Chapter 5 | Overarching Failures of Management

The Macondo disaster was not, as some have suggested, the result of a coincidental alignment of disparate technical failures.[1] While many technical failures contributed to the blowout, the Chief Counsel's team traces each of them back to an overarching failure of management.

Better management would have identified the risks at Macondo and prevented the technical failures that led to the blowout. In Chapter 4, the Chief Counsel's team identified particular management failures associated with each technical failure. This chapter synthesizes those findings into higher-level observations about the management system in place at Macondo.

The management breakdown at Macondo affected many of the operational aspects of designing and drilling the well. The Chief Counsel's team observed at least the following management failures: (1) ineffective leadership at critical times; (2) ineffective communication and siloing of information; (3) failure to provide timely procedures; (4) poor training and supervision of employees; (5) ineffective management and oversight of contractors; (6) inadequate use of technology; and (7) failure to appropriately analyze and appreciate risk. Ultimately, the companies placed undue reliance on timely intervention and human judgment in light of their failure to provide individuals with the information, tools, and training necessary to be effective.

BP's and Transocean's corporate guidance documents, in place before the blowout, show that they recognize how important each of these management areas is to safe and effective oil and gas exploration.[2] (Halliburton declined to provide management documents to the team.) The fact that failures in these areas led to the Macondo blowout reinforces the companies' conclusions about their importance. It also underscores the importance of management follow-through to ensure that policies affect cultures and day-to-day routines.

This chapter discusses each of these various failures in turn. The management observations in this chapter are limited to the Macondo well, which has been the focus of the Chief Counsel's investigation. The failures at Macondo were not inevitable, and the Chief Counsel's team sets them out here in the hope that they will not be repeated.

Leadership

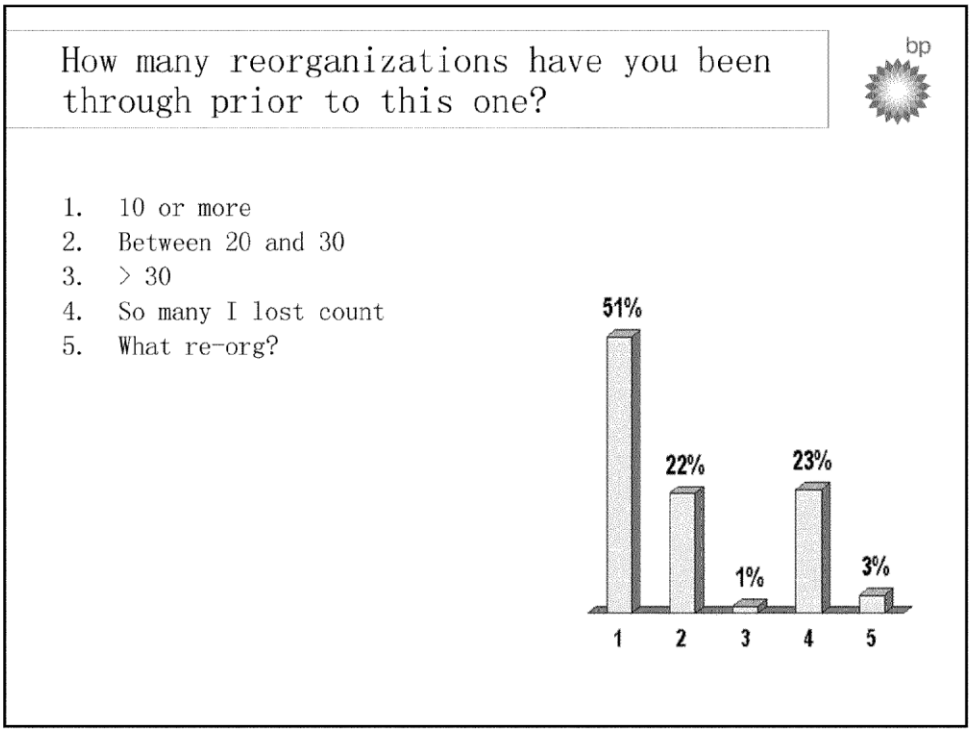
The first principle of BP's operating management system (OMS) is leadership. OMS calls for "operating leaders [who] are competent, exhibit visible, purposeful and systematic leadership and are respected by the organizations they lead."[3] BP further expects that "operating leaders create and support clear delegation and accountability."[4] Often this did not happen at Macondo. The Chief Counsel's team observed conflict between managers and confusion about who was accountable for critical decisions.[5] The team responsible for key decisions at Macondo did not always appear to be acting with a consistent and shared purpose.

In March, for example, operations to control the well after a kick led to disagreements between BP's managers on the Macondo team. BP engineering team leader David Sims wrote BP wells team leader John Guide: "We cannot fight about every decision.... I will hand this well over to you in the morning and then you will be able to do whatever you want."[6] Sims later explained this and other comments as "coaching" and stated that Guide's performance was atypical during this time period.[7] Guide himself appears to have acknowledged the concern and responded that he would "consult the team and make well thought out decisions."[8] Nonetheless, the comments suggest management friction during a critical operation, and leadership problems on the Macondo team did not end in March.

At the beginning of April, BP conducted a major reorganization of its exploration business unit, including the BP Macondo team, creating separate reporting structures for engineering and operations. Prior to the reorganization, the unit had been organized by project—all of the engineers and operations personnel for a given well reported to the same manager. Thus, Guide (representing operations) and Sims (representing engineering) both reported to the same person, BP wells manager Ian Little. BP senior drilling engineer Mark Hafle and drilling engineer Brian Morel reported to Sims; the well site leaders reported to Guide.[9]

The reorganization separated engineering and operations into distinct functional groups within the business unit. As of April, the wells team leader reported to a wells operation manager, and the engineering team leader reported to a separate engineering manager. BP also moved key personnel. BP promoted Sims from engineering team leader to wells operation manager. Instead of being Guide's peer, he was now Guide's supervisor. Gregg Walz, who had no prior experience with the Macondo well before March 2010, took over for Sims as engineering team leader. Walz now reported to new engineering manager John Sprague.[10]

Figure 5.1. BP internal presentation slide.



BP

The reorganization caused delays and distractions. Shortly before the reorganization, BP vice president of drilling and completions Pat O'Bryan questioned Gulf of Mexico managers about recent subpar performance, asking, "What's getting in the way...reorg uncertainty?"[11] Sims later shared that there were "challenges" associated with the reorganization and that "it may have taken a little more time to ensure that there was alignment between Ops and Engineering teams."[12] In an interview with Commission staff, Sims acknowledged that Walz may have been taking longer than usual to make engineering decisions as he came up to speed in his new role.[13]

Guide agreed. He told BP investigators that it was "easier" and "faster" to make decisions under the old structure.[14]

The reorganization also led to questions about authority and accountability, and apparent friction between team leaders Guide and Walz. Hafle noted that "no one argues with John Guide," but after the reorganization, Guide expressed confusion about his own authority to Sims and to Sprague.[15] In an April 17 email to Sims, Guide asked, "Everybody wants to do the right thing, but, this huge level of paranoia from engineering leadership [i.e. Walz] is driving chaos…. What is my authority? With the separation of engineering and operations I do not know what I can and can't do."[16]

Sims responded, "I don't think anything has changed with respect to engineering and operations," but went on to note, "If you don't agree with something engineering related, and you and [Walz] can't come to any agreement, [Sprague] or me gets involved." Guide later observed that the resolution of an issue by Sprague *or* Sims was precisely his concern.[17] While Little had previously been responsible for engineering and operations on his own, now there were two separate leaders for each team, each of whom had a different supervisor of their own. To find an individual who had responsibility for both engineering and operations, the Macondo team had to go all the way up to O'Bryan, the head of drilling and completions for the Gulf of Mexico.

The Chief Counsel's team does not presume to know whether the reorganization improved BP's previous management structure, but it is clear that the way BP handled authority and accountability created confusion during the Macondo project. For example, the BP team did not know who was accountable for important practices associated with safety. After the blowout, Hafle told BP investigators that he had no idea who was accountable for ensuring compliance with BP's standards on drilling safety.[18] Sims told BP investigators, "this accountability is not well documented" and "it is more like 'we are all accountable.'"[19]

Saying that everyone is accountable can be beneficial in certain instances, such as with respect to personal safety and "stop-job" authority, but can lead to a diffusion of personal responsibility for process safety. For example, BP has admitted that its internal engineering standards required the Macondo team to conduct a formal risk assessment of the annulus cement barriers in the well, and that such an assessment might have led the team to run a cement evaluation log.[20] Yet nobody on the team appears to have brought up the relevant Engineering Technical Practice (ETP) on zonal isolation.[21] There also appears to have been confusion about who was accountable for ensuring the adequacy of the cement slurry design, determining the risks attendant to changes in operations, and assessing the competence of personnel assigned to perform the negative pressure test.[22]

Though it is understandable that no one would wish to take ownership of the well after the blowout, the Chief Counsel's team found many instances in which nobody was taking ownership before the blowout.

Communication

Inadequate communication and excessive compartmentalization of information contributed to the Macondo blowout. Individuals making decisions regarding one aspect of the well, such as onshore engineers, did not always communicate critical information to others, such as the well site leaders, who were making related decisions on other aspects of the well. When faced with

anomalous data, decision makers often failed to seek counsel from others with expertise and instead made decisions based on incomplete information. BP and Transocean also failed to communicate lessons learned from other wells that could have assisted the decision makers at Macondo. Below are a few examples.

Information Compartmentalization

Information about drilling at Macondo was compartmentalized both within and between companies. In several instances, the BP onshore engineering team was aware of risks with the Macondo job but failed to communicate those risks to its own employees on the rig or the contractor personnel who might have helped mitigate those risks. The cementing and temporary abandonment processes provide key examples.

Cement jobs inevitably involve some uncertainty, but this job was particularly tricky. Due to equivalent circulating density (ECD) concerns, BP did not perform a full bottoms up prior to the cement job, it used foam cement, it pumped a smaller volume of cement than normal, it circulated the cement at lower flow rates than normal, and it used an overall slurry having a density approaching the density of the drilling mud in the annulus. BP pumped the job knowing that it had had difficulty converting the float equipment and that post-conversion circulating pressures had been unexpectedly low. And BP used fewer centralizers than called for by Halliburton's model. BP also decided to rely heavily on its difficult cement job soon after pumping it, by using temporary abandonment procedures that forced rig personnel to rely on the cement as the only constant barrier during riser displacement.

Despite knowing all of these cementing-related risks, BP's onshore team did not emphasize them to the individuals conducting the negative pressure test (including its own well site leaders). It also did not emphasize these risks to the individuals who were monitoring the well for kicks during riser displacement (Transocean and Sperry Drilling personnel), much less involve those individuals in discussions about how to mitigate the risks of cement failure.[23]

While rig personnel should always assume for well monitoring purposes that the bottomhole cement (or any other barrier) might fail, BP's onshore team should have, and easily could have, alerted the well site leaders and rig crew that cement failure at Macondo might be more likely than normal and instructed them to be extra vigilant regarding any odd pressure readings.

Chapter 4 is replete with similar examples.

Experts

BP did not always use its internal technical experts effectively.

For example, BP asked an in-house cement expert to help redesign the cement job to address ECD worries and thereby allow BP to use the long string production casing rather than a liner. During that process, the Macondo team asked the expert only for his general opinions about the suitability of foamed cement. Though Guide believed that the expert had "vetted" the cement program,[24] nobody on the Macondo team consulted the expert after April 14, and he never saw any laboratory testing data for the cement until after the blowout.

The Macondo team similarly did not consult completion engineers before reaching a decision on whether to run a long string or a liner. On April 15, one of the completion engineers wrote Morel:

"Yeah, well no one told us what the actual decision was, so we thought y'all were going with the liner…."[25] BP is now developing standards on how to consult internal experts and hiring more cementing experts.

Calling Shore

BP did not provide adequate guidance on when staff on the rig should consult onshore personnel. BP had a communications plan that described instances when rig personnel should call shore.[26] The plan did not address the negative pressure test specifically, and its general criteria for calls to shore did not apply clearly (if at all) to the negative pressure test on April 20.[27] After the incident, Hafle said that the communications plan "was not well written."[28] Another BP employee poked fun at its "weird drawings with boxes & arrows."[29]

It does not appear that the well site leaders ever contacted BP onshore personnel to discuss their inability to bleed off drill pipe pressure during the negative pressure test. They did not seek a second opinion from Sims or O'Bryan, both of whom are engineers and *were on the rig* during the negative pressure test as part of the VIP visit. Instead, according to their own accounts, the well site leaders accepted an explanation from a Transocean toolpusher who had no more training on test procedures than they had.

Less than one week after the blowout, BP well site leader Bob Kaluza wrote the following email to Guide and a colleague explaining how the "bladder effect" could account for the 1,400 pounds per square inch (psi) on the drill pipe:

> I believe there is a bladder effect on the mud below an annular preventer as we discussed. As we know the pressure differential was approximately 1400-1500 psi across an 18 ¾" rubber annular preventer, 14.0 SOBM plus 16.0 ppg [pounds per gallon] Spacer in the riser, seawater and SOBM below the annular bladder. Due to a bladder effect, pressure can and will build below the annular bladder due to the differential pressure but can not flow – the bladder prevents flow, but we see differential pressure on the other side of the bladder.
>
> Now consider this. The bladder effect is pushing 1400-1500 psi against all of the mud below, we have displaced to seawater from 8,367' to just below the annular bladder where we expect to have a 2,350 psi negative pressure differential pressure due to a bladder effect we may only have a 850-950 psi negative pressure until we lighten the load in the riser.
>
> When we displaced the riser to seawater, then we truly had a 2,350 psi differential and negative pressure.[30]

O'Bryan responded to the forwarded email as follows:

> Mike,
>
> ??
> ??
> ??
> ??
> ??

Regards,

Pat

It thus appears that, had Kaluza brought the "bladder effect" explanation to O'Bryan's attention on April 20, events likely would have turned out differently. Guide, Walz, Sims, and BP operations engineer Brett Cocales have each told the Chief Counsel's team that the "bladder effect" does not exist, that it would not account for the pressure readings seen that night in any event, and that they would have insisted on further testing before declaring the test a success had the well site leaders called to shore.[31] While these statements are self-serving, they are believable in this instance—everyone who has testified before the Joint Investigation Panel or spoken with the Chief Counsel's team has agreed the "bladder effect" does not exist and would not explain the pressure readings observed that night.

While O'Bryan appears to have been incredulous at Kaluza's explanation of the "bladder effect," BP management itself is to blame for failing to make clear to its well site leaders that they must call back to shore when confronted with unexpected results on a critical test.[32] After the fact, BP and Macondo team members have said the well site leaders on the *Deepwater Horizon* should have called back to shore on April 20. But they have been unable to point to any specific company policy, written or otherwise, that would have required the well site leaders to seek that second opinion.[33] When asked whether BP had any relevant policy at the Commission's November 8, 2010 hearing, BP's Mark Bly answered, "It's an expectation that if people feel they don't understand what is going on or they need help, that they will escalate and call back. So absolutely…I don't know if it's the policy. It's sort of the behavior that we expect from people."[34]

Given the importance of the negative pressure test, calls back to shore should be required as a matter of course regardless of the whether results appear anomalous. BP has apparently now instituted just such a policy.[35]

Sharing Lessons Learned

Transocean failed to communicate to BP and its rig crew lessons learned from a similar near miss on one of its rigs in the North Sea four months prior to the Macondo blowout. On December 23, 2009, gas entered the riser while the North Sea rig was displacing a well with seawater during a completion operation. As at Macondo, the crew had already run a negative pressure test on the lone static barrier between the pay zone and the rig and deemed it successful.[36] The tested barrier failed during displacement. Hydrocarbons flowed into the well, and mud spewed from the rig floor. Unlike at Macondo, the crew was able to shut in the well before a blowout occurred but not until nearly one metric ton of oil-based mud had spilled into the ocean.[37] The incident cost Transocean 11.2 days of additional work and more than 5 million British pounds.[38]

Transocean subsequently created an internal presentation for a March conference call reviewing the near miss. It warned that "[t]ested barriers can fail" and that "risk perception of barrier failure was blinkered by the positive inflow test [negative pressure test]."[39] It pointed out that "[f]luid displacements for inflow test [negative pressure test] and well clean up operations are not adequately covered in our well control manual or adequately cover displacements in under balanced operations."[40] The presentation concluded with a slide titled "Are we ready?" and "What if?" which contained the following bullet points: "[h]igh vigilance when reduced to one barrier underbalanced," "[r]ecogni[z]e when going underbalanced—heightened vigilance," and

"[h]ighlight what the kick indicators are when not drilling."[41] However, the call only involved toolpushers operating in the North Sea.

On April 5, 2010, Transocean issued an advisory setting forth anticipated amendments to its Well Control Handbook in light of the North Sea incident.[42] The advisory sought "to clarify the requirements for monitoring and maintaining at least two barriers when displacing to an underbalanced fluid during completion operations."[43] It noted that a Transocean rig recently experienced a well control event "due to a failure of a tested mechanical barrier."[44] To prevent a recurrence, the advisory required the drill crew to identify:

> (1) the volumes to be pumped, (2) the planned displacement rate(s), (3) the position of the fluid interface(s) at all times, (4) the resultant U-tube pressures in the well at all times and, (5) most importantly the point at which the completion fluid will become under-balanced with respect to formation pressure.[45]

The advisory ended with an apt warning: "*Do not be complacent because the reservoir has been isolated and inflow tested. Remain focused on well control and maintain good well control procedures.*"[46]

There are two problems with the advisory. First, it unduly limits the amendment to the "Completions" section of the handbook despite the fact that it should apply equally to temporary abandonment procedures such as those at Macondo. Second, it does not appear that anyone associated with the *Deepwater Horizon* ever received the advisory prior to the blowout.[47]

Transocean points out that it posted the advisory to an online, e-document platform accessible to the *Deepwater Horizon* crew.[48] But Transocean never alerted Macondo personnel to the posting, and there is no indication anyone actually saw it.

Transocean issued a more extensive advisory on April 14, less than one week before the Macondo blowout.[49] The new advisory described the North Sea incident and listed error-inducing conditions, missed opportunities, root causes, and contributing factors. Among the error-inducing conditions, it noted that the "drill crew did not consider well control as a realistic event during the…displacement operation as the [downhole barrier] had been successfully [negative pressure] tested," and the displacement was set up as "an open circulating system" nullifying pit monitoring.[50] The advisory admonished rig management that "[t]ested barriers can fail and risk awareness and control measures need to be implemented," "[s]tandard well control practices must be maintained through the life span of the well," and that well programs must "specify operations that induce underbalance conditions in the well bore."[51] As one Transocean executive noted after the incident, reading the advisory would "increase the awareness of anybody in the drilling industry."[52]

But Transocean circulated its April 14 advisory only to North Sea personnel, even though the lessons applied globally.[53] The company labeled the advisory in a narrow way, describing the North Sea event as a "Loss of Well Control During Upper Completion."[54] Transocean's operations manager for the Gulf of Mexico admitted that personnel involved in drilling operations might not read an advisory labeled this way.[55] Again, there is no evidence that anyone involved with Macondo or the *Deepwater Horizon* ever saw the April 14 advisory.

Transocean argues that alerting the crew to the advisory was unnecessary because the advisory simply restates good well control practice already known to the crew.[56] The Chief Counsel's team

does not agree. There is no evidence the rig crew on the night of April 20 followed any of the five steps mandated by the advisory. Asked whether he knew on April 20 that "monitoring the displaced volume alone is inadequate and does not satisfy the requirement for a known monitored column of fluid," Transocean's rig manager for the *Deepwater* Horizon, Paul Johnson, answered, "No. I'm thinking hard and clear about this, no."[57]

Transocean has stated that the North Sea incident and advisory were irrelevant to what happened in the Gulf of Mexico. The December incident occurred during the completion phase, in the North Sea, and involved the failure of a different tested barrier.[58]

Transocean's post-blowout reliance on these cosmetic differences is not an answer; to the contrary, these arguments only further reinforce the Chief Counsel's team's conclusions about the compartmentalization of information. The relevant facts of the Macondo and North Sea incidents are the same. Indeed, the North Sea incident may have had greater implications and relevance in deepwater. There is no reason why the lessons learned in the North Sea would not apply to the Gulf of Mexico or non-completion operations. Had Transocean adequately communicated the lessons from the North Sea to the crew of the *Deepwater Horizon* prior to April 20, events at Macondo may have unfolded differently.

Procedures

BP failed to provide its well site leaders and the rig crew with clear, detailed, and timely procedures. Instead, the evidence shows that BP's onshore Macondo team was rushing to design and provide procedures in order to keep up with operations on the rig. As a consequence, BP employees on the rig were not always sufficiently informed about upcoming operations.

The most obvious example is BP's temporary abandonment procedure. On April 12, for example, BP well site leader Murry Sepulvado wrote Morel: "Brian we need procedures for running casing, cementing and T&A work, we are in the dark and nearing the end of logging operations."[59] As set forth in detail in Chapter 4.5, the procedure changed repeatedly in the eight days between that email and the day of the blowout. It is not clear to the Chief Counsel's team why BP had not finalized and vetted the procedure much earlier in the process. The BP Macondo team instead waited until the last minute.[60]

BP ultimately did not send out the final "Ops Note" to the rig crew until the morning of April 20, meaning that once the well site leaders and rig crew did receive the temporary abandonment procedures, they had precious little time to digest and understand them (see Table 5.1 for breakdown of changes to temporary abandonment procedure).[61] BP could have at least ameliorated that problem by providing detailed guidance in the Ops Note to its well site leaders explaining how to, among other things, conduct the negative pressure test.

Contrary to the apparent views of BP's shore-based team, negative pressure test procedures are not self-evident to rig personnel, particularly in a case like Macondo in which the crew would have to displace and monitor a variety of different types of fluids. Sprague testified that, in order to interpret a negative pressure test, a well site leader would need to know the following: the hydrostatic pressure of fluids in the drill pipe, choke, and kill lines; bottomhole pressure; volumes and densities of fluids in the well, drill pipe, choke, and kill lines; and wellbore and drill string geometry.[62] Sprague acknowledged that "If you have more time to write detailed procedures, there is a greater chance that the result…might be more successful."[63]

Table 5.1. Timeline of changes to the temporary abandonment procedure.

Time/Date	Event
12:19 p.m. April 12	BP well site leader Murry Sepulvado emails BP drilling engineer Brian Morel (copying BP wells team leader John Guide) stating, "Brian we need procedures for running casing, cementing and T&A work, we are in the dark and nearing the end of logging operations."[64]
12:57 p.m. April 12	Morel sends Murry Sepulvado and BP well site leader Ronnie Sepulvado (copying Guide) a first draft of the drill plan for the final casing string, cement job, and temporary abandonment procedure.[65] The plan does not include a negative pressure test.[66] It calls for setting the lockdown sleeve in mud before setting the surface cement plug, and setting the surface cement plug at ~ 6,000 feet below sea level rather than the eventual 8,367 feet.[67] Morel says in his email, "This isn't perfect yet, but I wanted to get everyone a copy so you can ensure all the equipment required for our upcoming operations is offshore in time. Please let me know if you have any questions or suggestions how to improve the procedure."[68]
3:54 a.m. April 13	Ronnie Sepulvado emails Morel (copying Guide) saying "We need to do a negative test before displacing 14# mud to seawater."[69]
2:47 p.m. April 13	Morel emails back Murry Sepulvado and Ronnie Sepulvado (copying Guide) saying, "I will add details to the program. Currently my thoughts are negative testing with base oil to the mud line, you both ok with that?"[70] Murry Sepulvado replies, "Base oil sounds good to me."[71]
8:53 p.m. April 15	Morel emails the onshore team from the rig, saying that "Recommendation out here is to displace to seawater at 8300' then set the cement plug. Does anyone have issues with this? If we do a negative test prior to this with base oil to the wellhead the shoe will see about 360 psi less after the hole is displaced. Thoughts?"[72]
2:15 a.m. April 16	BP senior drilling engineer Mark Hafle writes back to Morel, "Seems ok to me. I really don't think [MMS] will approve deep surface plug. We'll see. Did permit look ok?"[73]
April 15	Morel finalizes a second draft of the casing, cementing, and temporary abandonment drilling plan.[74] It calls for running a negative pressure test with base oil to the wellhead after the cement job, then running the drill pipe to 8,367 feet and displacing with seawater, then setting the cement plug, and then finally setting the lockdown sleeve.[75] It contains a contingency, however, in case the MMS does not approve the deeper cement plug, calling for setting the lockdown sleeve first before setting the cement plug at 5,800 feet below sea level.[76]
9:35 a.m. April 16	Hafle emails the temporary abandonment procedure permit request to Heather Powell of regulatory affairs, asking her to submit it to the MMS. The submission includes BP's request to set the surface cement plug 3,000 feet below the mudline, which is 2,000 feet lower than otherwise allowed by MMS regulations.[77] At 10:54 a.m., Powell sends back the approved permit, meaning that MMS approved the request in less than 80 minutes.[78]
8:36 p.m. April 17	Morel emails the onshore Macondo team asking, "Anyone know if there are any requirements in the MMS regs for a negative test, can't find any specifics?"[79]
April 20	At the morning meeting on the rig, BP well site leader Bob Kaluza lays out the procedures for the day but does not mention a negative pressure test. Transocean offshore installation manager Jimmy Harrell apparently then insists that a negative pressure test be performed.[80]
10:43 a.m. April 20	Morel sends an email titled "Ops Note" to the well site leaders and onshore team. Unlike the earlier application submitted to MMS, the Ops Note calls for first running the drill pipe to 8,367 feet and displacing with seawater to above the blowout preventer (BOP) before running the negative pressure test "with seawater in the kill...[at] ~2350 psi differential."[81]

Planning problems extended beyond the temporary abandonment procedures. In April, Walz emailed Guide: "I know the planning has been lagging behind the operations and I have to turn that around."[82] Weeks earlier, on March 2, Cocales reassured a well site leader after the rig crew had problems interpreting procedures sent by Morel: "We will work on getting you guys any changes in the future sooner so you will have time to review."[83] And the difficulty appears to have extended beyond Macondo. In a meeting of the leadership team for drilling in the Gulf of Mexico, O'Bryan worried that "just in time delivery of well plans" had contributed to problems on other rigs.[84]

As detailed in Chapter 4, the pace and number of last-minute changes at Macondo apparently prompted Guide to write the following email to Sims on the morning of April 17, just three days before the blowout:

> David, over the past four days there has been so many last minute changes to the operation that the WSL's have finally come to their wits end. The quote is "flying by the seat of our pants." Moreover, we have made a special boat or helicopter run every day. Everybody wants to do the right thing, but, this huge level of paranoia from engineering leadership is driving chaos. This operation is not Thunderhorse. Brian has called me numerous times to make sense of all the insanity. Last night's emergency evolved around 30 bbls [barrels] of cement spacer behind the top plug and how it would affect any bond logging (I do not agree with putting the spacer above the plug to begin with). This morning Brian called me and asked my advice about exploring other opportunities both inside and outside of the company.
>
> What is my authority? With the separation of engineering and operations I do not know what I can and can't do. The operation is not going to succeed if we continue in this manner.[85]

Rather than react with alarm or stop work on the rig, Sims wrote back:

> John, I've got to go to dance practice in a few minutes. Let's talk this afternoon.
>
> For now, and until this well is over, we have to try to remain positive and remember what you said below – everybody wants to do the right thing. The WSLs will take their cue from you. If you tell them to hang in there and we appreciate them working through this with us (12 hours a day for 14 days) – they will. It should be obvious to all that we could not plan ahead for the well conditions we're seeing, so we have to accept some level of last minute changes.
>
> We've both [been] in Brian's position before. The same goes for him. We need to remind him that this is a great learning opportunity, it will be over soon, and that the same issues – or worse – exist anywhere else.
>
> I don't think anything has changed with respect to engineering and operations. Mark and Brian write the program based on discussion/direction from you and our best engineering practices. If we had more time to plan this casing job, I think all this would have been worked out before it got to the rig. If you don't agree with something engineering related, and you and Gregg can't come to an agreement, Jon or me gets involved. If it's purely operational, it's your call.

I'll be back soon and we can talk,

We're dancing to the Village People!

Sims has subsequently explained that he believed Guide was expressing temporary frustration and that he saw no cause for alarm. Emails from Guide later the same day support this view.[86] But once the well site leaders reported that last-minute changes were causing chaos and confusion on the rig, there was simply no reason why BP could not have stopped operations temporarily in order to allow planning to catch up.

Employees

Drilling is as much about people as it is about hydrocarbons and equipment. About 30 people designed the Macondo well. Roughly 130 others worked on the drilling rig at any given time. Success in oil and gas exploration depends on effective management of employees, yet the Chief Counsel's team observed poor management of staffing and inadequate training at Macondo.

People especially mattered at Macondo because BP, Transocean, and Halliburton placed heavy reliance on human judgment. For instance, during displacement of the riser with seawater, BP relied on the bottomhole cement as the only barrier in the wellbore. But awareness of whether that barrier was in place—because of the negative pressure test—depended on human judgment. Another barrier, the blowout preventer (BOP), also relied on human judgment because of the importance of kick detection and kick response. Yet, the companies failed to provide the rig crew and well site leaders exercising that judgment with adequate training, information, procedures, and support to do their jobs effectively.

Staffing

BP did a poor job of managing staffing and work assignments at Macondo. BP provided little support to a junior drilling engineer charged with critical design decisions and did not effectively seek input from technical experts. BP also sent a well site leader from another rig out to the *Deepwater Horizon* without properly determining if he was capable of substituting for one of the rig's veterans. BP did not supervise and support its employees as necessary to ensure safe operations.

Oversight

There were significant gaps in supervision and oversight at Macondo. In some cases, a single person made critical decisions and performed critical activities without checks—either by supervisors or other companies.

For example, BP relied very heavily on Morel to design not only the well itself, but also the cement program and temporary abandonment procedures at Macondo. Morel received his engineering degree in 2005, after which he started full time with BP. His first deepwater well was Mad Dog in 2007. BP assigned him to the exploration group in 2008, where he helped to plan two wells before being transferred to Macondo to work alongside Hafle—a much more senior drilling engineer who had been working on deepwater drilling since 1993.[87] The Chief Counsel's team found little evidence that Hafle closely reviewed Morel's work in the last few weeks before the

blowout. Indeed, none of BP's shore-based engineers appear to have reviewed Morel's temporary abandonment procedures carefully.

While Morel appears to have been talented and capable, it is not apparent why the team would put so much on his plate without additional supervision and mentoring.[88]

Temporary Substitutions

BP mishandled the substitution of Kaluza for regular well site leader Ronnie Sepulvado. Sepulvado needed a temporary replacement in order to attend well control training school onshore (per MMS regulations and BP policy). BP could have sought dispensation to allow Sepulvado to remain on the rig throughout the critical temporary abandonment phase but did not. BP instead substituted Kaluza, who was serving as well site leader on the *Pride*, a moored rig in BP's Thunder Horse field.[89]

It does not appear that BP undertook any significant effort to assure that Kaluza was qualified for the tasks he would be overseeing at Macondo. Whenever there is transfer or loss of personnel with specific knowledge or experience from a project, BP's internal guidelines require management to submit the change through a management of change (MOC) process, which requires sign-offs from multiple managers.[90] BP did not do so for Kaluza,[91] even though he had not been a well site leader on the *Deepwater Horizon* previously, did not know the history of the Macondo well, and his relief (BP well site leader Don Vidrine) had himself only been on the *Deepwater Horizon* for a few months.[92]

Training

BP and Transocean inadequately trained their personnel. BP did not train its well site leaders how to properly conduct and interpret a negative pressure test. Transocean did not adequately train its rig personnel regarding kick monitoring during end-of-well, nondrilling activities, such as temporary abandonment. It also did not adequately train its crews how to respond to emergency situations such as those that occurred on the night of April 20. Inadequate training set employees up for failure in the face of events outside their expertise and experience.

Nondrilling Situations

BP and Transocean failed to provide its personnel any formal training in how to perform or interpret a negative pressure test. This failure is symptomatic of a broader inattention to end-of-well, nondrilling activities generally. For instance, Transocean's Well Control Manual does not contain a section on monitoring or controlling the well during temporary abandonment procedures, focusing instead on drilling activities (and to a lesser extent, completion operations).[93]

The phenomenon is not limited to Transocean or BP. Like Macondo, the Montara blowout off the northern coast of Australia occurred after the production casing cement job had been pumped.[94] The Montara blowout lasted 10 weeks beginning on August 21, 2009, and spewed between 400 and 1,500 barrels per day of oil and gas into the Timor Sea.[95]

At least one independent expert has testified that in his experience it is not unusual for crew members to let down their guard or lose focus during end-of-well activities.[96] BP subsea wells supervisor Ross Skidmore, who has more than 30 years' experience in the industry, admitted that

once the final cement job has been poured, there is a tendency to think "everything is going to be okay" and to begin thinking about the next job.[97]

Emergency Situations

As discussed in Chapter 4.9, Transocean did not adequately train its rig crew how to respond to emergency well control situations, such as a severe blowout. Transocean required regular well control drills, but none focused specifically on emergency situations—how to recognize an emergency and what steps to take immediately upon recognizing it.[98] Transocean's Well Control Handbook provides little guidance on emergency situations, focusing instead on how to handle and circulate out more routine kicks. For instance, the handbook contains a section on "procedures for handling gas in the riser," which provides for the *possibility* of diverting a severe influx of hydrocarbons overboard as the ninth step in a lengthy diagnostic process.[99]

Transocean likewise did not adequately train or drill its dynamic positioning officers (DPOs) on how to respond to emergency situations. DPOs monitor a panel on the bridge that visually and audibly indicates whenever area-specific combustible gas, toxic gas, or fire alarms go off on the rig. The DPO acknowledges the alarms, contacts the affected area, and determines whether to initiate the general alarm to alert the entire rig (such as when more than one gas or fire alarm in contiguous areas goes off).[100]

Andrea Fleytas was the Transocean DPO on duty in charge of the alarm panel at the time of the blowout. After feeling a first jolt and noticing multiple combustible gas alarms sounding throughout the rig, she did not immediately hit the general alarm.[101] At the time, she received a call from the engine control room asking what was going on but did not instruct them to shut down the engines despite the multiple combustible gas alarms sounding throughout the rig.[102]

Asked why she hesitated, Fleytas said, "It was a lot to take in. There was a lot going on."[103] Fleytas said that Transocean provided no formal training or simulations on how to respond to combustible gas alarms.[104] She testified further that Transocean had not trained her to instruct the engine room to shut off the engines when combustible gas alarms were sounding.[105]

It is imperative that companies train and drill for emergency situations precisely because they occur so rarely.[106] There is no on-the-job training, as with more common events. Transocean senior toolpusher Randy Ezell told the Chief Counsel's team that he has worked on 60 to 75 wells during his career and has never seen anyone close the blind shear rams or use the emergency disconnect system (EDS) for well control purposes. He only had to engage the EDS twice in nine years on the *Deepwater Horizon*, both times when the rig had drifted off-site. He has never witnessed anyone divert flow overboard. He only saw the diverter used twice in his nine years on the *Deepwater Horizon*—both times to send returning flow to the mud gas separator.[107]

Contractors

At one point in time, operators owned their own oil rigs and directly employed the people who worked on them. But economic pressure and the complexity of offshore technology have pushed the industry away from that system. Modern offshore oil drilling now involves a team effort between an "operator" (which may have other oil company partners) and many specialized contractors and subcontractors. As Chapter 2 explains, Macondo involved just such a team effort. When the well blew out on April 20, only a handful of the 126 people on the rig worked for BP.[108]

The rest worked for one of the dozens of contractors and subcontractors associated with the project.

It is not necessarily problematic to use contractors to drill wells. Nor is it necessarily problematic to rely on specialized contractor expertise; drilling operations cannot be performed safely without their help, and Transocean and Halliburton are among the largest and best-regarded contractors in the oil and gas industry. But while the operator-contractor-subcontractor relationship can be beneficial in many ways, it also creates the potential for miscommunication and misunderstanding.

BP and its various subcontractors appear to have lost sight of that danger, compartmentalizing information that would have been useful to other companies carrying out their respective tasks. The onus fell on BP to ensure that its contractors were providing all of relevant information to the respective decision makers. As the party responsible for designing the well and well plan, the operator is best positioned to understand the big picture and how decisions and issues regarding one aspect of the well might affect decisions and issues regarding another.

BP's Oversight of Contractors

BP, like most offshore operators, relied heavily on its contractors to advise its engineers regarding important decisions. But BP did not adequately supervise its Macondo contractors in several instances.

The most egregious instances of inadequate supervision concern cementing. After the blowout, BP representatives and officials described Halliburton as "one of the, if not the leading cementing contractor in the world"[109] and contended that it relied on Halliburton's expertise to highlight cementing concerns.[110] But documents from before the incident show that BP's own employees were well aware that Halliburton's cementing services could be problematic. For instance, Chapter 4.4 discusses a 2007 auditing report prepared for BP, which concluded that Halliburton's "chemists and senior lab technicians do a very good job of testing cement slurries, but they do not have a lot of experience evaluating data or assisting the engineer on ways to improve the cementing program."[111] One of BP's top cement experts also described "the typical Halliburton profile" as "operationally competent and just good enough technically to get by."[112]

More importantly, BP engineers had specific concerns about Halliburton cementing engineer Jesse Gagliano, the Halliburton employee working on the Macondo well. Documents show that before the blowout, BP engineers thought Gagliano was not providing "quality work"[113] and was not "cutting it."[114] They highlighted that Gagliano had a habit of waiting too long to conduct crucial cement slurry tests. Three days before the blowout, Morel complained that he had "asked for these lab tests to be completed multiple times early last week and Jesse still waited until the last minute as he has done throughout this well."[115] Morel found "no excuse" for the tardiness.[116]

BP had known of problems with Gagliano for years[117] and "tried to work around" his shortcomings.[118] By the time of the Macondo blowout, BP had even asked Halliburton to reassign Gagliano.[119] Given this history, while waiting for his replacement, BP should have done more to supervise Gagliano's work, especially his work on the difficult production casing cement job at Macondo. At the very least, BP's management should have ensured that their own internal experts or senior Halliburton personnel double-checked Gagliano's cementing plan and foamed cement slurry design. Instead, BP's engineers admitted that they did not review his work "line by line"[120] and never fully utilized their in-house cementing expertise. They did not insist that he

report the final April 18 lab results in a timely manner, let alone review those results before allowing Halliburton to pump the final Macondo job.

BP did not even review the February 10 slurry test results that it *did* have. If BP had properly examined those results, it would have seen that the slurry had failed the foam stability test. The Macondo team had consulted BP cementing expert Erick Cunningham on other issues at Macondo. But it appears that nobody at BP ever showed him the foam stability slurry design or lab testing data. Instead, the Macondo engineering team focused exclusively on reducing ECD in order to mitigate the risk of lost returns without ever considering whether the slurry design was itself adequate to achieve zonal isolation.

Contractors' Deference to BP

If BP did not adequately review the work of some of its contractors, the converse problem was that many of BP's contractors were unduly deferential toward BP's design decisions. A Weatherford centralizer technician described the prevailing view as "Third party, we do what the company man requests."[121] In several instances, BP's contractors expressed private reservations about the plans and procedures at Macondo but did not more forcefully communicate to BP that there were better ways to do things.

Again, the failures of communication surrounding the cement job are a good case study. As self-described cementing experts, Halliburton had primary responsibility for designing and pumping the bottomhole cement. It should have alerted BP to any potential problems with that job. Yet, Halliburton often buried its analyses in highly technical reports (including laboratory tests and computer modeling) and never drew BP's attention to the importance of certain data.

Despite touting its cementing expertise in promotional materials, Halliburton adopted a posture of extreme deference throughout the Macondo project. Prior to the incident, Halliburton mentioned two concerns to BP. First, Gagliano mentioned that using a small number of centralizers could lead to cement channeling while admitting that he "did not think there would be a well control issue."[122] Second, a Halliburton cementing technician on the rig briefly suggested that a full bottoms up would be advisable.[123] But Halliburton never raised a host of other concerns to BP. It never pointed out that BP's plan called for a low total cement volume, noted that BP was using a relatively low flow rate, or argued that BP should perform a cement bond log. When asked why, Gagliano explained that this was not Halliburton's role. He said "we do not recommend running a [cement] bond log"[124] and, anyway, he "was never asked."[125] With full knowledge of all of these problems, Halliburton instead pumped the cement job and reported that the job had been "pumped as planned."[126]

Halliburton failed to highlight the importance of foam stability testing to the Macondo team and to communicate test data. In other contexts, Halliburton has argued that its job is merely to do what the operator says and pump the job as directed. But that posture is inconsistent with Halliburton's decision to selectively report stability testing data to BP, as discussed in Chapter 4.4. It is also inconsistent with Halliburton's failure to provide *any* April foam stability testing information to BP before pumping the job. If Halliburton's position is that the operator directs all aspects of the job, then Halliburton should provide the operator with *all* of the information needed to exercise that authority responsibly.

Chapter 4.4 also discusses the numerous concerns with Halliburton's internal management of its slurry design process. Halliburton does not appear to have: (1) ensured that internal experts

reviewed the Macondo slurry design; (2) ensured that Gagliano conducted timely lab tests; or (3) ensured that it otherwise adequately addressed BP's concerns about Gagliano's performance. Halliburton's refusal to provide documents that illuminate its internal policies and procedures cannot conceal these defects.

Lack of Clarity About Contractor Expertise and Responsibility

BP and Transocean have sparred since the blowout regarding the relative competence of Transocean rig workers to interpret negative pressure test data. But whatever the formal allocation of responsibility was or should have been, BP personnel certainly *believed* that Transocean personnel were not only competent to interpret those test results, but experienced and worthy of consultation. Based on the accounts of BP's well site leaders, the Transocean rig crew that participated in the test also believed they were competent to interpret it.

Chapter 4.6 explains that BP's well site leaders appear to have accepted a facially implausible explanation of the negative pressure test results from Transocean personnel. This was due in part to BP's inadequate well site leader training. But it was also due to the fact that Transocean personnel were experienced and the BP well site leaders thus believed they could rely on Transocean personnel. Kaluza and Vidrine both appear to have deferred to Transocean toolpusher Jason Anderson's experience. And Guide told the Chief Counsel's team emphatically that the Transocean personnel were in fact capable and competent to recognize the problems with the well during the negative pressure test.[127] Again, even if BP's expectations were justifiable, they were mistaken.

Transocean has argued after the fact to the Chief Counsel's team that its driller and toolpusher were merely "tradesmen" and not competent to interpret a negative pressure test. If that is the case, it is unclear why they would have advocated the "bladder effect" explanation. The Chief Counsel's team also finds it difficult to believe that the driller and toolpusher would be any less competent than the well site leaders to interpret a negative pressure test. During a negative pressure test, the crew underbalances the well to see if it leaks—in other words, whether the well kicks. Transocean agrees that its crew is expert in monitoring for and identifying kicks, even in underbalanced situations. Hence the rig crew did not call the BP well site leaders for advice when they noticed anomalous pressure readings during the displacement of the riser but instead relied on their own expertise to determine whether there was a kick.

Regardless of whether Transocean personnel were competent to interpret the negative pressure test, BP failed to adequately ensure that its well site leaders exercised independent judgment regarding the test results, or to resolve uncertainties before proceeding. In the absence of a clearly defined decision process and success criteria, BP's well site leaders appear to have tried to create consensus by accepting the explanation of the rig crew rather than independently verifying the explanation the rig crew had provided.

Technology

Deepwater operators employ exceedingly sophisticated technology to drill wells. But BP and its contractors had neither developed nor installed similarly sophisticated technology to guard against a blowout.

Displays, Sensors, and Instrumentation

The well monitoring equipment on the *Deepwater Horizon* was inadequate. For example, the data displays depended not only on the right person looking at the right data at the right time, but also that the person understood and interpreted the data correctly.[128] During the displacement, many signs of the kick could have been missed if monitoring personnel were distracted or not paying full attention.

As discussed in Chapter 4.7, the Chief Counsel's team believes that rig workers could benefit from systems that employ *automated* alarms, similar to those in airline cockpits, to call attention to potential kick indicators.[129] Such systems should also inform mudloggers of crucial events—such as a change to the active pit system or a change in fluid routing. On the *Deepwater Horizon*, the mud logger depended on direct communication or guesswork to learn what was happening elsewhere on the rig.[130]

As further discussed in Chapter 4.7, the Chief Counsel's team was surprised to find that rig personnel had to perform basic well monitoring calculations by hand, instead of having automated systems to help monitor, for instance, net flow from the well.[131] The Chief Counsel's team was also surprised by inadequacies in the sensors and instrumentation for detecting kicks on the *Deepwater Horizon*.[132] For instance, there was no camera installed on the rig to monitor flow on the overboard line—a person had to look behind the gumbo box to perform a visual confirmation of flow.[133] Flow sensors could be thrown off by listing seas, crane movement or other activity on the rig.[134] Where data are unreliable, the crew is more likely to discount kick indicators.

Finally, there was no equipment dedicated to identifying the presence of hydrocarbons in the wellbore during nondrilling activities. The oil and gas industry has developed sophisticated sensors that can be installed in drilling tools to detect kicks while actively drilling. But the Chief Counsel's team found no evidence that BP or anyone else in the industry has tried to adapt such sensors for routine well monitoring purposes. For instance, such sensors could be developed, and installed in the BOP or the wellhead to detect gas and other hydrocarbons before they enter the riser.

Utilizing Data and Equipment

BP and the other companies did not adequately use the data displays and monitoring equipment they did have. For instance, BP paid Sperry Drilling to gather and send real-time drilling and other data from the rig back to shore. Prior to the blowout, BP maintained large conference rooms in its Houston headquarters dedicated to each of its Gulf of Mexico wells. The room for the Macondo well had numerous monitors displaying the Sperry-Sun real-time data. The onshore team also could access the data remotely over the internet. But BP had no policy requiring full-time, or even part-time, monitoring from shore.[135]

As discussed in more detail in Chapter 4.7, BP itself apparently recognized the value of having engineers monitor data from onshore. As of the time of the blowout, BP had planned over the next four years to implement the Efficient Reservoir Access (ERA) advisory system.[136] The goal was to create a system that integrated real time drilling and mud logging data, displayed it to the driller in a more user-friendly and useful manner and simultaneously sent it to a drilling engineer or specialist on shore who could provide real time support.[137] "The primary objective of the ERA

Advisor" was "to facilitate the management of real time drilling data and its integration with drilling recommended practices and expertise to ensure the *right information is in the right place at the right time*."[138] Among the goals of the program were "[t]o maximize the use of available real time data and expertise to inform while-drilling decisions" and "[t]o minimize flying blind by improving the quality of real time data...."[139] Among other things, the system would "integrat[e]...expertise across multiple sites and multiple disciplines."[140]

While BP did not plan to have the system up and running until November 2013,[141] it clearly recognized the value of having a second set of eyes onshore—with engineering skills—monitoring well data and supporting rig personnel. Yet, the Macondo team did not use the real-time monitoring equipment it already had in place, relying instead on its well site leaders to alert onshore team members when and if there were issues.[142]

BP explained the disconnect by noting that it is difficult for onshore monitoring personnel to understand the significance of data without knowing what is happening on the rig. But these challenges can be overcome. Redundant shoreside monitoring would clearly have helped in several instances at Macondo—for instance, during the negative pressure test.[143] BP's explanation is also inconsistent with the entire premise for developing and deploying the ERA advisory system.

Risk

Deepwater drilling is a challenging and risky endeavor. It is also a competitive and potentially lucrative business that demands constant attention to economic considerations. Balancing the need to address risk with the need to manage costs is a constant struggle for operators.

The Chief Counsel's team finds that BP and Transocean did not have adequate procedures in place to properly account for risk or to assess the overall impact of decisions that appeared to relate only to one part of the well project. *As a result, understandable cost pressures drove decision making* and allowed some operational redundancies to be purged as inefficiencies. (Again, Halliburton declined to provide documents that would have allowed further insight into its operations at Macondo.)

Risk Assessment

The companies involved at Macondo failed to rigorously analyze the risks created by key decisions or to develop plans for mitigating those risks. *This appears to have biased decisions in the last month at Macondo in favor of cost and time savings while increasing the risk of a blowout.*

BP

Despite making multiple changes over the last nine days before the blowout, the Macondo team did not formally analyze the risks that its temporary abandonment procedures created. The Macondo team never asked BP experts such as subsea wells team leader Merrick Kelley about the wisdom of setting a surface cement plug 3,000 feet below the mudline to accommodate setting the lockdown sleeve or displacing 8,300 feet of mud with seawater without first installing additional physical barriers. It never provided rig personnel a list of potential risks associated with the plan or instructions for mitigating those risks.

BP's management system did not prevent such ad hoc decision making. It required relatively robust risk analysis and mitigation during the planning phase of the well but not during the execution phase.

Almost every decision the Chief Counsel's team identified as having potentially contributed to the blowout occurred during the execution phase.[144]

BP's Beyond the Best Common Process sets forth BP's procedures for selecting, designing, and drilling wells in the Gulf of Mexico.[145] It lays out a five-stage process: (1) Appraise, (2) Select, (3) Define, (4) Execute, and (5) Review. The first two stages consist of identifying and selecting a well site. BP plans and permits the well during the Define stage. During the Execute stage, BP and its contractors actually drill and complete the well. Finally, once drilling and completion is done, there is a Review stage to evaluate the project and to identify areas for improvement.[146] The engineering team is primarily accountable during the Define stage, although the wells operation team is involved. The wells operation team takes over primary accountability during the Execute stage, with engineering continuing to support planning and design decisions.

Before proceeding from one stage to the next, a well must satisfy certain "gate" requirements. For instance, before moving from the Select to Define and from the Define to Execute stages, the well concept, design, and plan must undergo a rigorous peer review process, which consists of "a multi-discipline assessment by an external team of how the balance between risk and value is being managed" and is led by a member of the functional drilling and completion excellence team.[147]

There is not, however, any such peer review process during the Execute stage.[148] The decision whether and to what extent to perform any formal risk analysis is left largely up to the team's discretion, in particular the wells team leader.[149] For instance, BP's MOC process—which imposes risk analysis, mitigation plan and approval requirements—continues to govern decision making during the Execute stage.[150] But the MOC process only applies to decisions to deviate from the well plan approved during the Define stage, not to drilling procedures (such as temporary abandonment procedures).[151]

As a result, after spudding the Macondo well, BP invoked the MOC process only a handful of times. It invoked the process for only three decisions after the *Deepwater Horizon* took over drilling in February.[152] Those three decisions were: (1) the change from a 16-inch to 13⅝-inch casing string; (2) the early total depth decision; and (3) the decision to employ the long string instead of a liner.[153] And some members of the team thought an MOC was unnecessary for the long string decision because the original approved well plan had a long string production casing.[154]

After the blowout, Walz observed that the MOC process was "not in place" and "not clear" for the Macondo team.[155] BP investigators summarized Walz's view of the team's culture as follows: "Performance – not require[d] procedures – do what we have been doing."[156] None of the other key decisions identified in this Report, such as those regarding centralizers, cement slurry design, temporary abandonment procedures, or simultaneous operations went through the MOC process.

BP was aware that its risk assessment process had flaws, but it acted too late to remedy the gap. In 2008, BP's own internal review found that risk assessment required improvement in the Gulf of Mexico. The review noted the "need for stronger major hazard awareness" and stated that "[r]isk assessment processes/results are not integrated."[157] The review went on to state: "As we

have started to more deeply investigate process safety incidents, it's become apparent that process safety major hazards and risks are not fully understood by engineering or line operating personnel. Insufficient awareness is leading to missed signals that precede incidents and response after incidents; both of which increases the potential for, and severity of, process safety related incidents."[158] Though BP later rolled out more robust risk assessment procedures in 2010,[159] the procedures were not in place for Macondo. In an interview after the incident, Sprague discussed a new requirement to evaluate the effectiveness of each barrier in a well but noted that it was ready only by the time of the incident.[160]

Problems with risk assessment practices appear to have affected decision making at Macondo in a number of ways. First, they allowed decision makers to avoid systematically identifying the risks their procedures created and the steps necessary to mitigate those risks. Second, the absence of formal risk assessment enabled late and rushed decision making. Third, the lack of rigorous risk assessments led decision makers to solve problems in isolation instead of considering the cumulative impact their solutions might have on the rest of the project. As discussed above, following the lost circulation event at the pay zone, BP's shoreside Macondo team focused almost exclusively on avoiding further lost returns and no longer considered the more general goal: effective zonal isolation. The team designed a cement job that decreased the risk of lost returns but increased the risk of cementing failure. The primary criterion the team used to determine the success of the cement job was whether there had been lost returns. Seeing none, they sent the Schlumberger crew home. With one problem solved, they moved to the next.

Transocean

Transocean's crew appears never to have undertaken any risk analysis nor to have established mitigation plans regarding their performance of simultaneous operations during displacement after the negative pressure test.[161] It is not clear what, if any, steps the crew took to ensure that they could continuously and reliably monitor return volumes during the displacement prior to sending the spacer overboard, or flow-out after they began sending the spacer overboard. There is no indication the crew calculated expected pressures during the displacement.[162] Internal Transocean reviews show that it did not believe that the rig crews could identify and mitigate all risks on their own. A Lloyd's Register audit of Transocean in 2010 found: "[Rig crews] don't always know what they don't know. Front line crews are potentially working with a mindset that they believe they are fully aware of all the hazards when it is highly likely that they are not."[163]

Transocean's crew seems to have concluded prematurely that risks had receded after the negative pressure test. Once the test had been declared a success, the driller and toolpusher appear to have put any concerns about the test behind them rather than increasing their vigilance. They did not immediately shut in the well upon observing unexpected pressure readings; they did not keep the mudlogger apprised of all pit changes and fluid movements and do not appear to have monitored data more closely in his absence.

After the March 8 kick on the *Deepwater Horizon*, Guide asked Transocean rig manager Paul Johnson to consider how to improve the rig crew's hazard awareness. Johnson wrote back: "I thought about this a lot yesterday and asked for input from the rig and none of us could come up with anything we are not already doing.... You can tell them what the hazards are, but until they get used to identifying them their selves, they are only following your lead.... Maybe what we need is a new perspective on Hazard recognition from someone outside the industry."[164]

Bias in Favor of Time and Cost Savings

On any drilling rig—no matter who is the operator—"time is money."[165] BP leased the *Deepwater Horizon* at a rate of about $533,000 per day.[166] The high daily cost made the rig the single greatest expense for drilling the Macondo well.[167] It also gave BP a strong incentive to improve drilling efficiency.

The Chief Counsel's team observed that the Macondo team understandably made individual decisions consistent with an orientation toward efficiency but did not step back to consider what the safety implications of those decisions were when taken together. In the absence of a stronger emphasis on risk assessment and process safety during the Execute stage, engineering and operations decisions tilted toward cost and time savings. The risk register for the Macondo well exemplifies the problem. Though the register was intended to help the team identify potential problems with the well and the consequences of those hazards, it did not include safety as an element.[168] The risk register focused exclusively on the impact risks might have on time and cost. (And there is no indication the Macondo team even used it once the well entered the Execute stage.)[169]

Examples of Decisions That Increased Risk and Saved Time

BP's employees made a number of important decisions that increased risk at Macondo. BP did not run a cement evaluation log, nor did it perform further well integrity tests after the unexpected results of the negative pressure test. BP did not install additional barriers during temporary abandonment, nor did it elect to install the surface cement plug closer to the wellhead. The list goes on. Chapter 4 of the Chief Counsel's Report provides background and detail on these decisions.

Many of the decisions that increased risk also saved time. Take BP's decision-making process about how many centralizers to use. When Gagliano recommended obtaining additional centralizers, Morel responded that it was "too late" to get more centralizers to the rig.[170] It is never "too late" if one is willing to stop operations and wait for the right equipment. Guide informed the Chief Counsel's team that he himself had suggested waiting at one point, but in emails before the incident he argued against using additional centralizers not only because they might hang up, but "also it will take ten hrs to install them."[171] (Guide explained to the Chief Counsel's team that further delaying casing installation would have raised risks of its own. The Chief Counsel's team notes that BP had left the wellbore open for several days at this point in order to log the wellbore, and while that entails some risk, there was no systematic discussion of this risk, or the pros and cons of waiting for additional centralizers.)

As shown in Table 5.2, the decision about centralizers is not an isolated example of time pressure apparently influencing well design or operations at Macondo.

Table 5.2. Examples of decisions that increased risk at Macondo while potentially saving time.

Decision	Was There a Less Risky Alternative Available?	Less Time Than Alternative?	Decision Maker
Not Waiting for More Centralizers of Preferred Design	Yes	Saved time	BP onshore
Not Waiting for Foam Stability Test Results and/or Redesigning Slurry	Yes	Saved time	Halliburton (and perhaps BP) onshore
Not Running Cement Evaluation Log	Yes	Saved time	BP onshore
Using Spacer Made From Combined Lost Circulation Materials to Avoid Disposal Issues	Yes	Saved time	BP onshore
Displacing Mud From Riser Before Setting Surface Cement Plug	Yes	Unclear	BP onshore
Setting Surface Cement Plug 3,000 Feet Below Mudline in Seawater	Yes	Unclear	BP onshore (approved by MMS)
Not Installing Additional Physical Barriers During Temporary Abandonment Procedure	Yes	Saved time	BP onshore
Not Performing Further Well Integrity Diagnostics in Light of Troubling and Unexplained Negative Pressure Test Results	Yes	Saved time	BP (and perhaps Transocean) on rig
Bypassing Pits and Conducting Other Simultaneous Operations During Displacement	Yes	Saved time	Transocean (and perhaps BP) on rig

Meticulous Tracking of Time and Cost

Each day of drilling counted to BP, and BP counted the cost of each day. BP's common process for well design and operations required engineers to set out "detailed time and cost estimates" for "the operational procedures for drilling" the well.[172] The estimates were based on prior drilling performance on other wells.[173] During drilling, BP had its team share with the rig crew every day how long each task should take.[174] The actual time to complete a task would then be recorded and performance shared with the rig crew.[175]

The *Deepwater Horizon* followed this process meticulously.[176] The rig had a database of the "fastest times" to complete "each task the rig carries out."[177] The engineers used the database to "construct a time estimate for the well being planned."[178] Every day, "the actual times for each operational task" were "checked against the Best of the Best data."[179] A spreadsheet accounted for all of the rig's time, from servicing the rig to running the drill pipe.[180] If an activity was "non productive time," then it was marked as such with a brief description of the cause.[181] BP may have linked this information into a worldwide database.[182]

BP tracked not only the time to complete each task, but also the cost of every item to drill the Macondo well.[183] The list runs from $15 for one cargo box to $533,000 for one day of the rig's time.[184] About 10,000 items were accounted for, tallied, and listed by day.[185] Daily costs varied from over $4 million on March 17, 2010, to as low as $6,300 during the planning of the well in 2009.[186]

By the time of the blowout, the Macondo well had taken longer to drill and cost much more than BP had anticipated. BP had spent more than $142 million on the well.[187] The original plans for Macondo set out a price tag for the well of $96 million.[188] Because the well kept going over budget, BP had to return to its partners three times to authorize supplemental expenditures.[189] The final authorization anticipated that the well would cost as much as $58 million more than planned.[190] The Macondo well had also fallen at least 38 days behind schedule.[191]

Comparable wells had taken less time and had cost considerably less to drill. Sims testified that days per 10,000 feet (a common industry metric) was the most important metric for drilling performance.[192] Hafle estimated that the well had taken about 70 days for each 10,000 feet drilled.[193] That performance put Macondo in the bottom 10% of wells drilled (more than 10 days per 10,000 feet slower than the threshold for that category).[194] The well's total cost also placed it in the bottom 10% of comparable wells.[195] So did the amount of what BP classified as "non-productive time."[196] (Nonproductive time is another common industry metric).

It is unclear as to the full extent to which these cost and time overruns impacted personnel and decisions onshore or on the rig. One well site leader remarked that the cost of the Macondo well was a concern and that he was aware the rig was running behind.[197] However, he and others have almost uniformly stated that cost and time pressure was not an issue and that they did not feel more pressure to hurry to get things done than would otherwise be the case.[198]

Cost accounting is a necessary and reasonable part of running a business. Nonetheless, given the many decisions that increased risk but saved time and money, it is a reasonable inference that cost and time overruns had an effect, conscious or unconscious, on decision making.

Well Design and Operations Guidance

At the Commission's November hearing, Steve Lewis testified: "[T]he pressure to make progress is actually inherent in the business. And it takes a stated, conscious management presence to counter that…drillers drill against each other. We want to be the fastest, best driller there is."[199]

Like many other operators, BP's guidance on well design and operations placed a premium on drilling quickly. The Beyond the Best Common Process[200] emphasized the achievement of the "technical limit" for drilling a well.[201] The term technical limit means "what drilling times might be possible if everything works perfectly."[202] Achievement of the technical limit depends on the elimination of "non productive time" and "invisible lost time."[203] Though BP did not expect its

engineers to achieve the "technical limit" (at least not yet),[204] they were told that the company's aspiration was to achieve the "Technical Limit as quickly as possible."[205] BP asked its engineers to accomplish times faster than what had been done before—"the 'best of the best.'"[206]

For well design, the emphasis on drilling performance and technical limit meant that BP engineers were expected to carefully account for how long it would take to drill each well. Engineers were asked to consider, "Could the well be constructed more efficiently?"[207] That question appears to have been important to the team that designed the Macondo well.

In an interview with the Chief Counsel's team, Sims shared that he was always thinking about how to drill wells faster.[208] He replied "yeah, that's safe to say" when asked whether Morel, the engineer who designed the temporary abandonment procedures at Macondo, was "always thinking about cost and efficiency."[209] Guide's supervisor flagged in his 2009 mid-year evaluation: "John needs to…take safety performance to the same level as drilling performance."[210]

BP's focus on driving down the time to drill wells could result in a tendency to treat redundancies as inefficiencies. Tasks that took additional time would have counted against the rig's time and cost performance.[211] In the absence of sufficient checks and balances, adding cost that did not immediately appear *necessary* to the safety of the well might not be judged fairly. A cement evaluation log may have been perceived as unnecessary when a negative pressure test was planned not long after. A mechanical plug or additional cement plug may have seemed inefficient when there was cement already at the bottom of the well. The problem is exacerbated for very low-frequency events, which might allow poor decisions to go unnoticed for many years where a particular type of failure (especially one that requires multiple things to go wrong) happens only rarely.

Personnel Evaluations and Incentives

BP provided incentives to its drilling personnel. For more senior personnel, the annual bonuses exceeded $100,000 on top of salaries over $200,000.[212] BP based the annual bonuses and promotions in part on performance evaluations.

The performance evaluations for the Macondo team emphasized, among other things, drilling performance. The Gulf of Mexico's metrics for drilling targeted days per 10,000 feet drilled and performance against AFE as priorities.[213] The AFE is the Approval for Expenditure, a metric for how much BP planned to spend on a well. Early in 2010, Sims listed delivering the wells "at or below" the targeted times as the "#1" priority for him and for Guide in the coming year.[214] O'Bryan also had drilling efficiency in his performance contract for 2010.[215]

The BP team that drilled Macondo had a history of focusing on cost and performance in their performance evaluations. Guide's list of key indicators for 2008 specified "performance," measured by days per 10,000 feet of drilling.[216] After that, Guide had "All Well Objectives delivered at a cost less than AFE."[217] Guide highlighted that "[o]perational performance has been top quartile," meaning that the rigs had outperformed most other BP rigs in how long it took to drill a well,[218] and observed that one well "set numerous industry and B[P] drilling records and finished 32day's / 10K."[219] In 2009, Guide's supervisor noted that Guide had "championed the every dollar counts culture."[220] "Every dollar counts" became a priority at BP during diminished demand for oil in 2008.[221] Guide noted in his self-evaluation that "[d]aily operational decisions now include the cost component."[222]

Sims provided the same level of detail for drilling performance. In 2007, he noted in his interim review that "we have done a good job of delivering fully evaluated wells under time and cost targets."[223] In 2008, Sims observed that the "Kodiak well finished under AFE cost and with top quartile performance."[224] He also highlighted that the "Freedom well finished the original scope under AFE time and budget.[225] In 2009, Sims highlighted when the time to complete a well was "top quartile" and when wells finished "under AFE."[226]

Importantly, BP's performance evaluations and internal standards also emphasized the importance of safety. BP's code of conduct provided: "BP is committed to providing a safe place of work for everyone—that includes stopping work if we ever have concerns about HSSE [health, safety, security, and the environment]. BP will not tolerate retaliation against anyone who in good faith stops work for HSSE issues—it's better to be safe than sorry."[227] BP also had in place "Golden Rules of Safety."[228] The Golden Rules emphasized that "Safety is a legitimate personal expectation and a constant individual responsibility."[229]

Though safety was important at Macondo, BP's approach was strongest with respect to easily measured personal safety metrics, such as injuries, rather than process safety risks of low-frequency, high-consequence events such as a blowout. BP put safety first on individual employees' performance evaluation forms,[230] but the metrics for safety encompassed only a subset of the risks of drilling. Guide's evaluation in 2009, for example, put safety at the top of the list of key performance indicators, measured by recordable injuries.[231] The well site leaders had similar standards, which emphasized recordable injuries and safety meetings.[232]

It is not apparent whether and to what extent BP has or assesses safety metrics regarding drilling procedure or well design. BP expected full compliance with its mandatory engineering policies.[233] But BP lacked a systematic way to assess whether engineers complied with those policies, especially after the peer review process was complete and the well entered the Execute stage.[234] BP did not track how employee decisions impacted process safety or risk.

It is perhaps not surprising that BP's performance evaluations relied on easy-to-track metrics such as injuries and safety meetings to account for an employee's commitment to safety. It would be difficult after the fact to analyze whether an employee's decisions actually increased the risk profile of a project unnecessarily. That is all the more reason why it was critically important for BP to have in place at all stages of the well a formal risk assessment system for evaluating drilling decisions that could increase the overall risk profile of the project.

Closing

As this review of management practices at Macondo demonstrates, the blowout occurred in large part because the companies diffused knowledge, responsibility for, and ownership of safety among themselves and among groups of people. The people onshore and on the rig had a false sense of security. They did not recognize the need for individual leadership in addressing the multiple anomalies and uncertainties that they observed. Instead, they relied on many ambiguous "dotted line" relationships within and between the companies and personnel involved.

To prevent an incident at Macondo from ever happening again, it will not be enough merely to add regulatory personnel. Just putting more inspectors on the *Deepwater Horizon* would not have prevented this blowout.

Nor will it be enough to issue new prescriptive regulations or write more voluminous safety manuals. Adding a new "don't do this either" rule after every accident ensures staying behind the curve.

What the men and women who worked on Macondo lacked—and what every drilling operation requires—was a culture of leadership responsibility. In hostile offshore environments, individuals must take personal ownership of safety issues with a single-minded determination to ask questions and pursue advice until they are certain they get it right.