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United 232: Coping With the "One-in-a-Billion" Loss of All Flight Controls

The aircraft's captain explains how well a flight crew handles a crisis in the air depending upon luck, communications, preparation, execution and cooperation.

by
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At 1516 hours on July 9, 1989, the author was captain of United Flight 232, a McDonnell Douglas DC-10-10. While cruising at 37,000 feet, the aircraft suffered a catastrophic engine failure. The uncontained disintegration of the number two engine's fan rotor caused the loss of all three of the aircraft's redundant hydraulic flight control systems and made the aircraft almost uncontrollable.

Capt. Haynes and his crew, augmented by a DC-10 instructor pilot who was aboard as a passenger, were able to navigate to the municipal airport at Sioux City, Iowa, U.S., where the aircraft was crash-landed approximately 45 minutes after the hydraulic failure. Of the 285 passengers and 11 crew members aboard, 174 passengers and 10 crew members survived.

That the aircraft was controlled at all and there were any survivors in this unusual circumstance was recognized by the industry as extraordinary airmanship by the crew. Among many other accolades, Capt. Haynes and his crew were awarded the Flight Safety Foundation President's Special Commendation for Extraordinary Professionalism and Valor during the Foundation's 42nd International Air Safety Seminar in Athens, Greece, during November 1989, the first formal international recognition of their accomplishment.

Capt. Haynes subsequently assembled his reflections on what happened during the ordeal along with input from a paper on the Sioux City area's response to the disaster by Michael T. Charles, Ph.D. The following is what he considers five primary factors involved in making it possible to cope with a major inflight emergency such as the one-in-a-billion loss of all flight controls.

Factor Number One Is Called Luck

There are five very important factors that contributed to the degree of success that occurred during the events that led to our landing at Sioux Gateway Airport: luck, communications, preparation, execution and cooperation.

The occurrence of good fortune may have differing connotations according to individual personal beliefs, but for this discussion we will call it luck. You could say we had bad luck in the form of an occurrence that, according to all the odds, could not be expected ever to happen. But we also had good luck, in that we were left with a chance to survive.

For instance, how did we get the aircraft to Sioux City to begin with, after the six-foot diameter fan on the number two engine (the center engine located on the vertical tail) failed? In less than one revolution, it instantaneously sprayed fan blades and pieces out through the right side of the engine housing, cutting a large gash in the forward edge of the horizontal stabilizer, separating a 12- by 10-foot cone section of the tail and peppering the horizontal stabilizer with more than 70 pieces of shrapnel.

The hydraulic lines of one of the three systems were torn out with the accessory section of the failed engine and the shrapnel from the disintegrated fan instantly severed the hydraulic lines of the remaining systems. The staggering import of that instantaneous and absolute occurrence can be better realized by an understanding of the workings of the flight control system on the DC-10.

In company with the Lockheed L-1011, Boeing 747, some military aircraft and others that are coming along, the DC-10 does not have cables running between the pilot's control column and the control surfaces that, in jumbo jets, can involve extreme distances. Long cables can develop slack, can bind and require considerable attention to lubrication and maintenance. This older technology is being replaced by electrical/electronic and hydraulic connections between the pilots' controls and the flight surface actuators.

Haynes: Everyone was confident that the "impossible" complete loss of all flight controls was not going to happen.

The cables from the control columns in the DC-10 lead only a short distance to the hydraulic controls that actuate the control surfaces through hydraulic piping that leads to actuators at each control in the wings and tail. There is no provision for manual operation of the flight controls. This is because of the triple redunduncy afforded by the three independent and continuously operating hydraulic systems. These systems are intended to provide power for full operation and control of the aircraft in case one, or even two, of the hydraulic systems fail.

A catastrophic failure of all three systems was considered by designers to be almost infinitely remote; we had enough redundancy in the system to feel that this was not going to happen. I was told one time that if I have odds of ten to the ninth power against something happening, that is a one-in-a-billion chance. And that is what the designers said was the case here. In the DC-10, the three hydraulic systems are not connected, fluidwise, so if the fluid is lost in one system, it will not lose the fluid in the other two. The systems are connected mechanically through an electric pump so that if the pressure in one system is lost, the pressure in another system will immediately start a motor that will drive a pump in the failed system and the three systems will be restored to service.

All of the separate hydraulic lines are routed to different control surfaces, which themselves are split for actuation by different hydraulic systems for even further redundancy. Hydraulic system number one operates some sections of the major controls such as ailerons, rudder and elevator and flaps; system two runs other sections of the same control surfaces; and system three adds further backup. So the three systems can actually be reduced to one hydraulic control system and the pilot can still control the airplane. And if all else fails, there is an air-driven generator that is extended from the underside of the airplane to drive one of the emergency hydraulic pump motors in the tail.

So, everyone was confident that the "impossible" complete loss of all flight controls was not going to happen.

But on July 19, 1989, Murphy's Law caught up with the airline industry and our aircraft lost all three hydraulic systems. That left us at 37,000 feet with no ailerons to control roll, no rudders to coordinate a turn, no elevators to control pitch, no leading edge devices to help us slow down for landing, no trailing edge flaps to be used in landing, no spoilers on the wings to slow us down in flight or to help braking on the ground, no nosewheel steering and no brakes.

That did not leave us a great deal to work with.

What we did have was control of the number one throttle and number three throttle, so by adding thrust on one side and reducing thrust on another we could force the airplane in a skid to turn one way or another. Our biggest problem was pitch control. With no pitch control, and just the slight amount of substitute steering capability we had, it is a wonder to me that we ever got the airplane on the ground, and I attribute that to a great deal of luck. The things that we happened to try that day (not having any idea of what would result because this situation had not been expected or practiced for) happened to be the right things, and they happened to work. So luck played a very big part in even getting the airplane to respond.

The second lucky thing was the location. We could have been half-way to Honolulu, or over the middle of the Rocky Mountains, or we could have been taking off right over a city. But as it was, we were over the reasonably flat lands of Iowa, which gave us a little bit of confidence in our minds about survival. I had serious doubts about making the airport at times, but the four of us in the cockpit did have some feeling that if we could just get the airplane on the ground, because of the flat farmland below, we could expect survivors. That helped in the back of our minds as we were trying to fight this problem.

Luck with the weather was another important factor. If you have ever flown over the U.S. Midwest in July, you know there is usually a line of thunderstorms that run

from the Canadian border down to Texas, and it would have been absolutely impossible with marginal control of the aircraft to get through a thunderstorm safely. As a matter of fact, one year to the day later, when we were in Sioux City for a memorial service for those on Flight 232 who did not survive, there was a huge thunderstorm directly overhead; had that storm been there the day of the accident, there was no way we could have gotten the airplane in to the airport at all. So the favorable weather was very important.

The time of day that our engine failure occurred was another very lucky circumstance. Almost four o'clock in the afternoon, it was approaching shift change at Marion Health Center and St. Luke's Hospital and all the other emergency services around the Siouxland area (Sioux City and surrounding communities). By the time we did arrive in Sioux City, our plight having been reported, the morning shifts were kept over and the day shifts were just going on duty, so both hospitals were double-staffed. Further, there were so many volunteers from the various emergency units and health clinics around the area that the hospitals had to turn some of them away.

… it's just an unbelievable amount of luck that helped us get the airplane there … .

And, as a final piece of luck, it was the only day of the month when the 185th Iowa Air National Guard was on duty, and there were 285 trained national guard personnel standing by waiting for us when we got to Sioux City. So, put all of those things together and it is just an unbelievable amount of luck that helped us get the airplane there, to receive the level of help we did and to experience the survival rate that we had.

Factor Number Two Is Communications

A second big factor in our favor that day was communications, which played another very important part in our having the survival rate that we had. It started in the cockpit with communications to air traffic control in Minneapolis Center and then with Sioux City approach control and control tower.

Communications within the cockpit intensified as soon as we realized that we were in very serious trouble. I turned to our second officer Dudley Dvorak, and said, "Dudley, get in touch with San Francisco aero maintenance (SAM) and see if there is any way they can help us, in case they know something we don't." We had ran out of ideas in about 20 seconds, and we needed some help. Dudley got on the radio and spent that entire time communicating with our SAM facility that had a group of experts who were immediately brought in. They got on the computers and checked through the log books to see if there was any information they could find that could help us. As it turned out, of course, there was nothing they could do to help us.

However, the communications that was established with SAM had the secondary benefit of allowing our dispatch center in Chicago find out where we were and what we were going to do. We certainly did not have time to call them separately, as well as SAM and ATC (air traffic control) to tell them what was going on, so they monitored what Dudley was saying to SAM. Therefore, the personnel in our Chicago flight center were so prepared for us to go to Sioux City that they pulled an airplane out of a hanger in Chicago, loaded it with emergency supplies and people, flew it to Sioux City, and some of our staff were in the hospital before I was admitted to my room. That is how quickly they responded. And it was done through communications, good positive communications on Dudley's part.

Kevin Bauchman, who happened to be on the radar console at Sioux City Approach Control at the time, became our primary contact with ATC services after we were handed off from the center. He was backed up by a team of five controllers in the Sioux Gateway Airport control tower, co-located with the approach control, who worked together to coordinate the many aspects involved in preparing for the arrival of our aircraft.

If you have a serious problem like we did, and you need the kind of help that does not add to the tension level, a voice like Bauchman's, as calm and as steady as he was, certainly was an influence on us and helped us remain composed. The only time that Kevin's voice ever cracked was when he found out that we were in position to land on runway 22 instead of runway 31 and he had emergency equipment sitting in the middle of our intended landing area — and it only had two minutes to get out of the way before we arrived. He raised his voice just slightly and then fell right back into his calm, soothing, here-it-is, voice. When I had the opportunity later to compliment Bauchman on his coolness throughout the tense situation, he told me, to my surprise, that he had transferred to Sioux City because he found his previous duty station too stressful.

Meanwhile, extensive communications were going on between the emergency response dispatcher and the individual ground units. They worked extremely well together. We heard controller Bauchman tell us, "We have equipment standing by at the airport and we also have them out in your direction." When we reported that we may not make it to the airport, emergency dispatchers

actually called local communities in the area we were flying over and had them dispatch emergency vehicles out to the highways to find us and follow us, and if we landed out there somewhere to be as close as they could possibly be. Good, very good communications.

The communications between the cockpit and the cabin crew were good, as good as they could be, considering the intense workload in the cockpit that precluded extensive contact with the cabin crew. And the communications between our flight attendants with their passengers were good all the way around — a very important factor.

Preparation Is the Third Factor

How do you prepare for something like this? I gave a talk to a safety council in Alaska and it had been titled "Crisis in the Air, Are You Ready?" My answer to that was "No. You are never ready. You can be prepared, but you are never ready." Preparation, therefore, is very important, and how did everybody prepare?

Let us start with the emergency response group in Sioux City. In 1987, they had a disaster drill; they are required to have one every three years, I believe. This is a live drill, and once every year, in between the live drills, there is an informal "paper" drill. During the live drill in 1987, the organizers pretended that a wide-body airplane that does not serve Sioux City crashed on the airport's closed runway. The "wreckage" was off to one side of the airport so that it would not really interrupt the operations of the airport, and rescue personnel had 150 survivors to work with. The director of emergency services, Gary Brown, was not completely satisfied with the drill, however; he thought it needed more. He made the necessary changes and began to reorganize the plan just a little bit. Brown brought in more services, and involved more communities in the general area in a mutual aid program.

Haynes: The communications between the cockpit and the cabin crew were … as good as they could be, considering the workload … .

I have seen pictures in magazines where a fire truck is sitting on a county border while the house across the street burns because the communities do not have a mutual aid program. We did not have that problem in Sioux City. No one cared whether they had mutual aid or not. The emergency dispatchers called a community and said, "this airplane is coming in and may not make it — get your equipment out and go there." They went out. And that was part of the Sioux City disaster plan, which had some flexibility so that they could use the surrounding communities. And, the communities' representatives sat in on the planning meetings.

One very important health group was also brought in to the planning meetings that heretofore had not been brought in very much — the post traumatic stress unit. Prior to my emergency, I did not pay much attention to the subject of post traumatic stress which Vietnam, Korean War and World War II veterans experienced. I certainly do now — it is a very, very serious problem. The after-the-fact stress of a trauma is going to occur; it can rear its ugly head any day, and in this particular case in Sioux City the response group brought in the post trauma unit right away, so its personnel could begin their operations at the scene of the accident.

So the preparation effort by Sioux Gateway Airport and the surrounding communities was to get a plan, keep it ready and come back for another look to see if it needs changing. The organizers updated it constantly, they rehearsed it, and they drilled it, they went through it at all their meetings to see that they were properly prepared.

Preparation also was an important factor for the members of the cabin crew of Flight 232. Their preparation was done through recurrent training every year, where they are taught to inform passengers how to prepare for an emergency landing. To be thrust into an actual emergency situation with disastrous implications was a great shock to all eight of the flight attendants (nine, actually, because one who was deadheading helped out). They had been practicing this procedure during their entire time in service from one month for our most junior flight attendant to somewhere between 15 to 20 years for the most senior one, but they never dreamed they would ever have to do it. Through proper preparation by our training center, which I am very confident is also practiced by other carriers, they were able to do what they had to do because they were prepared.

And then you come to us — how does the cockpit crew prepare for a situation like this? Well, there is no training on earth that can prepare you to do this. This is something that conventional wisdom said could not happen, would never happen, and therefore there was no procedure in the book for doing it; so preparation in that respect was not possible. But through the constant recurrent training that we accomplish every year, practicing in the simulator types of emergencies that we can expect, we were supplied with some clue as to how to start. I am firmly convinced that the best preparation we had is a program that United Airlines started in 1980

called Command Leadership Resource Management (CLRM) training. It is now referred to as Cockpit Resource Management (CRM).

The CRM training program was instituted following a couple of accidents that debunked the old axiom which states that what the captain says is law and implies that he is omnipotent. When the captain does not know how to resolve a situation, why should he be the only one involved in the problem-solving effort? During the development of this training program, we found that there is a lot of experience sitting in the other two seats, so why not use it? Why not train the other flight crew members to respond in such a way that the captain will consider their advice and utilize their knowledge?

When the captain does not know how to resolve a situation, why should he be the only one involved in the problem-solving effort?

This program was started as a kind of a game. Three chairs were arranged in a room, one each for the captain, the copilot and the second officer. A scenario was given to the crew members for them to follow. In a training session I participated in, I played the part of the copilot and I was to be the only one with any sense. The captain was what we call a demigod, he played the part of the autocrat who said, "If I say we're going, we're going," and his intention was to take off into a thunderstorm. My job, according to the script, was to keep him from doing it any way I could. The second officer was to act like a wimp. He did not care what the captain did; he would go along with it.

We all played our parts well. The captain was a complete tyrant. We did not like him, and I really almost did hate him by the time we completed the exercise. But what we did, was work together to try and find a way to stop the captain from putting the aircraft and its occupants into an unsafe situation. It reached the point where the only way I could stop him from taking off was to just stand on the brakes. Now, it is very difficult to make an airplane take off while the copilot is sitting on the brakes, and the goal of the exercise was attained. Thus, we focused on the main point of the CRM training program, which is that it teaches the crew to work together. It showed that we could have resolved this problem much more amicably and efficiently among the three of us if we had all applied the principles of CRM.

I am firmly convinced that CRM played a very important part in our landing at Sioux City with any chance of survival. I also believe that its principles apply no matter how many crew members are in the cockpit. Those who fly single-pilot aircraft sometimes ask, "How does CRM affect me if I fly by myself?" Well, CRM does not just imply the use of other sources only in the cockpit — it is an "everybody resource." To these pilots I say there are all sorts of resources available to them. Ask an astronaut if he thinks he got to the moon by himself. I don't think so — he had a great deal of help.

All pilots have a lot of help; all you have to do is ask for it and use it when you get it. What would we on Flight 232 have done without Kevin Bauchman, the ATC controller who did so much to get us to the Sioux City airport? The DME (distance measuring equipment) at the Sioux City VOR (visual omni range) navigational transmitter was not working that day, and we had no idea how far we were from the station. By informing him of our situation and asking him for help, he kept us constantly informed as to where we were, and adding the height information from our altimeters, we were able to get to Sioux City. The bottom line for pilots is that you have resources available to you. Use them as team members — you are not alone up there. If you do have a copilot, listen to her or him. They are sure to have some advice for you. There were 103 years of flying experience in that cockpit when we faced our nemesis and it came through to help — but not one minute of that 103 years had been spent operating an airplane the way we were trying to fly it. If we had not worked together, with everybody coming up with ideas and discussing what we should do next and how we were going to do it, I do not think we would have made it to Sioux City.

Execution Comes Next

Now for the execution. How did everyone accomplish what each was trying to do during the emergency over Iowa? We will begin with the cockpit crew. When the engine blew, William R. Records, the first officer, was flying the aircraft in the copilot's position. It was his leg, and the aircraft was on autopilot. Bill has about 26 years of flying experience with National, Pan Am and United.

The rest of the flight crew members were sitting there, on this beautiful day after lunch, having a cup coffee, watching the world go by, when without any warning whatsoever there was a very loud explosion. At first, I thought it was a decompression. It was that loud and that sudden. But there was no rush of air, no change of pressure and no condensation of the air in the aircraft. So I had to figure, it was something else.

I saw Bill immediately grab the control yoke and the red warning lights illuminate for the autopilot. He had cut

the autopilot off, I thought, and I assumed that he was taking over manual control of the airplane. Now, I thought, we have taken care of step one in any emergency and that is that someone flies the airplane. We have had a number of accidents in commercial aviation because everybody was working on the problem, which sometimes is not a big problem in the first place, and no one is flying the airplane. So step one, in any training center, is that somebody flies the airplane. That is a little difficult if you are going to be by yourself. But that is still the first thing you have to do: fly the airplane.

I thought next, now that Bill is flying the airplane, I can divert my attention to Dudley — second officer Dudley J. Dvorak — and we can shut the engine down which is our job. So he and I determined that the number two engine had failed, and at the time we thought that was all that was wrong. I called for the checklist and Dudley got out his book, laid it on the console, and read the first item of the engine shutdown procedure. He said, "Close the throttle."

And the throttle would not close.

Now, I have never shut a jet engine down before in flight, because they have become so reliable. This was my first experience of losing an engine in flight on a jet aircraft. In a simulator, you pull the throttle back and it goes back. This throttle would not go back. That was the first indication that we had something more than a simple engine failure. Number two item on the checklist was to close off the fuel supply to the engine.

Bill said to me, "Al, I can't control the airplane."

The fuel lever would not move — it was binding.

About this time, Dudley said to actuate the firewall shutoff valve. I did that, and the fuel supply to the number two engine was finally shut off.

By then, we were about 14 seconds into the episode, and Bill said to me, "Al, I can't control the airplane."

My focus quickly changed from the engine controls to the copilot. The first thing I noticed as I swung around was that Bill had applied full left aileron, something that you would never see in the air, much less at 35,000 feet. Further, he had the control column completely back in his lap, calling for full up-elevator. That is something else you would never expect to see in flight. But what really caught my eye was that with the control yoke in this condition, the airplane was in a descending right turn and at increasing angle.

With all those pilots on board, I then said the dumbest thing I ever said in my life: "I've got it." Well, I took control of the aircraft, but I surely did not know what I was going to do with it. Bill was absolutely right — the airplane was not responding to the control inputs. As the airplane reached about 38 degrees of bank on its way toward rolling over on its back, we slammed the number one (left) throttle closed and firewalled the number three throttle — and the right wing slowly came back up. I have been asked how we thought to do that; I do not have the foggiest idea. There was nothing left to do, I guess, but it worked. There is another instance where I talk about luck; we tried something that we did not know what to expect from and we discovered that it worked.

For the next few minutes we were trying to fly the airplane with the yoke and it took both pilots to do it. One person could not handle the yoke by himself because the pressures on it were just too great. We both had to do it. At the same time and trying not to let go of the yoke, we had to work our hands around the frozen number two throttle and make a number of quick adjustments to the number one and number three throttles to help control the aircraft. We had to close one, open one; open one, close one. We did this for a while and, in the meantime, Dudley was on the radio trying to get us some help.

After about 15 minutes of this, and talking to the ATC center and getting directions to Sioux City, we were advised that Capt. Dennis E. Fitch — an instructor pilot for the DC-10 — was a passenger in our aircraft. Considering the aura that surrounds flight instructors, we, naturally, invited him to the flight deck. Maybe he knew more about the systems than we did and could help us out of our dilemma. He arrived, took one look at the instrument panel and that was it — that was the end of his knowledge, too. He also had not faced this situation before.

I asked Fitch if he would go back into the cabin and look at the controls. He came back and said, "The controls aren't moving, how can I help now?" We were still struggling with the yoke and the throttles at the same time, and once again, out of the blue came a decision, "Take the throttles and operate them in response to our commands. Take one throttle lever in each hand — you can do it much smoother than we can — and see if we can't smooth this thing out and get a little better control of the airplane." For the next 30 minutes, that is how we operated. And working together like that is how we flew the airplane to Sioux City's Gateway Airport.

In the meantime, we began to realize that we had to work up some kind of a system so that the airplane and the Sioux City airport would be at the same place at the same

time. We took the formula normally used during descents in a DC-10: for every thousand feet you descend, you will travel three miles. Using that formula as a guide, because we certainly were unable to maintain a consistent rate of descent, we began a series of right turns because the airplane wanted to turn right all the time. That was one of the other little problems we had, the fact that we could not keep power the same on both good engines. If we ever allowed the throttles to remain at equal power settings, the aircraft would roll over, so we could not close or open them both at the same time.

To add to our problems, as if we did not have enough of them, there were the phugoids. These are longitudinal oscillations that are induced when an aircraft is displaced longitudinally from a stable and level flight condition. Generally, they are supposed to dampen themselves out after a few nose-up and nose-down cycles if the airplane is trimmed and power setting is constant. However, in our case with continuing wide variances in the power settings of the two remaining engines that are mounted below the center of gravity and with no power from the engine mounted above it, the phugoids, induced by the loss of number two engine power and initial dive-roll of the aircraft, never became completely controllable. We did our best to minimize them while trying to keep the airplane right-side-up and trying to navigate to the airport.

Haynes: Attempts to control the phugoids became a delicate balancing act.

Attempts to control the phugoids became a delicate balancing act. In an aircraft that is trimmed to fly in level flight, if you should push the nose down a little bit, it picks up airspeed, but it wants to fly at the speed it was trimmed for, so it will seek its trim speed all by itself. When you release the nose-down pressure the airplane will come back up, overshoot the airspeed, slow down and the nose will again lower again. After a few repetitions, it will level off and fly right where it was before being disturbed.

Our aircraft was trimmed for 270-knot cruise flight before the engine failed, and this is the trim speed it sought to return to for level flight, regardless of the fact that the top-mounted engine was producing no thrust (which would have tended to add a slight nose-down influence) and we were often adding large amounts of thrust in the two engines that, mounted beneath the wings, tended to raise the nose. Each phugoid oscillation took between 40 and 60 seconds, so the airplane was not really behaving erratically, it was fairly steady as far as the passengers were concerned.

However, the technique to dampen out the phugoids is to react just the opposite of what you think is normal. When the nose starts down and the airspeed starts to build up, you have to add power, because you want the pitch-up tendency created by the two, underwing-mounted engines to bring up the nose; but the hardest part is when the nose starts up and the airspeed starts to fall, you have to close the throttles, and that's not very easy to accept doing.

Adding to the problem, when we needed to add power or to close the throttles for phugoid control, it was necessary also to add or take away power on either side to keep the airplane from going over on its back. As a result, we could never eliminate the phugoids, and they went on for 41 minutes.

At one point, Fitch traded seats with Dvorak about the time we were ready to land. I said, "Let's get ready for landing. Denny [Fitch], you sit here and strap yourself in." Then, Dvorak swung around into a position where he could reach the throttles, and began to manipulate them. Fitch had been handling the throttles for about 20 minutes and he had a feel for what it took to give us what we needed. Dvorak, of course, did not have the benefit of that practice. He responded according to our calls such as "we need a wing up," "need to add power," and Fitch was adding adjustment commands like "you need a little more," "that's not enough," or "we need a little less turn," "you need a little more turn."

It soon became obvious that, although Dvorak was the regular crew member of the two, Fitch had developed a level of expertise at this entirely new skill. In another instance that illustrated the benefits of CRM, at Dvorak's suggestion, we decided it was better that Fitch sit by the throttle controls because he had been doing it. Dvorak got up and gave Fitch his seat and Dvorak took the seat behind me, the jump seat. That is why the deadheading captain was sitting in the second officer's seat when we landed.

Bauchman was vectoring us for runway 31 and when we got down to about 3,500 feet and saw a runway straight in front of us, we could not believe it. We were shocked. There was a runway and that was what we were going to land on. That is when the controller lost his cool a little bit, because it was not the runway he expected us to line up with. He had about three fire trucks sitting on runway 22 and we were lined up to land there.

Unfortunately, just as the airplane came over the trees as we approached the airport, the airplane began one of its down phugoids. We were about 300 feet in the air and the DC-10 decided that it was going to start down — the nose went down, the rate of descent increased, the airspeed increased, and we hit the ground.

Haynes: The fourth factor was execution — how everyone accomplished what each was trying to do during the emergency … .

We first touched down on the right main gear, the right wing tip and the number three engine. The nose wheel made contact just about simultaneously, and then the left main gear was slammed into the ground.

As we hit the ground, the tail broke off. The right wing tip also broke off spilling fuel on the ground causing a fire as we slid along on the runway. At this point, the left wing began to fly again, I think, and it came up. With no weight in the tail, the tail came up and the airplane bounced on its nose three times. We became airborne again, came back down, and fortunately for the four of us flight crew members, the cockpit broke off from the fuselage. It was unfortunate for most of the first class passengers, because their then-exposed section of the fuselage bore the brunt of the damage. The aircraft came to rest in a field to the right of the runway.

Where we had first touched down, the right main landing gear gouged an 18-inch hole through the 12-inch-thick concrete of the runway The reason for such force is that the airspeed for a normal touchdown in a DC-10 is 140 knots — because of our phugoids we were doing 215 knots. Also, the normal rate of descent at touchdown is about 300 feet a minute. Our rate of descent at touchdown was 1,854 feet a minute.

Further, in any kind of airplane, it is expected that the aircraft will travel straight along the runway after landing. Without flight controls, we had no way to crab or to otherwise correct a drift, plus we had a quartering tailwind that gave us an additional 10 knots of speed.

The Siouxland response program was fantastic. Emergency personnel did exactly what they had been trained to do and exactly what they had practiced during the emergency preparedness drill that had become reality. We put the same kind of aircraft, a DC-10, on that exact runway, in the exact spot that they had had their drill. The only measurable difference was that we gave them about 200 survivors instead of the 150 they had during the simulation. But by paying attention to the drill, they were prepared to act.

The execution of their duties by personnel at Marion Health Center and St. Luke's Hospital was outstanding, due in large part because they were staffed by double shifts. They also were able to do a lot of improvising on the original plan. With extra doctors available, the medical director of Marion Health Center said, "Let's try something." He set up separate medical groups to meet individual ambulances, each with a doctor, a nurse and a medical technician.

As an ambulance drove up and a patient was removed from it, the next available group went with the patient into the emergency room; and they stayed with the patient until he or she was admitted to the hospital or discharged. That is just the way I met my doctor; he was next in line when my ambulance drove up. There were all kinds of doctors there, it did not matter what their specialties were. This efficient and intensive level of care is one of the reasons why so many survivors who made it to the hospital survived, and did not succumb while they were in the hospital.

The Final Step Is Cooperation

The fifth and final item is cooperation. The excellent cooperation in the cockpit has already been mentioned, but we also benefited from tremendous cooperation between the cabin and the cockpit crew, especially considering that we did not have a lot of time to talk to them. Fortunately, for us, the senior flight attendant, Janice T. Brown, was very experienced and rose to the occasion. She mentioned later that when I had called her to the flight deck the first time, she recognized immediately that we did not have an emergency, that we had a crisis as soon as she opened the cockpit door. Another flight attendant, Virginia A. Murray, who came up a little later, also took one look into the cockpit and knew we were in very serious trouble. A lot of communication was not necessary to accomplish the level of cooperation we needed; it happened, to a large extent, spontaneously.

For something that you have practiced for but never are called upon to do, I was very pleased, rather than surprised, that the whole effort worked as well as it did. We crew members talked later about what ATC did, what the National Guard did and about the cooperation from Marion and St. Luke. We realized the benefit of advance notice to emergency services. We had announced the nature of our emergency early, and once we made the decision to head for Sioux City, the leaders of the response group were given about a 25-minute notice that we were going to crash.

Knowing beforehand how real was the danger of of a serious accident, the emergency services implemented the disaster plan at the "alert 3" level, which means an airplane has crashed. What that did was implement the plan to deal with an airplane that "has already crashed." In fact, as soon as that alert was broadcast, another radio call for additional help went to Des Moines where an aircraft from another Air National Guard unit was loaded with emergency medical supplies for Sioux City. With the advance notice, that airplane was dispatched just about the time we crashed. That extra time that the emergency services had was a great advantage to them and the crash survivors.

However, that 25-minute notice also gave the press time to reserve all the hotel rooms in Sioux City so that there were few lodgings left for the surviving passengers and their families who already were rushing in to town; they began to arrive very quickly as the news of the accident was broadcast. One of the doctors at St. Luke's looked up on the hill at Briar Cliff College and, noting that it was closed for the summer except for a skeleton crew, suggested its dormitories might be used. Emergency services called Sister Margaret Wicks at the college and asked for her help. By nightfall she had 250 people staying in the school's dormitories. That was just another instance of cooperation.

The general public of Siouxland responded with a tremendous outpouring of support and help. For instance, 400 people showed up spontaneously to give blood with no call for donors having been sent out; they just arrived because they figured it would be needed. Some actually had to be turned away. Our company, United Airlines, was a great help not only to us crew members, but to the surviving passengers even though only six staff members were on duty at the time — Sioux City is a very small station for United. The company brought ticket agents, passenger agents, reservation clerks and others from other locations. It took them right out of their jobs, put them on airplanes and flew them to Sioux City. By the next morning, there was at least one company employee for every passenger's family, both survivors and non-survivors, to help them and to talk with them.

… 400 people showed up spontaneously to give blood with no call for donors having been sent out … .

The help we received from our unions, the Association of Flight Attendants (AFA) and the Air Line Pilots Association (ALPA) was also of great benefit. A representative was in the hospital before I got to my room and a guard was at the door where crew members were accommodated, so that we would not be invaded by the news media. The guard stayed there 24 hours a day for the five days I was there. We were not interviewed until we were out of shock and ready to be interviewed, which was very important — anything we said before the shock wore off would have been useless, and possibly misleading, anyway.

The cooperation of passengers and family is important, also. Imagine being a passenger on an airplane and being informed that you are going to experience the hardest landing you have ever had in your life; and when I made that announcement, I did not realize what an understatement that was. But I warned them ahead of time that it was going to be rough, to listen to the flight attendants and to assume the best brace position they could for their own safety. They went through a horrendous crash, a tremendous tumbling that was so bad that they could not control their arms and legs which flailed about with such force that they could not maintain the brace position. Fortunately, they were restrained by their seat belts.

The passengers ended up upside down because the fuselage was on its back, with smoke, fire and debris all around. When they finally got out of the airplane, they found themselves standing in a corn field, surrounded by corn eight feet high. I cannot imagine what they must have felt like. But they stayed calm and they helped each other. One of the survivors started climbing out of the airplane and heard a baby crying; he went back inside, found the baby in an overhead bin where she had been tossed, took her out of the airplane and brought her to her family that had been driven out by the thick smoke. This type of thing occurred in a number of instances — passengers were helping each other and the flight attendants were continuing to carry out their duties even though they were victims as well.

The last group that is so important is family, my family and the families of the rest of the crew and the passengers, who were not directly involved in the accident but who provided comfort and support afterwards. Many of them traveled to Sioux City to be there; all of them shared in some part the lasting scars of the experience with loved ones who, although fortunate to have survived, had physical or mental trauma that lasted for extended periods.

Post traumatic stress deserves mention. I had a number of people tell me several days after the accident that they were going to call me to see how I was doing, but they figured because I was going to get so many phone calls, that they did not want to bother me. Well, it seems that they all felt that way, so I didn't get many phone calls. Because of this experience, I suggest to those who know someone who has had a trauma, who has been through a crisis, to give them a call, let them know you care and

that you are there, if they need you. If they do not want to talk at that time, they will tell you. They may even be rude or hang up but that is not them, it is the result of the trauma.

One of the biggest problems we have in post traumatic stress right now is that we tend to forget that, after an accident has occurred, the flight attendants and the crew are not rescuers, they are victims. And the need to treat post traumatic stress begins with them at the same time it does for the surviving passengers. In our particular case, we flight crew members were definitely victims because we were trapped in the wreckage.

Rescuers initially ignored the separated cockpit because it had been compressed to a waist-high section of wreckage and looked like an uninhabitable piece of junk. When we were discovered inside and alive by 185th guardsmen, however, they pried us out — very carefully because the four of us were confined in a small area and had a wide range of injuries.

Records broke both hips, eight ribs and a toe, and suffered numerous bruises and contusions. Dvorak suffered a shattered right ankle, multiple bruises and contusions; he has three pins in his right leg, his ankle is aimed a little bit off to the right, he has a permanent limp and will eventually have to have the ankle fused. Fitch suffered multiple bruises, contusions, a broken rib, internal injuries, a severed nerve in his right hand, a broken right arm and a dislocated left shoulder. I was relatively uninjured, suffering a slight cut on my right ankle, bruises, contusions and a black eye; I had no broken bones but needed 92 stitches to close lacerations on my head. Records, Dvorak and I were back at work approximately three months later; Fitch, with the most serious injuries of the flight crew, was back in about 11 months.

Of the flight attendants, one was killed, unfortunately. The rest suffered varying degrees of injuries, but all eventually returned to work. Right after the crash, they were outside continuing to do their jobs and had to be relieved immediately and be treated as victims. Fortunately, the emergency services at Sioux City recognized this and dealt with it extremely well.

Luck, communications, preparation, execution and cooperation — these five factors will not guarantee survival during a serious inflight emergency. It is regrettable that 111 passengers and one flight attendant did not survive the crash landing at Sioux City, and my deepest sympathies go to their families and friends. However, when the five factors involved in training for emergencies can act in concert as they did on our case, they can make the difference between a complete catastrophe and a survivable accident. ♦

About the Author

Capt. Alfred C. Haynes has been a line pilot for United Airlines since he began work with the company in February 1956. He has logged 29,967 hours of flight time, of which 7,190 is in the McDonnell Douglas DC-10. He holds an Airline Transport Pilot certificate with type ratings in the DC-10 and the Boeing 727.

Haynes was initially trained in the DC-10 as a first officer and completed this training early in 1976. He became type rated in the aircraft in 1983. He served as a Boeing 727 captain between 1985 and 1987, after which he was requalified as a DC-10 captain and has flown that aircraft since then.

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