Numerous factors contributed to fatal runway incursion at Milan Linate Airport
[from ICAO Journal]

A report on a runway collision in Milan in 2001 urges regulatory authorities and airport operators to ensure that ICAO provisions, particularly those of Annex 14, are implemented in the interest of safe airport operations.

The final report on the runway collision between a Boeing MD-87 and a Cessna Citation at Milan Linate Airport in October 2001 cites a combination of factors, from aerodrome shortcomings to pilot-controller miscommunication, that contributed to a runway incursion which resulted in Italy's worst aviation accident.

The accident took place at 0610 UTC [0710 local time] on 8 October 2001 when an SAS Boeing MD-87, while taking off from Runway 36R at Milan Linate Airport, collided with a Cessna 525-A which had taxied onto the active runway.

After the collision, the MD-87 -- airborne for a short distance -- overran the runway and veered slightly right before impacting a building used for baggage handling. The Cessna 525-A remained on the runway and was destroyed by post-impact fire.

All occupants of the two aircraft and four ground staff working inside the baggage handling facility -- 118 people in all -- suffered fatal injuries.

Following is a summary of the findings, conclusions and recommendations contained in the English translation of the final report issued by ANSV, the Italian air safety board.

History of flight

The Cessna 525-A, registration D-IEVX, arrived at Milan Linate Airport at 0454 UTC after a flight from Cologne, Germany. The aircraft landed on Runway 36R and proceeded to the general aviation apron on the west side of the aerodrome. At the time of landing, the tower controller reported general visibility of 100 meters with fog.

The MD-87, operating as SAS Flight 686 (SK 686) with 104 passengers on board, was scheduled to depart Milan Linate for Copenhagen at 0535 UTC. The crew contacted the ground controller at 0541 and was given the slot time of 0616 for take-off. The crew requested taxi clearance at 0554, at which time the controller instructed the crew to taxi from the North apron to the Runway 36 ILS Cat III holding position.

At 0558, the pilots of the Cessna received the following taxi clearance:
"Delta Victor X-ray taxi north via Romeo 5, QNH 1013, call me back at the stop bar of the ... main runway extension."

The Cessna crew acknowledged as follows: "Roger via Romeo 5 and ... 1013, and call you back before reaching main runway."

The Cessna left its West apron parking position and followed the yellow guideline until the point where it split into diverging directions, one to the left (northwards) and another to the right, leading south-eastwards. The Cessna followed the latter guideline and entered Taxiway Romeo 6. [The pilot turned right instead of left as
required by the clearance, and proceeded to Taxiway R6 instead of R5. Taxiway R6 was not marked by identification signs."
Continuing to taxi on R6, the crew made an unsolicited position report at 0608, informing the controller that the aircraft was approaching Sierra 4. [It was later established that the S4 marking on the taxiway was not indicated on aeronautical charts and was unknown to the controller, who continued to assume that the Cessna was positioned on Taxiway R5, as previously cleared.]
At 0608:36, the ground controller replied with the following instruction: "Delta Victor X-ray, Roger, maintain the stop bar. I'll call you back."
At 0608:40 the pilot replied: "Roger. Hold position."
At 0609:19, the ground controller cleared the Cessna to continue its taxi on the North apron (using the words "main apron"), and to follow the Alpha line. The Cessna pilot responded, "Roger, continue the taxi in main apron, Alpha line the ... Delta Victor X-ray."
Ground: "That is correct, and please call me back entering the main taxiway."
D-IEVX: "I'll call you on the main taxi-way."
The Cessna continued on R6, crossing a stop marking which was painted on the asphalt, then an ICAO pattern B runway-holding position marking painted on the taxiway, and a unidirectional lighted red stop bar alongside which was a lighted CAT III holding position sign. Immediately before entering the runway by following the green taxiway centerline lights, the Cessna crossed an ICAO pattern A runway-holding position marking painted on the taxiway without communicating with a controller. As the Cessna entered the active runway at the intersection with R6, the tower controller cleared Flight SK 686 for take-off. At 0610:18, the aircraft communications addressing and reporting system (ACARS) installed on the MD-87 communicated with the receiving installation in Copenhagen, which registered the take-off signal. At 0610:21 the two aircraft collided.
At the time of collision, the MD-87 was performing a normal take-off rotation. Approximately one second prior to the collision an additional large elevator nose-up command was registered by the MD-87 digital flight data recorder. It is probable that the crew of the MD-87 had a glimpse of the Cessna just prior to the collision (this is suggested by an unintelligible exclamation recorded on the cockpit voice recorder). At impact, the MD-87 had attained an indicated airspeed of 146 knots.
The Cessna Citation broke into three major sections on the runway near the intersection with Taxiway R2. The front and mid-section of the aircraft were destroyed by fire.
The right main landing gear leg and right engine separated from the fuselage of the MD-87 upon impact. The aircraft was airborne for a total of 12 seconds, reaching an estimated height of 35 feet.
The left engine suffered a noticeable thrust reduction caused by debris ingestion. Indicated airspeed increased to 166 knots before the MD-87 descended abruptly, contacting the runway surface with the left main landing gear, remains of the right main landing gear and right wingtip. Prior to touchdown the pilot reduced engine thrust, and after ground contact the engine reverse levers were activated, with reverser deployment on the left engine. Maximum available reverse thrust was selected, brakes were applied and the pilots attempted to maintain directional control.
The MD-87 slid beyond the runway end and to the right, coming to an abrupt stop after impacting an airport building.
Conclusions. The accident report cited a number of deficiencies that played a role in the outcome. While the immediate cause of the accident was identified as the runway incursion by the Cessna pilot, the report stated that the pilot error must be weighed against systemic shortcomings.

"The system in place at Milan Linate airport was not geared to trap misunderstandings, let alone inadequate procedures, blatant human errors and faulty airport layout," the report concluded.

Among its findings, the report stated that:
- the management and operation of Milan Linate Airport was complicated and involved three major organizations;
- the aerodrome did not conform with ICAO Annex 14 standards;
- no functional safety management system was in place;
- no aerodrome operations manual had been established;
- no recurrent training program for air traffic control (ATC) personnel had been provided;
- an effective system for reporting deviations was not in place;
- fear of sanctions discouraged the self reporting of incidents and individual mistakes;
- documentation provided by Aeronautical Information Publication (AIP) Italy and by Jeppesen was not consistent with the Milan Linate Airport layout;
- SAS flight support documentation was not consistent with the airport layout;
- taxiways had not been designated in a logical manner (in a clockwise direction with north as the starting point, the taxiways had been designated R1, R2, R3, R4, R6 and R5);
- markings on the West apron dedicated for general aviation were insufficient and not in conformity with ICAO provisions;
- the West apron was without signs:
  - Taxiway R6 [used by the Cessna] lacked markings and signs and those present were found to deviate from ICAO provisions;
  - markings on Taxiways R6 and R5 were not reported in AIP Italy, and consequently were not reflected in Jeppesen and SAS documentation; and
- aerodrome tower controllers "declared that they ignored the existence" of markings such as S4.

The report also states that equipment which had been installed near the intersection of Runway 18L/36R and Taxiway R6 for the purpose of preventing runway incursions had been deactivated several years previously. The ground controller had no control over the flight cross bars located on Taxiways R5 and R6 and could not adjust taxiway centerline lights to reflect the taxi clearance.

Radiotelephony phraseology used by controllers and pilots did not conform with ICAO phraseologies; in addition, communications [with various aircraft] alternated between Italian and English and could not always be understood by the German crew of the Cessna.

The investigation found that the taxi instructions issued to the Cessna by the ground controller were correct, but the readback was incomplete, and omissions by the pilot were left uncorrected. It was determined that aerodrome controllers were not consistent in enforcing the prescribed readback procedure.

In citing causes for the accident, the report indicates that the Cessna crew's situational awareness was diminished by inaccurate charts and a lack of visual aids. It also points out that despite the low-visibility conditions, ranging from 50 to 100 meters at the time of the accident, operational procedures allowed a high volume of
Controller workload was very high, with communications conducted in more than one language. Required markings, lights and signs either did not exist in the case of Taxiway R6 or were "in dismal order and were hard to recognize especially in low-visibility conditions (R5 and R6)".

**Recommendations.** The final report issued by the ANSV contains a number of recommendations, including several published in an interim report of July 2002. Among the new recommendations, it calls for the regulatory authority -- the Italian Ministry of Infrastructure and Transport -- to fully and quickly implement the European action plan for the prevention of runway incursions. **It also calls on the authority to ensure that the design and operation of all aerodromes are in compliance with the safety standards specified in ICAO Annex 14.**

Another recommendation calls for all aerodromes in Italy to establish a **functional safety management system.**

Other recommendations address training for air traffic controllers, Aeronautical Information Publication upkeep and accuracy, mandatory installation of cockpit voice recorders on aircraft operated under an air operator certificate (AOC) or equivalent approval [the accident Cessna was not equipped with a CVR], airport emergency procedures, ATC equipment and procedures, airport fire station organization, and a procedure for checking pilot certification [the Cessna pilots were not qualified to operate in the low-visibility conditions that prevailed at the time of the accident]. There were also recommendations concerned with radiotelephony adherence to standard phraseology, the use of English in air-ground communications, and incident reporting procedures.

The full report, including recommendations not cited here, is available at the ANSV website.