AVIATION OCCURRENCE REPORT

RISK OF COLLISION
BETWEEN

AIR CANADA
AIRBUS INDUSTRIE A320 C-FNNA

AND

CANADIAN AIRLINES INTERNATIONAL
BOEING 737 C-GFCP
BROADVIEW, SASKATCHEWAN
18 JUNE 1995

REPORT NUMBER A95C0127

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

Air Canada Flight 139 (ACA139), an Airbus A320, was en route from Ottawa to Vancouver at flight level (FL) 350 near Broadview, Saskatchewan when the pilots received a Traffic Alert and Collision Avoidance System (TCAS) warning of conflicting traffic and a resolution advisory (RA) to "descend now" which advice was followed. Canadian Airlines International Flight 636 (CDN636), a Boeing 737, was also in the vicinity, flying in the opposite direction en route from Calgary to Winnipeg at FL350. The pilots of CDN636 also received a TCAS RA and climbed their aircraft. The aircraft passed within approximately one mile of each other and a loss of separation occurred. There were no injuries or damage, and both aircraft continued on to their respective destinations without further incident.

The extent of the aircraft traffic in the area being controlled by the Broadview sector controller of the Winnipeg Area Control Centre (ACC) at the time of the occurrence was considered to be moderate to heavy with added complexities. There was thunderstorm activity in the area and a number of aircraft were deviating off course around weather build-ups or travelling at non-standard altitudes to avoid turbulence. The air traffic control radar displays functioned normally throughout the occurrence and all control information was correctly displayed. Unit staffing levels were considered normal and all equipment was functioning normally.

Other Factual Information

The Broadview Sector controller was qualified for the position and had worked the Saskatchewan specialty in the Winnipeg ACC since 1986. He had been on duty for approximately two and one-half hours prior to the occurrence and was carrying out the combined duties of the radar and data controller positions. Shortly before the occurrence, traffic levels began to increase and a number of estimates had been passed to the Broadview Sector controller. The supervisor noted this activity increase and approximately 10 minutes prior to the occurrence an additional controller was assigned and began to assist by assuming the data position duties.

Air traffic controllers assign flight levels appropriate to the aircraft track as set out in the *Cruising Altitudes Order* of the Air Navigation Orders. A flight level not appropriate to the aircraft track may be assigned by the controller if an aircraft crew requests the flight level because of turbulence. CDN636 was travelling at the same altitude (FL350, wrong way for direction of flight) as ACA139 because of excessive turbulence at the standard altitude and the flight progress strip indicated the non-standard altitude. CDN636 was travelling on Jet route(high level airway) 504 (J504) (see Appendix A) until approximately 50 miles west of Regina, Saskatchewan when the flight was placed on radar vectors for separation from a north-west bound aircraft that was also at FL350. CDN636 carried out a small turn and then was given a vector to Broadview, resulting in little change to the original route (J504).

ACA139 had been given an air traffic control (ATC) clearance along a route that, in the Winnipeg, Manitoba area, resulted in the aircraft travelling along fixed RNAV route T467 (see Appendix A). ACA139 was to proceed along T467 until reaching a waypoint known as KEDGE (near Brandon, Manitoba) and then turn left to proceed along T475 until Medicine Hat, Alberta. However, prior to reaching KEDGE on T467, the pilot of ACA139 contacted the Winnipeg ACC Winnipeg West sector controller and requested clearance to deviate north of track because of en route weather. The request was approved and subsequently coordinated with the Broadview sector controller. Warning indicators (red W) were marked on the flight progress strips for both CDN636 and ACA139, indicating a possible conflict. The Broadview sector controller noted ACA139 to be moving north of T467 and confirmed there were no conflicts. A few minutes later, while handing off ACA139 to the Broadview sector controller, the Winnipeg radar controller again advised of ACA139's deviation to the north. The Broadview sector controller assumed control of ACA139, believing that it would be continuing on T467, and continued to monitor the aircraft as it continued to deviate to the north.

The pilot of ACA139 carried out a deviation approximately 25 miles north of track, about 85 miles beyond KEDGE, before turning southwesterly back towards track (T475) again, approximately seven minutes prior to the occurrence. ACA139's original track, T475, was south of both T467 and J504 and ACA139 had to cross both routes to regain the originally cleared track. There was no instruction issued

to the pilot in his deviation clearance, that required him to request clearance back to his original track nor is there any regulatory requirement for him to do so.

Traffic Alert and Collision Avoidance System (TCAS) is an aircraft-installed device that functions independently from the ground-based air traffic control radar system. TCAS uses the radar beacon transponders installed in other aircraft to provide collision avoidance information to the flight crew in the form of recommended vertical escape manoeuvres known as resolution advisories (RA). The required separation between ACA139 and CDN 636 was 2,000 feet vertically and five miles horizontally. ACA139 continued southwest-bound converging on the eastbound CDN636 until both flight crews received TCAS RAs and advised ATC that they were descending and climbing respectively. Both crews reacted promptly to the RAs and 20 seconds later the aircraft passed each other with 900 feet vertical and 1.3 miles horizontal spacing (see Appendix B).

The Radar Modernization Project (RAMP) was designed to completely replace Canada's existing national ATC radar network with a system utilizing advanced computer technology and was designed with a traffic conflict warning system; however, that warning capability is not yet functional. The Canadian Automated Air Traffic System (CAATS) system, which is currently scheduled to upgrade the RAMP system in 1998, originally incorporated a conflict resolution system, as well as a traffic conflict warning system. The conflict resolution features of the anticipated system have recently been deleted from the project; however, it is anticipated that the traffic conflict warning capability will be retained. The United States Federal Aviation Administration (FAA) has successfully used a traffic conflict alert system as part of their air traffic control system for approximately fifteen years.

Air traffic controllers use data provided by radar displays and radio communications to form a mental picture of air traffic that assists with the conceptualization and prediction of aircraft movement. Studies suggest that an air traffic controller's mental picture consists of two definable elements: a mental model, and situation awareness (Gilson et al, 1994). The mental model is the underlying knowledge that is the basis for situation awareness and consists of knowledge of airspace, aircraft, and ATC procedures as well as an understanding of the associated electronic systems. The term 'situation awareness' refers to "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" (Endsley, 1988). Data from auditory or visual displays are

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Gilson, R.D.,Garland, D.J.,& Koonce, J.M. (1994) editors; *Situational Awareness in Complex Systems, Proceedings of a CAHFA Conference*; Emery-Riddle Aeronautical University Press.

Endsley, M.R. (1988). *A construct and its measurement: the functioning and evaluation of pilot situation awareness*. (NOR DOC

momentarily perceived, held in situation awareness (if they will be needed), and may update the mental model if there are long term implications. Information in the mental model influences and structures the data held in situation awareness and directs an individual's attention. A controller relies on his mental picture to provide a basis for analyzing new information and making decisions.

Analysis

Research into human decision making has shown that in the process of making decisions people develop hypotheses (Wickens, 1992). The contents of the mental model and situation awareness will set the framework for these hypotheses. However, when people select a particular hypothesis, they tend to give inordinate diagnostic weight to any information that supports the chosen hypothesis. Much less weight is then given to data that may support a competing hypothesis. Once a person becomes locked onto a particular hypothesis, it becomes very difficult for them to discard it, even when faced with compelling evidence to the contrary.

The Broadview Sector controller believed that ACA139 was going to continue on T467. On two occasions the controller was prompted about ACA139, and being aware of a possible conflict, he analyzed the available information, and concluded that ACA139 would not conflict with any other aircraft. After determining that ACA139 was no longer a problem, the dynamics of the air traffic situation at the time required the controller to dedicate his time to other aircraft, and their potential conflicts. With his attention now diverted to other aircraft, the change in direction in the radar target representing ACA139 was not sufficient stimulus to cause the controller to discard his previous conclusion that there was no conflict, and to generate a re-evaluation of the available information. The traffic density, the complexity of the coordinations required, the limited time available, and the characteristics of human information processing combined to allow the change in the status of the previously de-conflicted aircraft to go undetected, and the loss of separation occurred.

Findings

1. The controller was qualified for the position.

2. Staffing levels were considered normal.

3. The controller had been carrying out the combined duties of the radar and data controller until approximately 10 minutes prior to the occurrence.

88-30). Hawthorne, CA:Northrop Corporation.

Wickens, C. D. (1992). *Engineering psychology and human performance.* New York: HarperCollins.

4. The control radar was serviceable, and the displays functioned normally throughout the occurrence.

5. Traffic density was moderate to heavy with added complexities.

6. There was thunderstorm activity in the area and a number of aircraft were deviating off course around weather build-ups or travelling at non-standard altitudes to avoid turbulence.

7. There was no instruction issued to the pilot in his deviation clearance that required him to request clearance back to his original track nor is there any regulatory requirement for him to do so.

8. After ACA139 turned back towards track (T475), the controller did not recognize the developing traffic conflict between Air Canada 139 and Canadian 636.

9. The TCAS systems were activated in both aircraft and provided the flight crews with the information necessary for collision avoidance.

10. The aircraft passed within 1.3 miles and 900 feet of each other.

11. The traffic conflict warning system incorporated in the radar system is not yet operational.

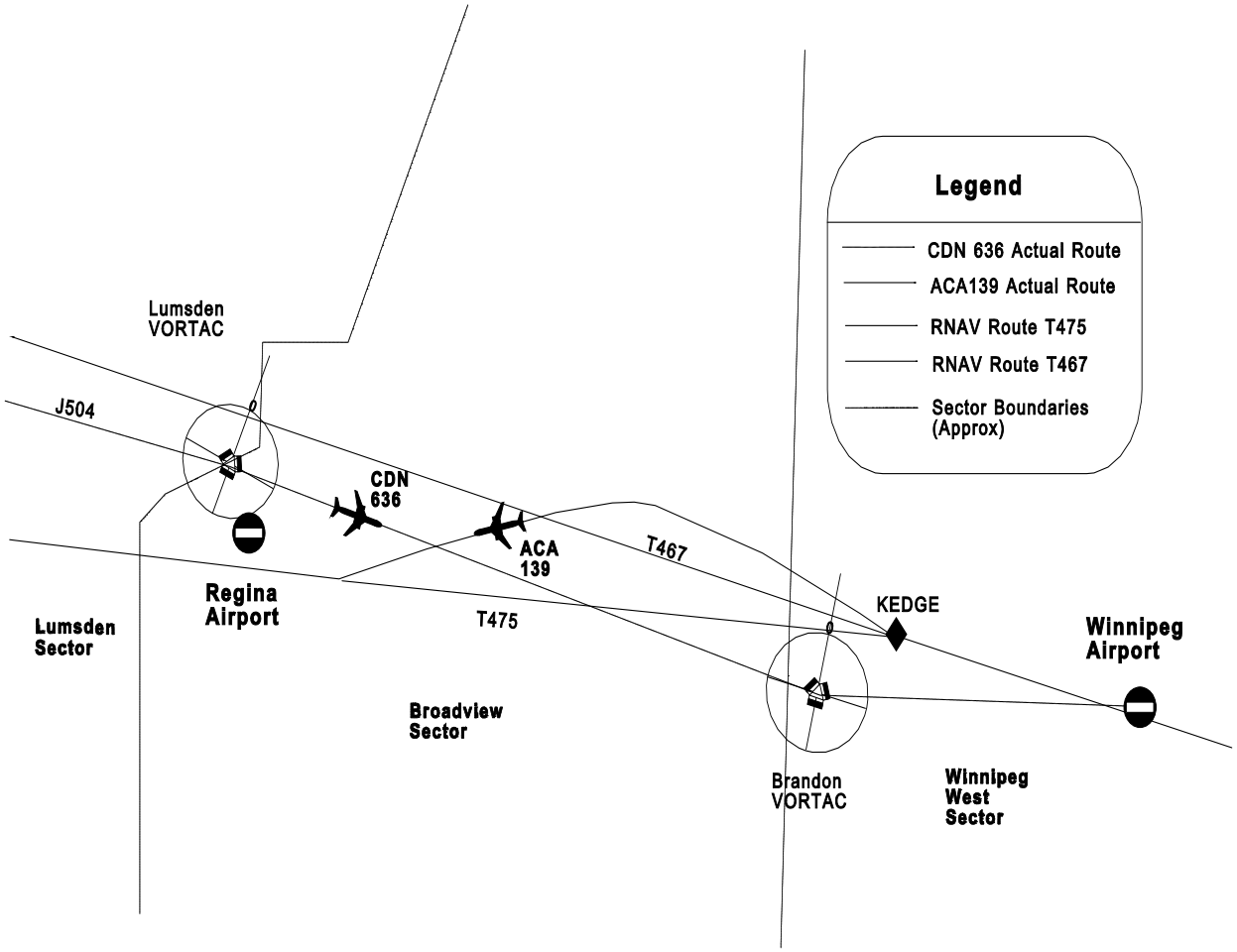
Causes and Contributing Factors

The controller did not recognize the developing traffic conflict between Air Canada 139 and Canadian 636 and did not maintain the required separation criteria for the two aircraft. The combined effect of the traffic density, the complexity of the coordinations required, the limited time available, and the characteristics of human information processing combined to allow the change in the status of the previously de-conflicted aircraft to go undetected. Contributing to the occurrence was that the traffic conflict warning system was not operational.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, John W. Stants, and members Zita Brunet and Maurice Harquail, authorized the release of this report on 24 April 1996.

APPENDIX A

Aircraft Tracks and Routings



APPENDIX B

RAMP Radar Data Table

A95C0127 - Occurrence Radar Data Analysis									
RDA Data from Regina Radar Source - 18 June 1995									
Time (Z) (hh:mm:ss)	Trnspndr Code	A/C Call sign	Range (nm)	Azimuth (deg)	Altitude (FL)	Ground Speed (Kts)	Dist Btwn A/C (nm)	Rate of Closure (Kts)	Time to meet (sec)
23:22:22	7330	CDN636	16.42	27.33	350	400	108.5	880	443
	2264	ACA139	118.16	78.05	350	480			
23:26:04	7330	CDN636	33.50	71.74	350	400	56.8	850	240
	2264	ACA139	89.91	79.06	350	450			
23:29:51	7330	CDN636	56.73	83.14	350	390	5.9	850	25
	2264	ACA139	62.53	84.27	350	460			
23:29:56	7330	CDN636—	57.23	83.32	352	390	4.8	830	21
	2264	ACA139¯	61.97	84.40	349	440			
23:30:16	7330	CDN636	59.22	83.85	358	370	1.3	810	5
	2264	ACA139	59.66	85.03	347	440			