid the Gulf coast community with economic recovery. Within that a \$170 million grant was provided to the Gulf coast states, Louisiana, Alabama, Mississippi and Florida, to aid with recovery of the tourism industry [4].

Iron Triangle and Measuring Project Success

The overview of the Gulf of Mexico oil spill has given an example of two projects. It is clear to see that the project to complete exploration operations on the Macondo well was a failure and that the well capping and clean up areas of the response project were successful. To understand how these conclusion can be drawn it is first necessary to define how a project is measured.



Iron Triangle of Project Management [7]

A successful project is defined as a one that achieves its objective(s) on time, within budget at desired performance level and utilises it resources effectively and efficiently [8]. This definition can be represented graphically by the Iron Triangle as shown left. The diagram shows the interrelation between the three main aspects that need to be met for project managers to deliver a successful project. So why was the completion of exploration operations project undertaken by the Deepwater Horizon and its rig personnel a failure

and the well capping and clean up project areas successful?

The underlying difference between the two project examples is the quality with which they were delivered (i.e. achieving the required performance level and effective utilisation of the resources available).

On Deepwater Horizon the project managers failed to deliver the objective with the quality that was required. Failures in quality assurance, technical assurance and communication by both Halliburton and BP led to a cement compound being used that was unsuitable for the task of sealing the well. Failures in risk management, technical competency and communication between project managers from Transocean and BP led to key information about well conditions either being misinterpreted or not noticed. More failures in risk management in ensuring that the contingencies would work in case of an emergency meant that the two control pods were both incapable of performing a well seal that would have stopped the oil spill. Contrasting this with the well sealing and clean up areas of the response project it is possible to see the difference in quality. Effective communication between Oceaneering and BP engineers showing technical expertise in using the resources available; good interpretation of data and correct use of risk management in ensuring contingencies would be successful resulted in the Macondo well being successfully capped stopping the flow of oil into the Gulf. Similarly with the clean up effective use of communication and resources allowed for the control of vast numbers of trained and un-trained personnel to successfully remove approximately 20% of oil from the ocean surface. Also, appropriate use of new technology and understanding of organisms within the ocean meant that much of the oil did not reach the beaches and if it did good communication to the fast response teams allowed effective removal of oil.

It is also possible to compare the projects in terms of the cost and showing that the Deepwater Horizon exploration well completion project was a failure and the response project was successful. The budget for drilling and completing exploration wells varies from project to project however it is generally considered to cost approximately \$100 million. It is possible to attribute the cost of the response project to the Deepwater Horizon exploration well completions project. This implies that overall cost of the project that wasn't even delivered was approximately \$29 billion, nearly 300 times over budget. Originally, \$32 billion was budgeted to cover the response project. Subtracting the cost of the long term initiatives left \$11.5 billion to cover the cost of well sealing and clean up. Currently the overall spend on those aspects of the project total \$8 billion with the majority work complete [4]. This shows that the well sealing and cleanup projects came in under budget.

The conclusions that can be drawn are that for projects of these magnitudes require a number of aspects to come together to be successful otherwise the project will be unsuccessful. This was the case with the events that led to the Deepwater Horizon drilling rig. The investigation revealed that

no one of the key findings could be blamed solely for causing the incident and that the combination of failures of technology and project managers was, ultimately, the reason. This is similar to the well sealing and clean up areas of the response project. No one special effort by one particular group of project managers, trained personnel or civilian volunteers can be attributed for making the project successful. It took a monumental effort by all the people involved to ensure that these areas of the response were delivered with the quality required to ensure that this was the case.

Glossary of Terms

Blowout Preventer (BOP): Subsea equipment used to connect well casing to riser. Contains valves, sensor and well seals to allow for control of well and reservoir conditions

Well Casing: Metal casing that is inserted into the hole in rock and mud in the sea bed created by drill head. Create an effective path free off mud to remove hydrocarbons from reservoir.

Riser: Tubing that connects drilling rig or oil platform to BOP. Allows for path for hydrocarbons to flow to surface and contains the control communication lines to BOP.

Protective boom: Tubing that sits on the surface of the water used to encase oil that has reached the surface and stop it travelling any further. Controlled burns are then carried out on the oil encased by the boom

References and Further Reading

The following is a list of references used. Most of the information was obtained from the BP website and online newspaper articles. Further information can be found at all the links presented.

1. <http://www.nytimes.com/2010/05/28/us/28flow.html> (11/11/10); T Zeller Jr; "Estimates Suggest Biggest Spill in US history"; New York Times; 27/5/2010.
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4. <http://www.bp.com/extendedsectiongenericarticle.do?categoryId=9034427&contentId=7063885> (11/11/10); BP Gulf of Mexico Response Website; Making it Right.
5. <http://www.nytimes.com/interactive/2010/05/25/us/20100525-topkill-diagram.html> (11/11/10); "Methods That Have Been Tried to Stop the Leaking Oil"; New York Times; 17/8/2010
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7. Dr Jillian MacBryde; MS418 Lecture Slides; "The Iron Triangle"
8. Harold Kerzner Dawsonera; "Project Management: A Systems Approach to Planning, Scheduling, and Controlling"; 10th ed; John Wiley & Sons; 2009; pp 2 - 8.