

Command and Control (C2) Failures: A Taxonomy and Analysis

18th ICCRTS, Paper 049

Marius S. Vassiliou

Science & Technology Division
Institute for Defense Analyses

mvassili@ida.org

David S. Alberts

Strategy, Forces, and Resources Division
Institute for Defense Analyses

dalberts@ida.org



Why Study C2 Failures?

- **C2 is central to the military mission**
- **We spend a lot of money on C2 research**
 - Over 40% of U.S. DoD S&T funding is interpretable as supporting C4ISR
- **It's easy to hypothesize on why things may go wrong**
 - But how can we be sure?
- **Thus, it is useful to study cases where something actually did go wrong and understand why!**
- **We studied 20 operational cases since the 1st World War**
 - Identified explicitly in the literature as involving “C2 failure”
 - Drawn from
 - » Military operations
 - » Terrorist Attacks
 - » Disaster & Emergency response

Cases (1): Military Operations

The Great British Cavalry Retreat from Mons, World War I, August 1914



<http://www.iwm.org.uk/collections/item/object/205024060>

1st Battle of Savo Island, Guadalcanal Campaign, World War II, August 1942



<http://www.history.navy.mil/photos/images/g10000/g13488.jpg>

The German Offensive before 1st Marne, World War I, August – September 1914



<http://pierreswesternfront.punt.nl/content/2008/08/marne-verberie-nery-villers-cotterets>

Mayaguez Incident/Battle of Koh Tang, May 1975



http://www.specialoperations.com/Operations/mayaguez_USMC_deploying_on_Koh_Tang.jpg

Cases (1): Military Operations (Cont.)

US Iran Hostage Rescue Mission, April 1980



http://media.washtimes.com/media/image/2012/10/11/argo_web_3589_4-1980_s630x431.jpg?80e003d3227bcbe8c85816c8b2123c96a33e47ff

US Invasion of Grenada, October 1983



<http://www.defenseimagery.mil/imageRetrieve.action?guid=ceb1e816ab2ca40ae10443bc1118590417ed95b4&t=1&w=538&h=538>

Operation Desert Storm, January-February 1991



<http://www.wallsonline.org/wp-content/uploads/2012/12/Operation-Desert-Storm-War-.jpg>

Russia-Georgia War, August 2008



<http://nimg.sulekha.com/others/original700/russia-georgia-war-anniversary-2009-8-7-7-41-29.jpg>

Cases (2): Terrorist Attacks

Oklahoma City Bombing, April 19, 1995



http://alt.coxnewsweb.com/cnishared/tools/shared/mediahub/05/98/52/slideshow_1529857_Oklahoma_City_Bombing_15t-1.jpg

7/7 London Bombings, July 7, 2005



<http://www.dailymail.co.uk/news/article-1198170/7th-July-London-bombings-Four-years-7-7-seen-picture-inside-Russell-Square-train.html>

9/11 Attacks, September 11, 2001



http://totallycoolpix.com/wp-content/uploads/2011/10092011_remembering_9_11/nyc_002.jpg

Norway Attacks, July 22, 2011



<http://www.smh.com.au/world/police-begin-questioning-of-christian-fundamentalist-20110723-1hua4.html>

Cases (3): Disaster/Emergency Response

**King's Cross Underground Fire, London,
November 18 1987**



<http://secondsfromdisaster.net/wp-content/uploads/2013/01/kings-cross-fire.jpg>

**Clapham Junction Railway Accident,
London, December 12 1988**



<http://media.popularmechanics.com/images/clapham-wreck-470-0609.jpg>

Hillsborough Stadium Disaster, April 15, 1989



<http://static.guim.co.uk/sys-images/Guardian/Pix/pictures/2012/12/19/1355903591995/Hillsborough-disaster-010.jpg>

Hurricane Andrew, August 24, 1992

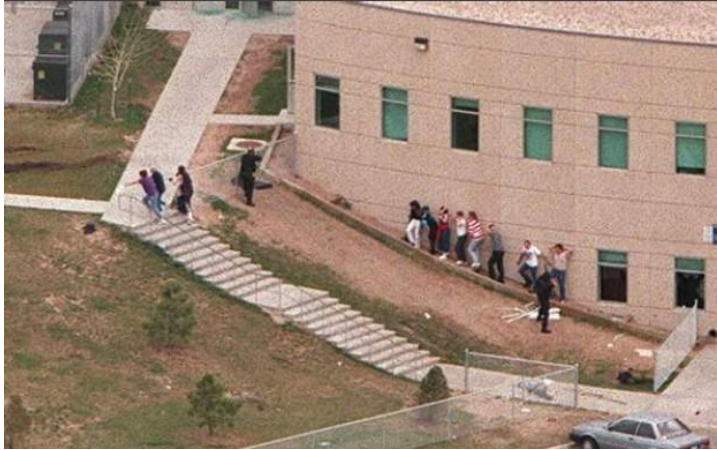


C. W. Griffin / The Miami Herald

<http://3.bp.blogspot.com/-P0ei7ovXTw/UDcHtBSkqLI/AAAAAAAAABhY/w1rB6P5QDXk/s1600/86+Hurricane+Andre>

Cases (3): Disaster/Emergency Response (Cont.)

Columbine High School Shootings, April 20, 1999



<http://bossip.files.wordpress.com/2012/11/massacre-e1352384704110.jpeg?w=625&h=389>

Indian Ocean Tsunami, December 26, 2004



<http://www.sanandreasfault.org/Sumatra1.jpg>

Hurricane Katrina, August 23 2005



<http://www.katrina.noaa.gov/images/katrina-08-28-2005.jpg>

Black Saturday Fires, Victoria, Australia, February 7, 2009



http://www.sydneycare.org.au/content/r337173_1529332.jpg

“What we’ve got here, is failure to communicate”

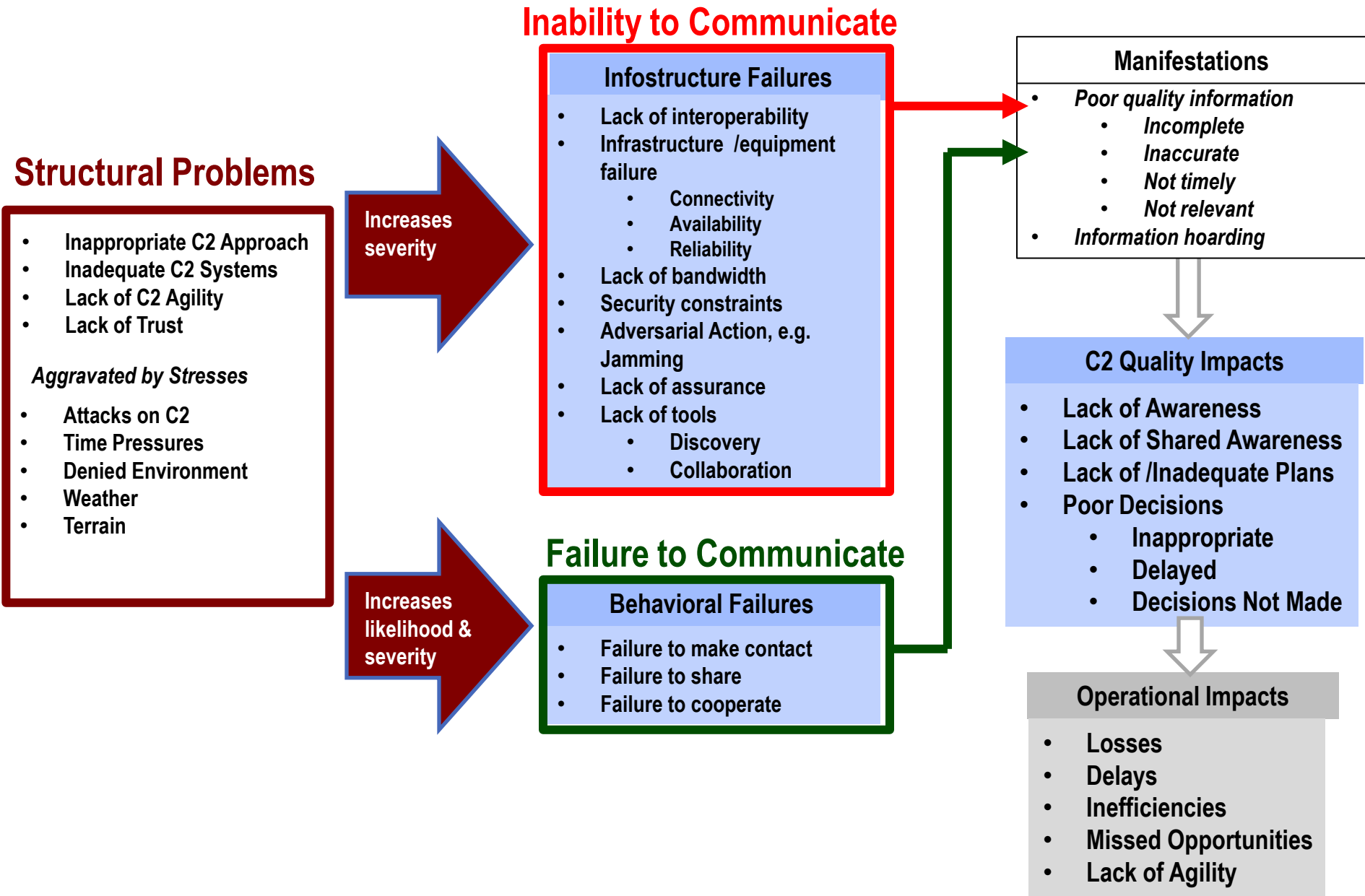


[http://media.beta.photobucket.com/user/boro_01/media/Cool_Hand_Luke_Martin.jpg.html?filters\[term\]=strother%20martin&filters\[primary\]=images&o=1](http://media.beta.photobucket.com/user/boro_01/media/Cool_Hand_Luke_Martin.jpg.html?filters[term]=strother%20martin&filters[primary]=images&o=1)

Strother Martin as “The Captain,” *Cool Hand Luke*, (Warner Brothers, 1967)



Causes, Manifestations and Impacts of C2 Failures





It All Boils Down to This:

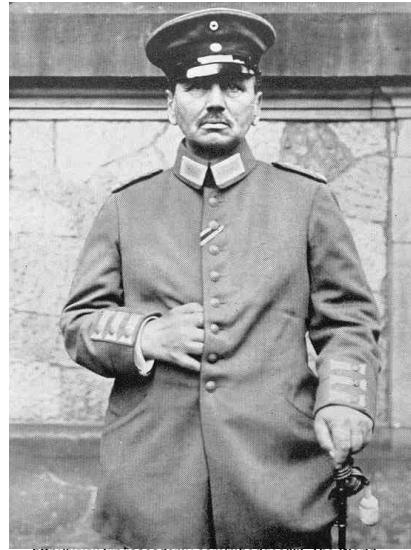
Somebody didn't talk to somebody

and/or

Somebody couldn't talk to somebody

German offensive of 1914 (WW1)

- Cars & motorcycles to pass messages
- Wireless communications
 - Distances up to about 130 miles
 - French jamming station on top of the Eiffel Tower severely limited effectiveness
 - Messages often had to be repeated several times
 - Often 12 hours + to successfully pass a wireless message
- German armies in the west spread over hundreds of miles
- Commanders made field decisions that resulted in deviations from Schlieffen plan
 - Von Kluck's turn to the Southeast, Aug. 31
 - Prince Rupprecht counterattack in Lorraine, Aug. 18th
- Coordination problem was produced that could not be solved with the slow and unreliable communications available.
- Contributed to German defeat in 1st Marne
- Dashed German hopes for a quick victory
- End of mobile conflict & beginning of bloody trench warfare
- *Auftragstaktik* needs good communications & shared awareness!
 - Worked well in Franco Prussian War of 1871, with smaller armies & smaller fronts



http://www.kingsacademy.com/mhodes/03_The-World-since-1900/02_World-War-One/02a_1914.htm

Gen. von Kluck



http://www.kingsacademy.com/mhodes/03_The-World-since-1900/02_World-War-One/02a_1914.htm

Prince Rupprecht of Bavaria (L)



<http://pierreswesternfront.punt.nl/content/2008/08/marne-verberie-nery-villers-cotterets>



<http://pierreswesternfront.punt.nl/content/2008/08/marne-verberie-nery-villers-cotterets>

British “Great Retreat” of 1914 (WW1)

- Communications collapsed completely as cavalry brigades separated from each other
- Communications depended greatly on motor vehicles
- roads of northern France had become so clogged as to be almost impassable

Russia/Georgia 2008

- Russian forces not enough communications equipment
- What they did have was antiquated
- Commanders relied on personal mobile phones for C2
 - Worse yet, calls had to go through the enemy's infrastructure
 - South Ossetian cellular networks run by Georgia!
- 58th Army Commander, Lieutenant Anatoliy Khrulev, had to borrow a satellite telephone from a journalist to communicate with his forces



<http://nimg.sulekha.com/others/original700/russia-georgia-war-anniversary-2009-8-7-7-41-45.jpg>

Mayaguez 1976

- UHF radios destroyed in a helicopter crash
- Remaining VHF radios overloaded
- Communication between aircraft and Marines on the ground very difficult
- Crucial problems coordinating air strikes



<http://dmn.wpengine.netdna-cdn.com/wp-content/uploads/2012/07/Koh-Tang-Island-SOF-Mission.jpg>



Inability to Communicate: Equipment/Bandwidth

- **9/11**
 - FDNY radios performed very badly inside buildings
 - Repeater system that had been set up to solve such problems was not properly activated because of human error
 - Shortage of bandwidth also plagued both the NYPD and FDNY.
- **King's Cross Underground Fire, 1987**
 - Responders had severe difficulties with radio communication underground



http://totallycoolpix.com/wp-content/uploads/2011/10092011_remembering_9_11/nyc_008.jpg



<http://secondsfromdisaster.net/wp-content/uploads/2013/01/kings-cross-fire.jpg>

Inability to Communicate: Interoperability

Iran hostage rescue attempt, 1980

- Army Rangers guarding landing site in the Iranian desert used radios that could not communicate with Delta Force or Air Force personnel
- Rangers unable to inform ground commanders in a timely fashion when a bus full of Iranian civilians appeared, complicating the operation.
- Landing site could not talk to the helicopter fleet



http://news.bbc.co.uk/1/04/shared/spl/hi/picture_gallery/04/middle_east_iran_hostage_crisis/img/6.jpg

Grenada 1983

- Marines in north & Army Rangers in south used radios in non-interoperable fashion
- Could not talk to each other.
- Marines ran into trouble, the Rangers did not know about it
- Highly publicized incident in which a soldier had to call for air support by placing a commercial long distance telephone call from Grenada to Fort Bragg, North Carolina



<http://www.defenseimagery.mil/imageRetrieve.action?guid=ceb1e816ab2ca40ae10443bc1118590417ed95b4&t=1&w=538&h=538>

Russia-Georgia War, 2008

- Ground units unable to communicate with space-based & electronic intelligence assets
 - Russians could not employ electronic warfare systems to full advantage to suppress Georgian air defenses
 - Could not make full and effective use of satellite targeting support or precision guided munitions
- Interoperability problems between units of different services of Russian armed forces
- Ground commanders very little control over needed air support
 - Reportedly, Colonel General Aleksandr Zelin directed air operations personally by mobile phone from Moscow



<http://www.defence.pk/forums/military-forum/170680-russian-commander-explains-air-force-acquisition-plan.html>

Inability to Communicate: Interoperability

- **9/11 Runup**
 - No interoperability between IT & C2 systems of FAA & NORAD
- **9/11 Aftermath**
 - Units of first responders on the ground often unable to communicate with each other
 - Port Authority Police Department radios could not talk to those of the FDNY



http://totallycoolpix.com/wp-content/uploads/2011/10/092011_remembering_9_11/nyc_002.jpg

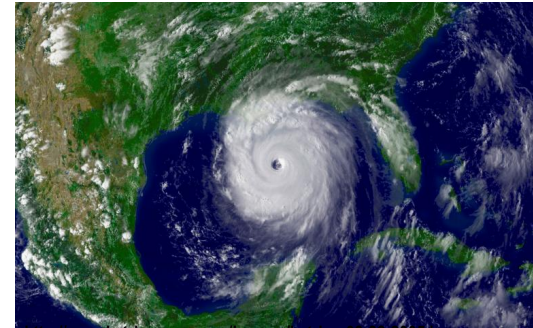


http://totallycoolpix.com/wp-content/uploads/2011/10/092011_remembering_9_11/nyc_008.jpg

Inability to Communicate: Interoperability

Hurricane Katrina, 2005

- DoD no information sharing protocol for situational awareness between all deployed military units
- Interoperability problems between units of different federal, state, & local agencies on the ground
- Joint Task Force Katrina, National Guard, & States of Louisiana and Mississippi could not talk to each other



<http://www.katrina.noaa.gov/images/katrina-08-28-2005.jpg>

Australia Black Saturday fires, 2009

- Metropolitan & regional police forces--incompatible radio systems
- No interoperability between different emergency agencies



http://www.sydneycare.org.au/content/r337173_1529332.jpg

King's Cross Underground fire 1987

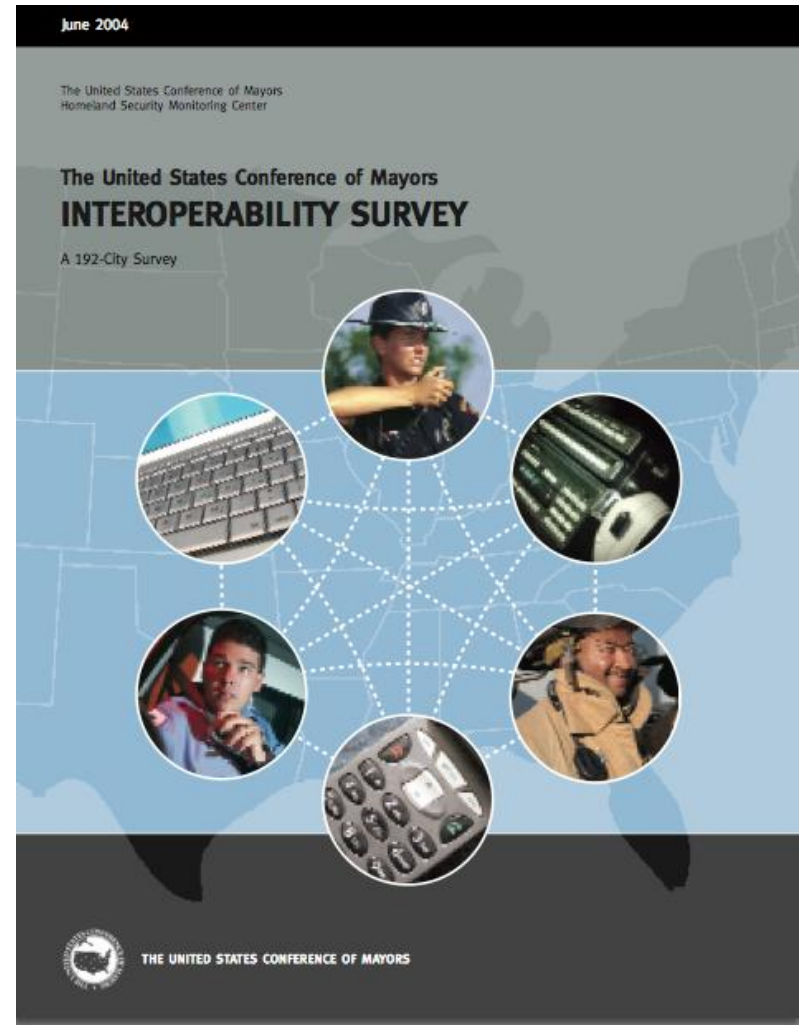
- No interoperability between different emergency agencies
- No interoperability and between them & London Underground
- Identified as problem in Fennell Report (1988)
- But recurred at least partially in response to the 2005 "7/7" London bombings



<http://secondsfromdisaster.net/wp-content/uploads/2013/01/kings-cross-fire.jpg>

Study of 192 U.S. cities published 2004 by U.S. Conference of Mayors

- 86% did not have interoperable communications with their state transportation department
- 83% not interoperable with the DoJ or DHS
- 60% not interoperable with their state emergency operation centers
- 49% not interoperable with state police.



Iran Hostage Rescue, 1980

- C-130 transport airplane heading to landing site (“Desert One”) encountered a large desert dust cloud (a *haboob*)
- *Haboob* not a major problem for the airplane but serious threat to 8 helicopters following far behind
- C-130 **did not warn the helicopters because of strict dictate of radio silence**
- Helicopters entered *haboob*
- **Because of radio silence could not tell each other** what they were doing or where they were going
- One helicopter had to abort because of a suspected blade failure
Two others left *haboob* & landed
 - First: Group Leader
 - Second: Helicopter carrying spare parts
- Leader made secure call to U.S. command center in Egypt
 - Told to proceed to the rendezvous landing site (“Desert One”)
 - But none of the other helicopters could hear the conversation
- Second made independent decision to return to aircraft carrier *Nimitz*
 - None of the helicopters could talk directly to Desert One and thereby learn that landing site was clear
 - Later he said he would have continued had he known
- **Critical loss of needed helicopters and crucial spare parts at Desert One**

Example of a *haboob* (Iraq, 2005)



<http://dmn.wpengin.netdna-cdn.com/wp-content/uploads/2012/07/RH-53-Sea-Stallions-Iran-Operation.jpg>

Failure to Communicate (Behavioral)

- **Battle of Savo Island, Aug. 8, 1942**
(Guadalcanal Campaign, WW2)
 - Cruiser groups of Allied screening force guarded against Japanese naval attack
 - On night of battle, commander of the screening force, Rear Adm. V.A.C. Crutchley, took his ship out of the southern cruiser group to attend conference with Admiral Richard Turner
 - Did not inform 2nd-in-command, Capt. Frederick Riefkohl, who was in the northern cruiser group
 - Riefkohl remained ignorant that he was now in command of the screening force
 - Moreover, a crucial radio message warning of an impending attack was not relayed to Riefkohl, because of human error
 - Japanese attacked, with no coordinated response



Adm. Crutchley



Capt. Riefkohl



Failure to Communicate (Behavioral)

- Hurricane Katrina (2005)
 - Louisiana Superdome—collection center for people who would later be further evacuated
 - FEMA had evacuation plan & was ready to execute.
 - Commander of Joint Task Force Katrina, General Russel L. Honoré, told National Guard to cancel the plans
 - —but he did not inform FEMA
 - Delayed evacuations
 - Ernest N. Morial Convention Center declared as refuge by Mayor Nagin
 - Mayor did not broadly communicate this decision
 - FEMA & DHS did not realize until two days later
 - 19,000 people were stranded at the convention center without supplies



<http://hiphopwired.com/wp-content/uploads/2012/08/KatrinaSuperdome.jpg>

Louisiana Superdome



http://media.nola.com/politics/photo/convention-center-chaper-katrina-book-dd1f9bd619c9c82c_large.jpg

Morial Convention Center

Failure to Communicate (Behavioral)

- **Hillsborough Stadium Disaster, April 15, 1989**
 - “communications between all emergency services were imprecise and inappropriately worded, leading to delay, misunderstanding, and a failure to deploy officers to take control and coordinate emergency response.” [Hillsborough Independent Panel Report, 2012]
- **Norway Attacks, July 22, 2011**
 - After bombing but before mass shootings
 - Citizen gave police a description of perpetrator, and vehicle license number
 - Officers did not pass the information up command chain for at least 20 minutes
 - Did not reach right people for two hours
 - By that time shootings on Utøya Island had already begun



<http://static.guim.co.uk/sys-images/Guardian/Pix/pictures/2012/12/19/1355903591995/Hillsborough-disaster-010.jpg>



<http://www.smh.com.au/world/police-begin-questioning-of-christian-fundamentalist-20110723-1hua4.html>

- **9/11 Runup**
 - Air defense organizations & civil air traffic organizations each had own independent silos
 - Vertical communication, not horizontal
 - Not enough cross-coordination
 - Delays meant not enough time to shoot down hijacked planes

- **9/11 Aftermath**
 - Organizational seams between NYPD, FDNY, PAPD
 - Exacerbated interoperability & other communications problems
 - Redundant searches for civilians & other inefficiencies



http://totallycoolpix.com/wp-content/uploads/2011/10/092011_remembering_9_11/nyc_002.jpg



http://totallycoolpix.com/wp-content/uploads/2011/10/092011_remembering_9_11/nyc_008.jpg

Iran Hostage Rescue, 1980

- Highly complex operation
- Several organizations
 - US Army Delta Force
 - US Army Rangers
 - US Air Force Pilots
 - US Navy Helicopter Pilots
- Compartmentalization & mutual mistrust
- Lack of unified command
 - No single component commander to unify AF airplanes and Navy helicopters
 - No single ground component commander to unify Delta Force & Rangers
- Put this together with communications interoperability problems, security constraints, and bad luck, and you get disaster



<http://dmn.wpengine.netdna-cdn.com/wp-content/uploads/2012/07/RH-53-Sea-Stallions-Iran-Operation.jpg>



http://news.bbc.co.uk/1/1/shared/spl/hi/picture_gallery/04/middle_east_iran_hostage_crisis/img/6.jpg

Mayaguez Incident and Battle of Koh Tang, May 1975

- Insufficient unity of effort between
 - US Marines
 - US Air Force
 - US Navy
- Not organized into cohesive task force
- Planning process disjointed both physically & organizationally
- Not everyone attended sessions or knew the plans well
- Exacerbated by communications equipment shortages on the ground
- On top of this, micromanagement from Washington
 - At one point, in heat of battle, Marines had to respond to info request from Washington:
 - Did they have a Khmer interpreter?
- US won, but fighting was difficult and margin of victory much smaller than should have been
- C2 problems overcome by initiative and heroism



<http://www.usmm.org/mayaguez.html>



http://www.specialoperations.com/Operations/mayaguez_USMC_deploying_on_Koh_Tang.jpg

Russia-Georgia War, August 2008

- Russian military organized along Cold-War Soviet lines
 - For large fights involving massive armies
- Little overall coordination between
 - Army
 - Air Force
 - Navy
 - For joint prosecution of a small operation
- Subordination of Army aviation to Russian Air Force
 - Led to failures to provide close air support
 - Calls for return of tactical aviation to Army Ground Units
- Russians won, but not as easily as they should have
- War acted as stimulus for Russian military reform



<http://nimg.sulekha.com/others/original700/russia-georgia-war-anniversary-2009-8-7-7-41-29.jpg>

Great British Cavalry Retreat of August, 1914, WW1

- Heads of cavalry brigades used to taking initiative and not being micromanaged.
 - Served British well in the various “small wars” of the Empire
 - Created problems in WW1
- Retreating cavalry brigades did have difficulties communicating with General Allenby at HQ
- But they were not terribly inclined to communicate in the first place
- As brigades retreated, completely lost touch with each other and HQ
- British Cavalry effectively disintegrated as a viable unit for a time
- In battle of Le Cateau on 26 August, Allenby unable to offer any assistance to the Second Army Corps—his brigades were effectively gone.



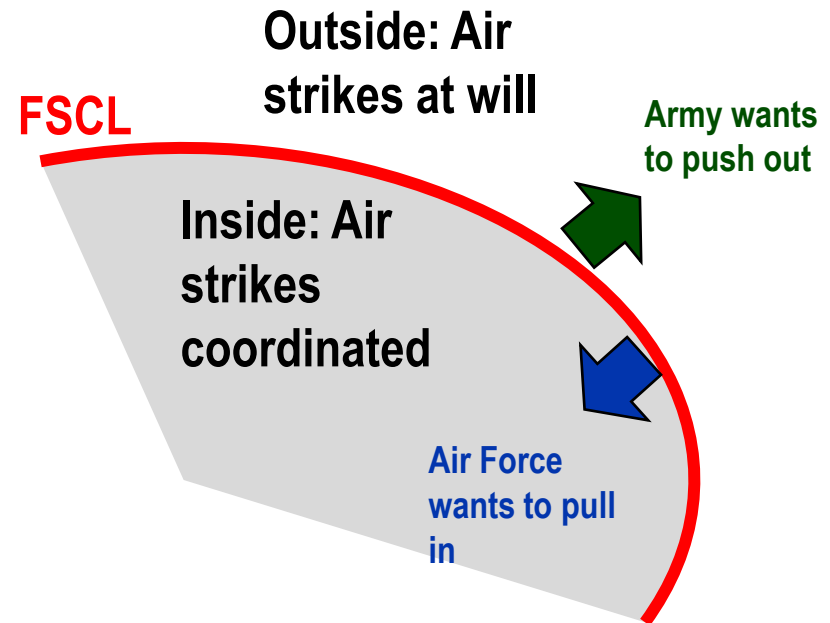
<http://pierreswesternfront.punt.nl/content/2008/08/marne-verberie-nery-villers-cotterets>



<http://www.iwm.org.uk/collections/item/object/205024060>

Fire Service Control Line (FSCL), Desert Storm, 1991

- Placement of FSCL not properly coordinated
- Army kept moving it out to avoid fratricide
- AF preferred to pull it in to maximize ability to engage enemy
- Army often did not advance fast enough to justify outer placement
- But line not repositioned
- Hampered AF from pursuing enemy forces
- FSCL served to shield a significant portion of the Iraqi Army!



Hurricane Katrina, 2005

- Roles of U.S. federal agencies were not properly delineated
- Neither was relationship to state & local agencies
- Major structural *a priori* coordination deficits between
 - DoD
 - FEMA
 - State of Louisiana
- E.g., Both local police & National Guard working at Louisiana Superdome
 - But each side said the other was supposed to lead
 - This led to security problems, & many responders left



<http://www.katrina.noaa.gov/images/katrina-08-28-2005.jpg>

Similar problems in other disasters

- **Indian Ocean Tsunami, 2004**
 - Militaries from 11 countries
 - Each had different relationship with Indonesian Government
 - Lack of coordination between:
 - The various militaries
 - The militaries & NGOs
 - The International NGOs & Indonesian NGOs
 - US & UN agencies
 - Meetings “a shambles” [NATO SAS 065]
- **Australia Black Saturday Fires, 2009**
 - Roles of senior personnel unclear
 - Victoria Country Fire Authority (CFA) & Victoria Dept. of Sustainability & Environment (DSE) followed inconsistent operating procedures
- **King’s Cross Underground Fire, 1987**
 - London Underground uncoordinated, haphazard
 - Poor coordination between London Underground, Police, & Fire Agencies



<http://www.sanandreasfault.org/Sumatra1.jpg>



http://www.sydneyfire.org.au/content/r337173_1529332.jpg



<http://secondsfromdisaster.net/wp-content/uploads/2013/01/kings-cross-fire.jpg>

C2 Failure Characterization

Military Operations		Inability to Communicate				
Incident	Structural Problems	Failure to Communicate	Lack of Interoperability	Infrastructure/Equipment Failure	Equipment or Bandwidth Shortage	Security Constraints
Great Retreat of 1914, First World War						
German army in runup to 1st Battle of the Marne, First World War						
1st Battle of Savo Island, Guadalcanal Campaign, Second World War						
Mayaguez Incident						
US Hostage Rescue Mission						
US Invasion of Grenada						
First Gulf War, Operation Desert Storm, FSCL						
Russia-Georgia War						

C2 Failure Characterization

Terrorist Attacks

Incident	Inability to Communicate					
	Structural Problems	Failure to Communicate	Lack of Interoperability	Infrastructure/Equipment Failure	Equipment or Bandwidth Shortage	Security Constraints
Oklahoma City Bombing Response						
911 Attacks Response and Possible Prevention						
7/7 London Bombings Response						
2011 Norway Attacks Response						

C2 Failure Characterization

Disasters and Emergencies						
Incident	Structural Problems	Failure to Communicate	Inability to Communicate			
			Lack of Interoperability	Infrastructure/Equipment Failure	Equipment or Bandwidth Shortage	Security Constraints
King's Cross Underground Fires Response						
Clapham Railway Junction Accident Response						
Hillsborough Stadium Disaster Response						
Hurricane Andrew Response						
Columbine High School Shootings Response						
Indian Ocean Tsunami Response						
Hurricane Katrina Response						
Black Saturday Fires Response						

“No one in charge”

Incident	Quote	Reference
Black Saturday Fires Response	"...roles of the most senior personnel were not clear, [...] no single agency or individual in charge ..."	Parliament of Victoria, 2009 Victorian Bushfires Royal Commission (2010), p.8
Hurricane Andrew Response	"... failure to have a single person in charge with a clear chain of command."	Florida Governor's Disaster Planning and Response Review Committee (1992), p. 60
9/11 Attacks	"... no one was firmly in charge of managing the case...Responsibility and accountability were diffuse." [about intelligence]	National Commission on Terrorist Attacks upon the United States (2004), p.400
King's Cross Fire Response	"... uncertainty over which of the London Underground staff was in charge ..."	Fennell (1988), pp. 73-74
Iran Hostage Rescue	"...confusion about ' who was in charge '"	Anno & Einspahr (1988), p.10
	"... uncertainty as to who was in charge ."	Thomas(1987) p.10
	"... no one..who was in overall charge ..."	Gass (1992), p.15
	"... no way to quickly find out or locate who was in charge ..."	Holloway (1980), p. 51
Mayaguez Incident Response	"[planning activity] lacked coordination... No one seemed to be in charge ."	Toal (1998), p.18
Hurricane Katrina Response	"... no single individual who took charge ..."; "State officials and FEMA disagreed about who was in charge ..."	Moynihan (2006), pp. 22,24
	"Too often, because everybody was in charge, nobody was in charge "; "... no consensus on who was in charge "; "... disagreed on who was in charge,could not find out who was in charge , or did not know who was in charge ..."	U.S. House of Representatives (2006), pp. xi, 185, 186
Indian Ocean Tsunami Response	"...coordinating meetings were 'very unwieldy' and 'internal coordinating meetings were a shambles.'"	Huber et al. (2008), p.4
Columbine High School Shootings	"... ' Who's in Charge? ' No one could answer the question ."	Moody (2010), p.39



This Does Not Mean a Single Organization Always has to be in Charge

- **Key is C2 approach matched to mission & circumstances**
- **Shared awareness & intent**
- **Roles & responsibilities understood**

- **C2 failures do not always result in mission failure, although they typically result in adverse effects**
- **Different C2 approaches, of varying degrees of decentralization, may have different failure propensities under different circumstances**
 - E.g., a collective that is distributed, but not properly integrated, may sometimes be more adversely affected by communication failures than a traditional, tightly-knit hierarchy
 - » Relatively decentralized mission-command paradigm of the German Army at the beginning of World War I is a did not work well in the absence of assured communications
 - » Russians in Georgia (2008) were perhaps too hierarchical, but would a more decentralized paradigm really have helped given all the communications limitations?
 - Parallel hierarchical structures with vertical communications silos may not be able to respond to rapidly changing conditions
 - » E.g. NORAD and FAA in 9/11



Causes, Manifestations and Impacts of C2 Failures

