ICAO Safety Management Systems (SMS) Course

Handout N° 6 – Collision between two aircraft at Milano-Linate International Airport

International Civil Aviation Organization

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SAFETY MANAGEMENT SYSTEMS (SMS) COURSE

Exercise 10/02 – Collision between two aircraft at Milano-Linate International Airport

1. Narrative

A brand new Cessna 525A Citation Jet 2, **D-IEVX**, arrived at Milano-Linate International Airport following a flight from Köln, Germany. The Cessna was to carry out a return flight to Paris-Le Bourget, carrying two pilots, a Cessna sales manager and a prospective customer. The plane arrived at 06:59 and was taxied to the general aviation apron, also known as **"West apron"** *(See diagram below).* It was a foggy morning at Milano-Linate International Airport and one of the passenger flights parked on the **"North apron"** was **SAS MD-87** flight **SK686,** which was being prepared for a flight to Copenhagen, scheduled to depart at 07:35. At 07:41, the pilot of the MD-87 **SK686** contacted **Linate Ground Control** for his engine start clearance, as the boarding of 104 passengers had been completed. The Ground Controller cleared the pilot to start engines and advised that the slot time for takeoff of the flight was at 08:16. Thirteen minutes later flight **SK686** was cleared to taxi to runway **36R**: *"Scandinavian 686, taxi to the holding position Cat III, QNH 1013 and please call me back entering the main taxiway."*

A few minutes later, the Cessna Citation pilot requested permission to start the engines. The Ground Controller then gave start-up clearance. The Ground Controller then requested flight **SK686** to contact the Tower Controller. From this moment on, the MD-87's crew and the Cessna's crew were tuned on two different radio frequencies. At 08:05 the pilots of the Cessna received taxi clearance: *"Delta Victor Xray, taxi north via **Romeo 5**, QNH 1013, call me back at the stop bar of the ... main runway extension."*

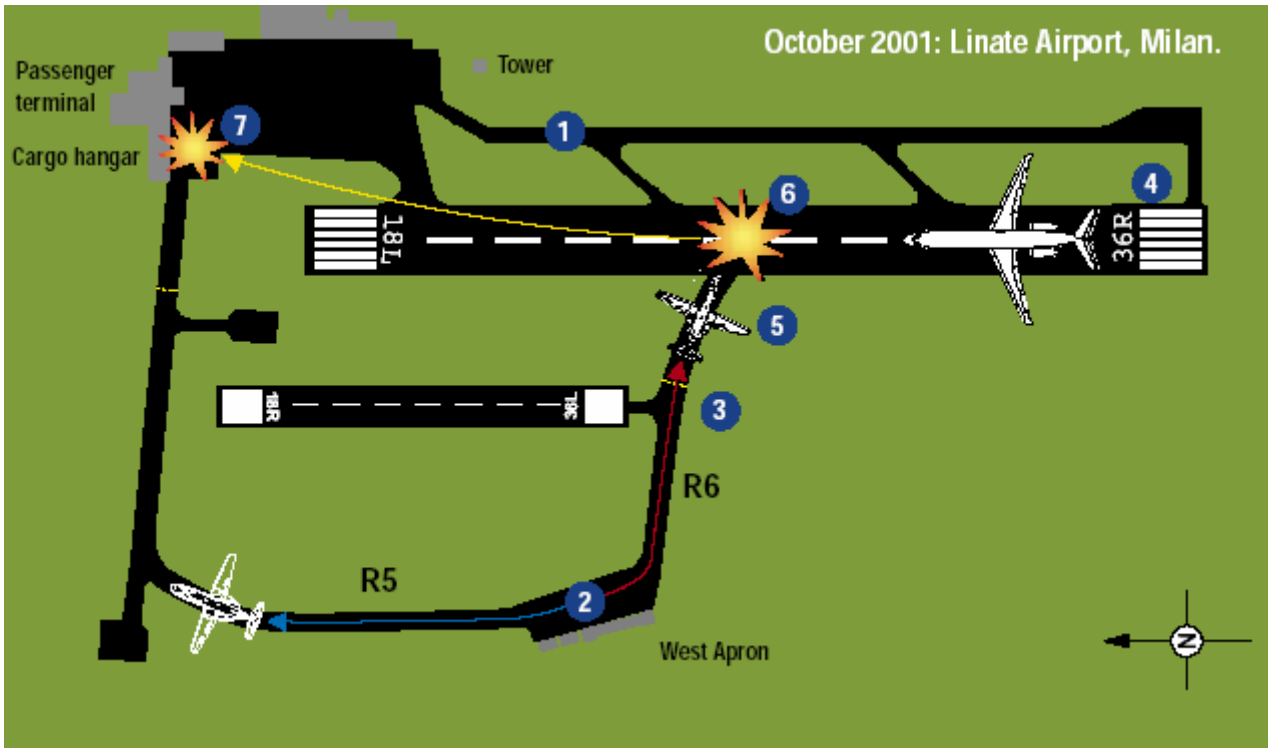
The pilot acknowledged by saying: *"Roger via **Romeo 5** and ... 1013, and call you back before reaching main runway."*

The Cessna started to taxi from the general aviation parking position, following the yellow taxi line. After reaching the position where the yellow taxi line splits into two diverging directions, the pilot erroneously took the taxi line to right and entered taxiway ***Romeo 6***. At 08:09 the Ground Controller cleared the Cessna to continue its taxi on the **North Apron**. At the same time the Tower Controller cleared the MD-87 for takeoff: *"...Scandinavian 686 Linate, clear for takeoff 36, the wind is calm report rolling, when airborne squawk ident."* The pilot advanced the throttles and acknowledged the clearance: *"Clear for takeoff 36 at when...airborne squawk ident and we are rolling, Scandinavian 686."* When the MD-87 was speeding down the runway, the Cessna crossed the runway holding sign and entered the active runway **18L/36R**.

At 08.10:21 the nose landing gear of the MD-87 had left the ground and main gears were extending the shock absorbers but the main wheels were still on the ground at airspeed of 146 knots (270, 5 km/h).

At that moment the MD-87 crew probably saw a glimpse of the Cessna through the fog and reacted with additional large nose-up elevator. At that moment the MD-87 collided with the Cessna Citation Jet. The right wing of the MD-87 sustained damage at the leading edge and the right hand main landing gear leg broke off. It damaged the right flap and struck the N° 2 engine which then separated from the pylon. The pilot of the MD-87 gradually advanced the throttles and then the aircraft was airborne for a total of 12 seconds, reaching an estimated height of about 35 feet (11 meters). The left hand engine suffered a noticeable thrust reduction as a result of debris ingestion, which became insufficient to sustain flight.

The airspeed had increased up to 166 knots (307,6 km/h), but the MD-87 descended abruptly making contact with the runway with the left hand main gear, the truncated right hand main gear leg and the tip of the right hand wing. Prior to touch down the pilot reduced engine thrust and after ground contact the engine reverse levers were activated and deployed (on the left hand engine only). Maximum available reverse thrust was selected and the brakes applied. The plane skidded past the grass overrun area, across a service road, crashing sideways into a baggage handling building, which partly collapsed. This building was located 20m/67 feet to the right of the runway, and 460m/1500 feet from the runway end.



Legend

1. Flight **SK686** taxied to the holding point for runway 36R. Heavy fog had delayed the flight by more than one hour. While the visibility was improving, RVR was still only 225 metres.
2. The Cessna Citation parked at the West Apron was cleared to taxi via taxiway **Romeo 5** and to report reaching the first holding point. The pilot read the clearance back correctly, but entered taxiway **Romeo 6**.
3. The Cessna Citation's pilot called for clearance to proceed from the **Romeo 5** holding point though it was in fact at the **Romeo 6** holding point.
4. Flight **SK686** was cleared for take-off.
5. The Cessna Citation crossed the holding point for runway **36R-18L**.
6. The two aircraft collided.
7. The stricken MD-87 skidded off the runway into a baggage hangar adjacent to the passenger terminal.

2. Investigation

After analysis of evidence available and information gathered, it can be assumed that the immediate cause for the accident has been the runway incursion in the active runway by the Cessna Citation. The obvious consideration is that the human factor related action of the Cessna Citation crew – during low visibility conditions – must be weighted against the scenario that allowed the course of events that led to the fatal collision; equally it can be stated that the system in place at Milano-Linate Airport was not geared to trap misunderstandings, let alone inadequate procedures, human errors and faulty airport layout.

The following list highlights immediate and systemic causes that led to the accident:

- The visibility was low, between 50 and 100 meters.
- The traffic volume was high.
- The lack of adequate visual aids.
- The Cessna Citation crew used the wrong taxiway and entered the runway without specific clearance.
- The failure to check the Cessna Citation crew qualification.
- The nature of the flight might have exerted certain pressure on the Cessna Citation crew to commence the flight despite the prevailing weather conditions.
- The Cessna Citation crew was not aided properly with correct publications (AIP Italy-Jeppesen) lights (red bar lights and taxiway lights), markings (in deformity with standard format and unpublished, S4) and signs (non-existing TWY R6) to enhance their situational awareness.
- Official documentation failed to report the presence of unpublished markings (S4, S5, etc.) that were unknown to air traffic managers, thus preventing the ATC staff from interpreting the ambiguous information from the Cessna Citation crew, a position report mentioning **S4**.
- Radio communications were not performed using standard phraseology (read back) or were not consistently adhered to (resulting in untraced misunderstandings in relevant radio communications).
- Operational procedures allowing high traffic volume (high number of ground movements) in weather conditions as were current the day of the accident (reduced visibility) and in the absence of technical aids.
- Radio communications were performed in Italian and English language.
- ATC personnel did not realize that Cessna Citation was on taxiway **Romeo 6**.
- The ground controller issued a taxi clearance toward north (main) apron although the reported position **S4** did not have any meaning to him.
- Instructions, training and the prevailing environmental situation prevented the ATC personnel from having full control over the aircraft movements on ground.
- The aerodrome standard did not comply with ICAO Annex 14; required markings lights and signs did not exist (**Romeo 6**) or were in dismal order and were hard to recognize especially under low visibility conditions (**Romeo 5** - **Romeo 6**), other markings were unknown to operators (**S4**).

- No functional Safety Management System (SMS) was in operation.
- The competence maintenance and requirements for recent experience for ATC personnel did not comply fully with ICAO Annex 1.
- The Low Visibility Operations (LVO) implementation by ENAV did not conform to the requirements provided in the corresponding and referenced ICAO Doc 9476.

The combined effect of these factors, contemporaneously present on the 8th of October 2001 at Milano-Linate Airport, have neutralized any possible error corrective action and therefore allowed the accident.

3. Epilogue

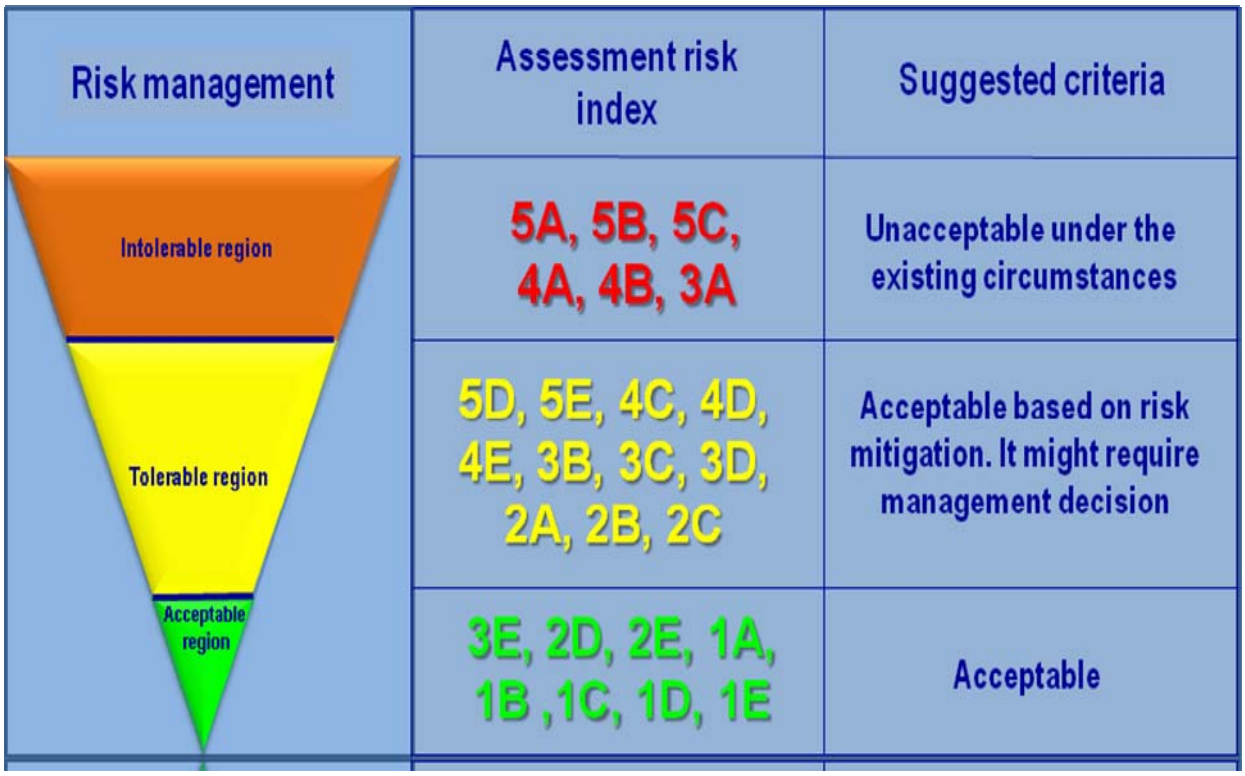
In April 2004 four officials accused of negligence and multiple manslaughter were sentenced to jail terms ranging from 6½ to 8 years. Judges gave eight-year prison sentences to the director of the Milano-Linate Airport and the air traffic controller who was on duty at the time. The former CEO of Italy's air traffic control agency ENAV and the person who oversees Milan's two airports, there were sentenced to six years and six months each.

4. Risk assessment matrix

Probability of occurrence		
Qualitative definition	**Meaning**	**Value**
Frequent	Likely to occur many times *(has occurred frequently)*	**5**
Occasional	Likely to occur some times *(has occurred infrequently)*	**4**
Remote	Unlikely, but possible to occur *(has occurred rarely)*	**3**
Improbable	Very unlikely to occur *(not known to have occurred)*	**2**
Extremely improbable	Almost inconceivable that the event will occur	**1**

Severity of occurrences		
Aviation definition	**Meaning**	**Value**
Catastrophic	➢Equipment destroyed. ➢Multiple deaths.	**A**
Hazardous	➢A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely. ➢Serious injury. ➢Major equipment damage.	**B**
Major	➢A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of increase in workload, or as a result of conditions impairing their efficiency. ➢Serious incident. ➢Injury to persons.	**C**
Minor	➢Nuisance. ➢Operating limitations. ➢Use of emergency procedures. ➢Minor incident.	**D**
Negligible	➢Little consequences	**E**

Risk probability	Risk severity				
	Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent 5	5A	5B	5C	5D	5E
Occasional 4	4A	4B	4C	4D	4E
Remote 3	3A	3B	3C	3D	3E
Improbable 2	2A	2B	2C	2D	2E
Extremely improbable 1	1A	1B	1C	1D	2E



EXERCISE 10/02

5. Group activity

A facilitator will be appointed, who will coordinate the discussion. A summary of the discussion will be written on flip charts, and a member of the group will brief on their findings in a plenary session.

6. Your task

Task N° 1

1. List the type of operation or activity.
2. State the generic hazard(s)
3. State the specific components of the hazard(s).
4. State the hazard-related consequences and assess the risk(s).
5. Assess existing defences to control the risk(s) and resulting risk index.
6. Propose further action to reduce the risk(s) and resulting risk index.
7. Establish individual responsibility to implement the risk mitigation
8. Complete the attached log (Table 10/01).

Task Nº 2

1. The Accident Investigation Board has identified that no functional Safety Management System (SMS) was in operation at Milano-Linate International Airport. Therefore you should:

   a) Develop a SMS implementation plan for Milano-Linate International Airport.

   b) Complete the attached Gantt chart (Table 10/02).

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TABLE 10/01 – HAZARD IDENTIFICATION AND RISK MANAGEMENT

Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index	Responsible person
Flight operations	All weather operations at an aerodrome where one of the two parallel runways is closed due to a construction work. *(Example only, not related to the present case study)*	Aircraft taking off or landing on a closed runway. *(Example only, not related to the present case study)*	Aircraft colliding foreign object. *(Example only, not related to the present case study)*	1. NOTAM issued by the aerodrome manager to notified users on the construction work on the closed runway. 2. ATIS 3. Aerodrome layout available in the national AIP 4. New signage and lighting 5. Company operations manual 6. Dispatch performance manual 7. Aircraft operating manual 8. Flight crew competency requirements in AWOP. 9. Recurrent training 10. CRM training *(Example only, not related to the present case study)* *Risk index: 3A* *Risk tolerability: Unacceptable under the existing circumstances*	1. Ensure that flight dispatchers and operations officers inform flight crew on the risk of taking mistakenly the closed runway. 2. Ensure that flight crew is aware of the current layout of the aerodrome. 3. Issuance of company NOTAM concerning the closed runway and new routing on the movement area. 4. Review of the Low Visibility Operations (LVO) during training sessions. 5. Review procedures in the Company Operations Manual and Route Manual. *(Example only, not related to the present case study* *Risk index: 1A* *Risk tolerability: Acceptable after review of the operation*	1. Director of the operations control centre (OCC) 2. Chief pilot 3. Head of Flight operations engineering 4. Flight training manager 5. Head of Documentation Department *(Example only, not related to the present case study)*

Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index	Responsible person
				Risk index: *Risk tolerability:*	*Risk index:* *Risk tolerability:*	
				Risk index: *Risk tolerability:*	*Risk index:* *Risk tolerability:*	

TABLE 10/02 – GANTT CHART FOR THE SMS IMPLEMENTATION PLAN

Nº	Component/element	Date: January 08				Date: February 08				Date:				Date:			
1	Safety policy and objectives																
1.1	Identification of the accountable executive																
1.2	Designation of the SMS planning group																
1.3	Development of the safety policy																
1.4	Development of safety standards																

Nº	Component/element	Date: January 08				Date: February 08				Date:				Date:			

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