SOFEMA AVIATION SERVICES

CASE Study SAS (Scandinavian Airlines System) Dash 8 Q400 Landing Gear Incidents

Case Study supported by Sofema Aviation Services – www.sassofia.com

Introduction - CASE Study SAS (Scandinavian Airlines System) Dash 8 Q400 landing gear incidents in 2007 are significant aviation safety events that triggered both technical scrutiny and organizational lessons.

- The SAS Dash 8 Q400 incidents serve as a critical case study in how design limitations, maintenance practices, and organizational decision-making intersect in aviation safety.
- While no lives were lost, the reputational and operational impact was severe.
- The industry responded with updated design guidance, tighter regulatory controls, and a renewed focus on risk-based thinking and preventive maintenance strategies—lessons that continue to resonate in aircraft operations today.

Notes - The SAS Dash 8 Q400 events exposed not only a technical design weakness, but also the need for agile, coordinated, and compassionate emergency response.

The ERTs faced unpredictable physical hazards, psychological stress from recurrence, and intense scrutiny—yet ultimately ensured that all passengers and crew survived.

The events served as a wake-up call to treat emergency response not as a static plan, but as a dynamic capability that must evolve with experience, environment, and equipment.

What Happened: Three Gear-Related Accidents in 2007

SAS experienced **three separate landing gear collapses** on its Bombardier Dash 8 Q400 fleet between **September and October 2007**:

September 9, 2007 – Aalborg, Denmark (Flight SK1209):

- The right main landing gear collapsed on landing.
- The aircraft skidded off the runway; substantial damage occurred, but there were no fatalities.

September 12, 2007 – Vilnius, Lithuania (Flight SK2748):

- Right main gear again failed to deploy properly and collapsed during emergency landing.
- The aircraft sustained major structural damage; all on board evacuated safely.

October 27, 2007 – Copenhagen, Denmark (Flight SK2867):

- This time, the right main gear collapsed after landing, causing the aircraft to veer off the runway.
- The aircraft was written off; one passenger sustained a minor injury.

Why It Happened: Root Causes

The root cause analyses, carried out primarily by Bombardier and national safety authorities, pointed to a combination of mechanical failure, corrosion, and maintenance practices:

- Corrosion in the landing gear retraction actuator eyebolt (critical for holding the landing gear in position) was identified as a common failure point.
- Incorrect or inconsistent maintenance practices, including cleaning and lubrication routines, exacerbated the issue.
- There was also insufficient guidance from the manufacturer regarding the inspection and replacement intervals of vulnerable parts.
- The Q400 landing gear design had limited fault tolerance to certain types of component degradation.

Lessons Learned

Maintenance Oversight Must Reflect Real-World Operating Conditions

- The incidents highlighted gaps in scheduled maintenance versus actual aircraft wear patterns.
- SAS had followed the prescribed maintenance, but these procedures proved insufficient under certain environmental and operational conditions.

Design Vulnerabilities Can Have System-Wide Impact

- A single-point failure (eyebolt) led to total gear collapse, underscoring the need for **redundancy and better failure containment** in landing gear design.

Communication Between OEM, Operator, and Regulator is Critical

- Delays or lack of clarity in maintenance bulletins and airworthiness directives contributed to prolonged risk exposure.

Fleet-Wide Response is Sometimes Necessary

- SAS grounded its entire Q400 fleet after the third incident.
- Eventually, SAS **permanently removed the Dash 8 Q400** from its fleet due to lost confidence, despite remedial actions.

Industry and Regulatory Response

- **Bombardier issued multiple Service Bulletins**, and aviation authorities (like EASA and Transport Canada) issued **Airworthiness Directives (ADs)** mandating inspections and replacements of affected components.
- The **design was modified**, with changes to component materials and protection against corrosion.
- **Improved inspection protocols** were implemented across all operators.

How to Move Forward: Recommendations for the Industry

- **Predictive Maintenance and Condition-Based Monitoring**
    - Use real-time data and AI-driven systems to anticipate wear and tear, especially on critical components like landing gear.
- **Proactive Safety Management Systems (SMS)**
    - Encourage organizations to **investigate "near-miss" mechanical trends** and escalate findings proactively, even before an incident occurs.
- **Enhanced OEM Accountability and Responsiveness**
    - Aircraft and component manufacturers must **continuously assess field performance** and communicate proactively with operators.
- **Integrated Design Safety Reviews**
    - Apply **Failure Modes and Effects Analysis (FMEA)** and **System Theoretic Process Analysis (STPA)** early in design to assess risk exposure and mitigate single-point failures.
- **Fleet Risk Assessment After Repetitive Events**
    - Airlines should perform **systematic fleet-level risk assessments** after even one significant failure, especially if component aging or design vulnerability is involved.

Lessons Learned – Taking it Forward

The SAS Dash 8 Q400 landing gear incidents in 2007 presented a unique set of challenges for Emergency Response Teams (ERTs)—both on-site (airport-based) and organizational (airline-based).

- While no fatalities occurred, the complexity and frequency of the events tested SAS's emergency preparedness, stakeholder coordination, and crisis communication strategies.

Consider the following – issues / elements

Repetitive Nature of the Emergencies – "Crisis Fatigue"

Challenge - Three similar accidents within 7 weeks created cumulative pressure on emergency responders.

- Each event carried emotional and operational weight, reducing the "novelty" effect but also risking complacency or desensitization.
- The need to remain vigilant despite apparent pattern familiarity required strong leadership and mental resilience.

ERT Response:

- Rapid reactivation of emergency protocols each time.
- Emphasis on fresh situational awareness for each event.
- Maintenance of mental and emotional well-being of responders and support teams.

Unpredictable Landing Gear Collapse – Elevated On-ground Hazards

Challenge: The **asymmetrical gear collapses** created unstable aircraft configurations on the runway, posing risks to:

- Evacuation teams
- Firefighters and rescue personnel
- Aircraft recovery crews

Sloped fuselages, fuel leakage risks, and difficult cabin access required non-standard rescue approaches.

ERT Response:

- On-site ERTs had to **assess structural integrity** rapidly before allowing evacuation or deploying rescue equipment.
- Fire and rescue services had to prepare for **fuel ignition** scenarios due to sparks or friction during runway contact.

Passenger Management and Evacuation Under Stress

Challenge:

While no fire occurred, the **sudden gear collapse and runway veer-off** in all three cases caused:

- Panic
- Minor injuries
- Risk of head trauma due to low-altitude impact force

Efficient evacuation without causing additional injuries required quick judgment.

ERT Response:

- Cabin crew executed rehearsed emergency evacuation drills.
- Airport medical teams supported **triage and first response** at the scene.
- Passengers were stabilized emotionally and physically before being transferred for further assessment.

Crisis Communication with Media, Public, and Families

Challenge:

Multiple incidents attracted global media attention, raising suspicion and fear regarding the aircraft type and SAS's safety culture.

- The airline was under public scrutiny, and consistency in messaging was paramount.
- Reassuring passengers and families without pre-empting investigation findings proved difficult.

ERT & Corporate Communication Response:

- Crisis communication teams coordinated with airport authorities and civil aviation regulators.
- SAS quickly grounded its fleet after the third event—a bold but necessary public relations move to preserve trust and demonstrate responsibility.
- Care teams were deployed to provide emotional support and timely updates to affected passengers and families.

Coordination with External Stakeholders

- National Aviation Authorities

- Local emergency services
- Airport operators
- Accident Investigation Boards

Varying procedures and jurisdictional nuances made unified coordination complex.

ERT Response:

- SAS deployed dedicated crisis teams to each location to work in parallel with local responders.
- Emergency response plans were localized and adapted to align with each country's operational protocols.

Business Continuity and Operational Disruption

Challenge:

- Runway closures following the incidents affected airport operations.
- SAS faced crew disruptions, equipment shortages, and a damaged public image.

ERT / Organizational Response:

- Business continuity teams activated contingency flight plans and rebooking services.
- Operations control centers managed real-time disruption minimization and communication with partners.

Lessons for Future Emergency Response

- **Multiple Event Preparedness** – Organizations must plan not only for isolated events but **cascading or repeated emergencies**.
- **Stress Management for ERTs** – Psychological debriefs and rotations are essential to avoid burnout.
- **Consistent Crisis Communication** – Clear, calm, and accountable messaging builds long-term trust.
    - **Integrated Response Plans** – Harmonization between airline and airport ERTs is critical across different jurisdictions.
    - **ERT Training for Unusual Landing Configurations** – Evacuations and rescues from tilted or gear-failed aircraft must be practiced, not theorized.