

Bridge Resource Management

By: Captain Grant Livingstone, Captain John Merrigan, and Captain John Konrad

Managing Resources or Managing Audits?

Speaking at an INTERCARGO (International Association of Dry Cargo Shipowners) event in London Oct 2018, Chairman John Platsidakis asked, “Are we managing ships or are we managing regulations? We were supposed to do the first, but I am afraid we are mostly doing the second. By the time we conclude one regulation, another one appears in the scene.”

Current BRM Shipboard Execution

- a. Are the critical elements and original intent of BRM SOP worldwide?
- b. Are identifying potential threats—then developing, communicating, implementing plans to mitigate—a priority on the bridge at all times?
- c. Are blending technical and human skills the standard for compliance audits, or is the audit standard the auditors checklist?
- d. How do professional mariners avoid complacency?
- e. Has BRM insidiously evolved into a checklist?
- f. The rate of that change (in BRM) has been directly proportional to the cost of liability and accidents.
- g. Regulators have addressed increasing liability, non compliance, accidents and near misses with ever increasing (symptomatic) regulations. A debilitating administrative drain of time and attention on all shipboard personnel contrary to the critical elements of BRM.
- h. As compliance becomes a primary focus of BRM in practice, accident investigations continue to show non compliance as an increasing issue. How can that be?
- i. Adding ever more regulations to enforce compliance is treating the symptom not addressing the upstream source. A lack of experienced professional mariners conducting regulatory audits leaves the inexperienced auditor dependant on checklists.

Original Intent of BRM

The original intent of Bridge Resource Management was a safety and error management tool for improving and preventing the recurrence of incidents/accidents. It has become an integral part of professional mariner training as it seeks to make use of *all available resources* including equipment and information (technology) and *human resources* to achieve safe operations.

Much of the terminology used in BRM came from the aviation industry's Crew Resource Management (CRM). Such as training that focuses on group dynamics, leadership, interpersonal communications and decision making. One of the most important concepts in CRM is that it is **a process** (not just a checklist) to identify existing and **potential threats** and then develop, communicate and implement plans and actions to avoid or mitigate **threats**. The phrases 'potential and existing threats', 'process' and 'group dynamics' are key word choices. There is a significant difference in the attitude and attention of those directed to watch for threats as opposed to BRM's wording, to watch for potential dangers.

Another purpose of BRM was to empower junior personnel to speak up and question the traditional unilateral authority of the master, so a better decision—concluding in a better outcome—would be made. BRM was a game changer and remains an extremely important component of our industry. However, BRM was developed prior to many of the essential tools used by modern mariners (AIS, ECDIS, etc.) and prior to current theories and practices on managing the Human Element. BRM must remain relevant for Millennials, Gen X'ers, Gen Z as well as veteran Baby Boomers.

Current BRM relies too heavily on check lists; there are now checklists for everything in our industry. These checklists may benefit the third party inspector or governmental regulators, but they ultimately do very little to assist the Bridge Team in safely navigating their vessel. With more and more regulations bombarding us daily, we are steadily losing the skill sets and in-depth professional knowledge of what it is to be a professional mariner. The question stands: "Are we managing ships, or are we managing the next audit?"

A solution is a return to the original nonlinear dynamic adaptive critical elements of BRM CRM. Moving away from a checklist mentality by first asking the question: are checklists *the* problem?

Checklists

In his groundbreaking book, *Checklist Manifesto*, Dr. Atul Gawande looks to the aviation industry and construction industry to help solve the epidemic of simple mistakes made in hospitals and operating rooms, which account for thousands of unnecessary deaths each year. In his research, Dr. Gawande discovered that simple mistakes in hospitals were causing more deaths annually than automobile accidents. Dr. Gawande discovered the Boeing Checklist as well as commercial construction checklists. He adapted for simple procedures in hospitals and emergency rooms and the results were dramatic. Check lists work. Checklists for routine procedures are imperative for successful operations. However he hit a roadblock. *The results showed check lists only worked on simple hospital procedures or complicated procedures that could be broken down into simple steps.*

Complex Procedures Require More Than a Simple Checklist

“Much of the most critical work people do, however, is not so simple. ICU work is complicated and complex- are we really able to create and follow checklists for every possible one of them? There is no straightforward recipe for the care of ICU patients. It requires multiple practitioners orchestrating different combinations of tasks for different conditions. Matters that cannot be controlled by simple checklists.....”

Communication Checklist

Dr. Gawande found that highly complex situations required two types of checklists: (a) the routine step by step procedural checklist, and (b) the Communication Checklist. It specifies points where individuals and teams are required to share or submit their information before moving on, in the hopes of enforcing communication between team members. The communication checklist drew upon the knowledge and judgement of the group as an entity with the hope of avoiding the autocratic single person error. By standardizing input of all group members we decentralize command and control, and as a result, Group IQ raises to the highest common denominator. (The Checklist Manifesto)

When regulators enforce BRM through oversight dependent upon procedural checklists the original intent and critical nonlinear elements of BRM are undone. Of course there are many shipboard procedures that are made safer with checklists. But simple checklists fail in highly complex and dynamic human element situations.

Managing Resources

The original intent of Bridge Resource Management was clear. BRM is to make use of *all available resources*—including equipment and information—and *human resources* to achieve safe operations. It supports safer and more efficient execution of operations *by blending technical skills and human skills*. Are blending technical and human skills the standard in compliance audits? Or is the audit standard the auditors checklist? Most mariners at sea today would tell us the latter is the case. By default then the auditors checklist becomes the priority. The mariner cannot disregard the auditor and the checklist develops a life of its own. That often becomes the dominant influence over many shipboard operations. One cannot audit or blend technical and human skills through a checklist. Don't throw the checklist away, but get back to the human element as the priority through the audit and in BRM.

Human nature will never change and liability at sea will never be less. Whatever goes wrong this year will be exponentially more costly in the future. When it does happen the next time and little is mitigated or it's worse, human nature thinks develop a more complicated formula with longer checklists. We naturally treat symptoms expecting to cure the disease. More medication has been the human response for centuries. The answer lies upstream.

The displacement of the critical human element in BRM by checklist mentality cannot be overstated. How do we reconnect the human element and managing all available resources? Move away from a checklist mentality by blending technical and human skills as BRM originally intended. That requires a balance of strategic thinking and philosophy:

1. Uncertainty is the unavoidable starting point
2. Complacency is the Professional Mariners opponent.
3. Prudent Seamanship is the cultural DNA that has always bonded mariners to the Human element.
4. Organizational Learning not Organizational Monitoring
5. Time competitive decision making process (using time as an ally)
6. Increase our capacity for effective action

7. Tactics; How to prevail not just how to execute
8. Decentralized Command and Control. Bottom up leadership
9. All human competition involves a continuous cycle of observation and decisions.
10. Orientation is key
11. LEARN; Continuously observe, assimilate, adapt
12. Change is inevitable, learn to thrive in it.

Aside from the reference to professional mariners, that abbreviated list is from the mind of

Colonel John Boyd. A list that mirrors much of the original intent of BRM. Colonel Boyd was an Air Force fighter pilot in the Korean war whose genius in strategic theory and human nature evolved into one of the most influential military and strategic scientific theorists of modern times. "His teachings were the base model for the strategy of Gulf War 1. He was the founding theorist and architect for the Air Force Fighter Weapon School. After years of study and practical air combat experience, Boyd developed a strategic mental process for analysis and synthesis of facts (a pilot's decision making process) in air-to-air combat that he called the OODA Loop. " *

But John Boyds theories were far greater than simply air to air combat and The OODA Loop. "Boyd expanded the OODA Loop first to warfare generally, then to any contest between individuals or groups and finally to the problem of human survival in an ever changing universe."* Boyd focused on the human element, situational awareness and critical thinking at a tactical level in a time-competitive environment. As stated it began with air to air combat. The fighter pilot has to make critical decisions often in seconds under tremendous pressure. All the while maintaining acute situational awareness in constantly changing circumstances.

What mariners can learn from John Boyd's evolved theories is how to philosophically and strategically blend technical and human skills, making use of all available resources including equipment and information (in a time competitive fashion) just as BRM originally envisioned. There is a philosophical connection between Prudent Seamanship and Boydian Theory that may help professional mariners understand.

Prudent Seamanship is a way of life. A carefully crafted and practiced lense through which everything on shipboard (and ashore by habit) is observed and analyzed. A quick glance across a deck taking a current mental photograph that is matched up with the previous mental photograph. Anything new or changed or out of place instantaneously stands out. But it's more, it's also prescience. It not only observes what has changed it can hypothesis what is likely to change in the future. Prudent Seamanship is the feel, the Third Eye that corresponds to 6th Sense. What our DNA, aptitude and learned experience brings to the equation.

Prudent Seamanship cannot be turned on like a light switch. What has happened is key to what will happen. Prudent Seamanship must be engaged in the narrative of facts leading up to decisions; absent critical facts good decisions cannot be made. One must be in a "Prudent Seamanship state of mind" prior to needing that state of mind to execute successful decisions at sea. Prudent Seamanship is a way of life at sea.

That is Boydian. Boydian theory and OODA Loop is a way of life not simply an acronym to organize better decisions.

OODA Loop coalesces well learned and practiced experience into tactical time-competitive synthesis, analysis and execution. Like Prudent Seamanship

Boydain theory cannot be turned on like a light switch as needed. The OODA Loop is moot without the narrative of facts prior and leading up to all decisions. Like Prudent Seamanship it is a lense through which one engages and analyses the greater environment surrounding them.

OODA LOOP

The overriding theme of the OODA Loop is organizational adaptation and learning through orientation; nonlinear thinking. Boyd said all human competition involves a continuous cycle of observations and decisions. In a time competitive decision making process, it is essential to use time as an ally. Boyd specifically used the OODA Loop to teach his fighter pilot students how to learn and adapt under stressful time constraints.

The OODA Loop: Observation; Orientation; Decision/Hypothesis; Action. I observe everything I can within my environment. I orient myself within that environment. I create a mental image of my ship within that environment and where I want my ship to be next (which may be right where it is!). I hypothesis and make a decision and then take action. I execute and simultaneously test my action. Am I getting the result I expected? I immediately loop back to observe in order to validate the action taken. It is a continuous mental loop of observations, orientation, decisions and results of actions taken. Verifying or changing decisions and actions as required.

Bridge System

Boyd would argue that bridge personnel are a small system within greater systems of moving parts, organic and inorganic. Steel and water and wind and human beings all interacting in such a way that makes each part unavoidably related to the other. Our vessel and personnel interact with all systems in our environment whether we are aware of it or not. Linear thought processes are overwhelmed under such conditions. Dynamic conditions require nonlinear education and training. Vigilantly observing, orienting, learning, synthesizing, executing in order to adapt and learn from ever changing conditions riddled with the unanticipated; the original intent of BRM. Boyd would argue that the purpose of the bridge system is to be a learning and adapting organism within the greater environmental system. Organizational learning not organizational monitoring.

Orientation: the box around which the OODA Loop graphically revolves

The purpose of accurate orientation is to adapt tactically to an ever changing situation. OODA Loop model allows the organization (think bridge team) to monitor continued relevance of its goals and actions. Orientation shapes the way we observe, the way we decide, the way we act. **Adapting to ever changing situations also addresses the challenge of complacency.** Professional mariners must anticipate and be on the alert for change from routine to threat back to routine. A deliberately managed tempo that alters between moments of critical action demanding the highest attention to those of routine operations. One cannot maintain the highest levels of concentration indefinitely but must be on alert for change. Managing tempo is a key challenge for professional mariners.

Another key to orientation is multiplicity. Group IQ vs Individual. Boyd understood that human nature carries personal unknown biases based on culture, experience, education and personality. One may be unaware of their own individual biases. If the bridge is taught to execute individual multiple OODA Loop cycles and input that; individual bias is mitigated. Other members of the bridge system may challenge my orientation bias or blind spots.

Mental Imagery

Another key component in Boyd's theory is mental imagery. Always maintaining a highly accurate, detailed mental image of the vessel's position and motion relative to its environment. My own experience as a pilot mirrors Boyd's description of mental imagery. Without being conscious of it I had a mind's eye view of every ship I've piloted. An up to the minute mental image that ran concurrently with the visual image my eyes reported back to me. I can switch my mental image to that of the tug master or to a helicopter view of my vessel as though a drone was recording a video. Veteran maritime pilots likely develop extensive mental imagery subconsciously or consciously. Accurate mental images are key to Orientation and fully utilizing the OODA Loop. If my mental view does not match my eye view I must stop and reassess. Spontaneously looping through OODA. What do we see? What decisions/actions do we need to adapt? Get new facts, new orientation. A process very similar to what many emotionally intelligent, mature leaders have learned to do naturally if not formally. As the bridge personnel continuously cycle through multiple individual OODA Loops, the system lead by the master and the pilot decide on an action. Execute that action simultaneously cycling OODA to reorient and affirm that the last action/order is producing the intended result. The Bridge personnel become a learning system/organism as opposed to a monitoring team.

Is it too much to expect professional mariners to comprehend OODA Loop? Is the OODA Loop concept foreign to mariners? An accurate mental picture and successful method of

analysing and synthesizing all that surrounds and interacts with their vessel; human nature and mother nature, present and future? On the contrary, it was the standard.

Captain Daniel McLaughlin, Master Mariner 47 years at sea, would understand well. In 1884 at 61 years old, Capt. McLaughlin relinquished command of the *Glory of the Seas*. One of the last great clipper ships built by John Mackay. Rounding Cape Horn 42 times and circumnavigating the globe three times. Having lost two vessels in those years but successfully mitigating several near disasters including the complete knockdown of 'Glory of the Seas' at Cape Horn in hurricane conditions. After being hit beam on by a mammoth sea and hurricane force wind, *Glory of the Seas* lay on her beam ends, her cargo having shifted dramatically.

Gigantic seas fully washing over her now exposed port side, braces tight, sails out and underwater locking her and all aboard in a death knell. Through the courage of certain crew and cool head of Capt McLaughlin, several death defying hours later *Glory* finally—near even keel—was able to make sail to Valparaiso for repairs, against all odds.

How was it possible for Capt McLaughlin to routinely and successfully round Cape Horn under sail in such demanding conditions? Was it only because they were made of tougher stuff? Those masters without any modern technology, without even the use of sextants due to winter weather, were able to assimilate vast amounts of rapidly changing facts under highly charged emotional conditions and synthesize that into decision and action routinely. Not only Capt McLaughlin but hundreds, perhaps thousands of other masters and crews under sail in similar—if not worse—conditions. Was it luck? Or did they possess something modern mariners have forgotten?

Displaced Knowledge and Skill

We believe the later and we aren't alone. Mariners have witnessed how technology naturally displaces specialized knowledge and skill sets. But we wondered if everything technology displaced should have been displaced? That vastly improved technology has displaced so much knowledge and skill that the maritime industry is ironically less safe? The thought naws at us. We talk to each other about it on the bridge of ships, in the wheelhouse of tugs, on the pages of our blogs. We see it in the latest accident reports. We've lost something vital. Knowledge and skill sets that enabled mariners to routinely mitigate what would be overwhelming circumstances today.

When Capt. McLaughlin stood on the quarter deck of 'The Glory of the Seas' the night it was knocked down off Cape Horn, his thought process was the same as he had learned from

generations of masters before him. Observing and assimilating all that surrounds their ship in a savant like way. Wind, sea, current, Cape Horn looming to leeward, crew on deck and below, everything that opposed and interacted with their vessel. Determining current position only by Dead Reckoning and a seemingly mystical relationship with the elements that surrounded him. By an uncanny understanding of the ship under his feet and the crew that stood before him. By hard earned experience and training, synthesizing an accurate mental picture of all in the system in order to take action, make sense and order out of the chaos before his eyes. Synthesizing and analysing the avalanche of constantly changing dynamics charged with the thought of losing all (including ones life) in a most terrifying way. Captain McLaughlin would have understood the OODA Loop and John Boyd's theories very well. An accurate mental picture and successful method of analysing and synthesizing all that surrounds and interacts with their vessel. Boyd said uncertainty is the pervasive element of human nature (think going to sea on ships). "Therefore thinking strategically under such conditions requires a continuous combination of analysis and synthesis and a multidisciplinary approach." John Boyd

Boyd would have also noted Capt. McLaughlin's "cool head". Very strong emotions like fear or anger can derail advanced thought processes. The Amygdala at the core of the human brain , triggered by strong emotions, will hijack rational thought process into "fight or flight". Boyd understood that fighter pilots had to be well practiced not only in advanced and emergency maneuvers in the air but mentally as well. Boyd states; "to ensure adaptability to a variety of challenges, it is essential to have a repertoire of orientation patterns and the ability to select the correct one according to the situation at hand and the ability to validate and devise and incorporate new actions to survive in a rapidly changing environment". That can only be accomplished by theoretically analyzing possibilities well in advance. Strong emotions may cut our minds off from rational advanced thought process in critical situations. But we're human and we will experience strong emotions. Self awareness is key to effective Boydian theory. Regroup and reassess when strong emotions strike.

Boyd also emphasized "Getting inside your opponents OODA Loop." This concept has been challenging for teaching OODA Loop to professional mariners. Upon deeper reflection mariners may agree that complacency is one of our greatest challenges. If professional mariners were able to view complacency as an "opponent", it would become the #1 threat to be alert for. Getting inside the mind of your opponent. An insidious, silent, dangerous opponent waiting for the mariner to provide the opportunity to strike. Awareness is the enemy of complacency.

Piling on new regulations or laws for every accident/incident is attempting to cure the illness by controlling the symptoms. That will always fail. Prioritizing the process of facilitating and executing the critical elements of BRM as originally intended is the upstream solution to

symptomatic issues and failures in execution of BRM on the bridge. The purpose of the bridge system is to be a learning and adapting organization within the greater environmental system. To utilize OODA Loop as well as a Multi Scientific approach that evolves with knowledge and accounts for human nature. Applying that science on the bridge to enhance all of the critical elements of BRM. If compliance is the priority in practice, it displaces the process and original intent of BRM. BRM becomes a mere checklist.

A random sampling of maritime accidents brings to light the recurring issues of Single Person Error, Checklist Mentality, Confirmation Bias and significantly Complacency. Boyd would say it's not simply how to execute it's how to prevail; tactics. That bottom up leadership is key; decentralized command and control. That the leader's responsibility is to mentor and enable all those under their command by ensuring that the mission and goals are clearly communicated and understood to the ground level. Dr. Gawande called it the Communication Checklist. Clear communications between departments or groups before moving to the next action, inputting the knowledge and judgment of the group as an entity. That clear communication is foundational; the Master working with their team must clearly communicate possible actions based on the independent analysis of team members to facilitate a vigorous exchange of ideas to rapidly and precisely communicate the optimal response. Leaders with superior technical skills, without the ability to communicate succinctly and effectively, will fail. Finally step back and allow those under their leadership to make decisions and execute. Mistakes are a given. Utilizing the OODA Loop, BRM and a multi scientific approach the bridge system under the leadership of the master, synthesizes, analyzes, learns, adapts.

Global Resource Management

In the days of Capt. McLaughlin, prudent seamanship did not end at the shoreline. In those days sailing as master was the surest path to becoming a shipowner. The world had no shortage of statesmen, ship builders, and industrialists who had climbed up the hawse pipe on the way to success. Even civilians had exposure to the harsh realities of the sea while traveling and read the tales of popular authors like Joseph Conrad, an accomplished master mariner. The idea of prudent seamanship permeated regulatory bodies, business, and society itself. That is not the case today.

Today the master mariner working shoreside is just one cog in a large machine. He is often respected and deferred to on strictly nautical matters but the hard lessons learned at sea rarely permeate into the business itself.

Even captains with an MBA degree often compartmentalize the business side and ship management side of their jobs. This needs to change.

The concepts here are not strictly for use on the bridge of a ship. The ability to orient yourself to the perspective of the ship, her master, and crew does not require a maritime education, nor

does the ability to build basic mental images. Friction between the master and chief engineer or steward is a sign that the orientation process has been short circuited. Checklist created by regulators or shoreside personnel created without the use of Resource Management are, at best, a waste of time and, at worse, a danger to the vessel and crew.

Today communication technology improves daily. Increasingly complex systems share data continuously as system updates and procedures get pushed out to the ship in real time. To prevent future incidents we need to push back by teaching resource management and prudent seamanship to all who's actions affect the safe navigation of ships.

OODA Loop example

What would individual rapid OODA Looping look like in an actual emergency? The best modern example may be the recorded audio transcript of Capt Sully Sullenberger landing on the Hudson.

While reading Capt Sullenberger's recorded audio, try using the OODA Loop as a key: Observe, Orient, Decide, Action. Capt Sullenberger rapidly loops through options, taking in all information/facts possible. Quickly, calmly, systematically discarding the options/actions that would fail to achieve the desired result: Don't Crash and Burn. Please note that the start time is 15:26 and the landing on the Hudson was about 15:31. Everything you read below and every decision Capt Sullenberger made took place in roughly 5 minutes:

NEW YORK CITY -- The transcript of the cockpit and radio communication from the US Airways flight that landed in the Hudson River after striking a flock of geese was released today by the National Transportation Safety Board.

The following is an excerpt of the transcript: (In the transcript Flight 1549 is sometimes mistakenly referred to as 1539 and 1529.)

Capt. Chesley Sullenberger (15:26:37): Uh what a view of the Hudson today.

First Officer Jeffrey Skiles (15:26:42): yeah.

Skiles (15:26:52): Flaps up please, after takeoff checklist.

Sullenberger (15:26:54): Flaps up.

Sullenberger (15:27:07): After takeoff checklist complete.

Sullenberger (15:27:10.4):
Birds.

Skiles (15:27:11):
Whoa.

(15:27:11.4): (Sound of thump/thud(s) followed by shuddering sound.)

Skiles (15:27:12): oh
(expletive).

Sullenberger (15:27:13): Oh yeah.

15:27:13): (Sound similar to decrease in engine noise/frequency begins.)

Skiles (15:27:14): Uh
oh.

Sullenberger (15:27:15): We got one roll -- both of 'em rolling back.

(15:27:18): (Rumbling sound begins and continues until approximately 15:28:08.)

Sullenberger (15:27:18.5): Ignition,
start.

Sullenberger (15:27:32.9): Mayday mayday mayday. Uh this is uh Cactus fifteen thirty
nine hit birds, we've lost thrust (in/on) both engines we're turning back toward
LaGuardia.

LaGuardia departure control (15:27:42): Ok uh, you need to return to LaGuardia?
Turn left heading of uh two two zero.

(15:27:43): (Sound similar to electrical noise from engine igniters begins.)

Skiles (15:28:02): Airspeed optimum relight. Three hundred knots. we don't have
that.

Flight warning computer (15:28:03): (Sound of single chime.)

Sullenberger (15:28:05): We
don't.

Departure control (15:28:05): Cactus fifteen twenty nine, if we can get it for you do

you want to try to land runway one three?

Skiles (15:28:05): If three nineteen...

Sullenberger (15:28:10.6): We're unable. We may end up in the Hudson.

Departure control (15:28:31): Arright Cactus fifteen forty nine it's gonna be left traffic for runway three one.

Sullenberger (15:28:35):
Unable.

Traffic Collision Avoidance System (15:28:36): Traffic traffic.

Departure control (15:28:36): Okay, what do you need to land?

Skiles (15:28:37): (He wants us) to come in and land on one three ... for whatever.

Predictive Windshear System (15:28:45): Go around. Windshear ahead.

Skiles (15:28:45): FAC (Flight Augmentation Computer) one off, then on.

Departure control (15:28:46): Cactus fifteen (twenty) nine runway four's available if you wanna make left traffic to runway four.

Sullenberger (15:28:49.9): I'm not sure we can make any runway. Uh what's over to our right anything in New Jersey maybe Teterboro?

Departure control (15:28:55): Ok yeah, off your right side is Teterboro airport.

Traffic Collision Avoidance System (15:28:59): Monitor vertical speed.

Skiles (15:29:00): No relight after thirty seconds, engine master one and two confirm

Departure control (15:29:02): You wanna try and go to Teterboro?

Sullenberger (15:29:03):

Yes.

Sullenberger (over public address system) (15:29:11):

This is the Captain brace for impact.

Departure control (15:29:21): Cactus fifteen twenty nine turn right two eight zero, you can land runway one at Teterboro.

Skiles (15:29:21): Is that all the power you got? ... (Wanna) number one? Or we got power on number one.

Sullenberger (15:29:25): We can't do it.

Sullenberger (15:29:26): Go ahead, try number one.

Departure control (15:29:27): Kay which runway would you like at Teterboro?

Flight Warning Computer (15:29:27): (Sound of continuous repetitive chime for 9.6 seconds.)

Sullenberger (15:29:28): We're gonna be in the Hudson.

Departure control (15:29:33): I'm sorry say again Cactus?

Departure control (15:29:53): Cactus fifteen forty nine radar contact is lost you also got Newark airport off your two o'clock in about seven miles.

Enhanced Ground Proximity Warning system (15:29:55): Pull up. Pull up. Pull up. Pull up. Pull up. Pull up.

Skiles (15:30:01): Got flaps out.

Skiles (15:30:03): Two hundred fifty feet in the air.

Ground Proximity Warning System (15:30:04): Too low. Terrain.

Ground Proximity Warning System (15:30:06): Too low. Gear.

Skiles (15:30:06): Hundred and seventy knots.

Skiles (15:30:09): Got no power on either one? Try the other one.

Radio from another plane (15:30:09): Two one zero uh forty seven eighteen. I think he said he's going in the Hudson.

Enhanced Ground Proximity Warning system (15:30:15): Caution terrain.

Skiles (15:30:16): Hundred and fifty knots.

Skiles (15:30:17): Got flaps two, you want more?

Sullenberger (15:30:19): No lets stay at two.

Sullenberger (15:30:21): Got any ideas?

Departure control (15:30:22): Cactus fifteen twenty nine if you can uh you got uh runway uh two nine available at Newark it'll be two o'clock and seven miles.

Enhanced Ground Proximity Warning system (15:30:23): Caution terrain.

Skiles (15:30:23): Actually not.

Enhanced Ground Proximity Warning system (15:30:24): Terrain terrain. Pull up. Pull up. ("pull up" repeats until the end of the recording).

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