

Today's flight path



1. WestJet's Story
2. Background
3. Approach
4. Results and Recommendations
5. Questions?

Optimization of a Planned Schedule



Operations Research

Simio User Group Meeting May 10th, 2018

Jenn Kneller

Operations Research Team

Our Mission: Advanced decision making support

Areas of expertise:

Optimization

Simulation

Statistical analysis

Revenue Management

Approach:

In partnership with management to identify and prioritize issues

Focus on business impact

Build an objective, quantitative framework for analysis

Transfer technology



“Its magic”

WestJet's story

By the numbers

Network



105 destinations in North America, Central America, the Caribbean and Europe



175 destinations in 21 countries through our global partners

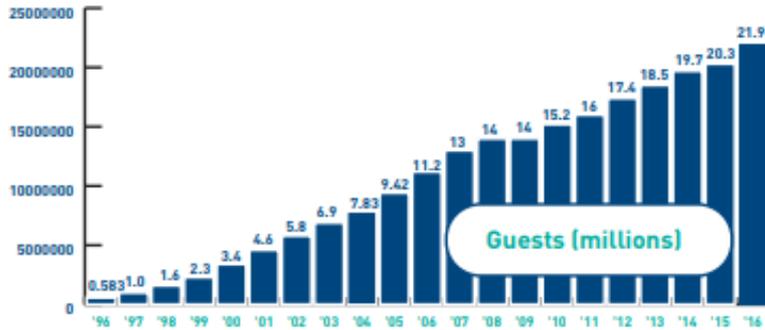
Fleet



Coming soon...

Boeing 737 MAX

Boeing 787 Dreamliner



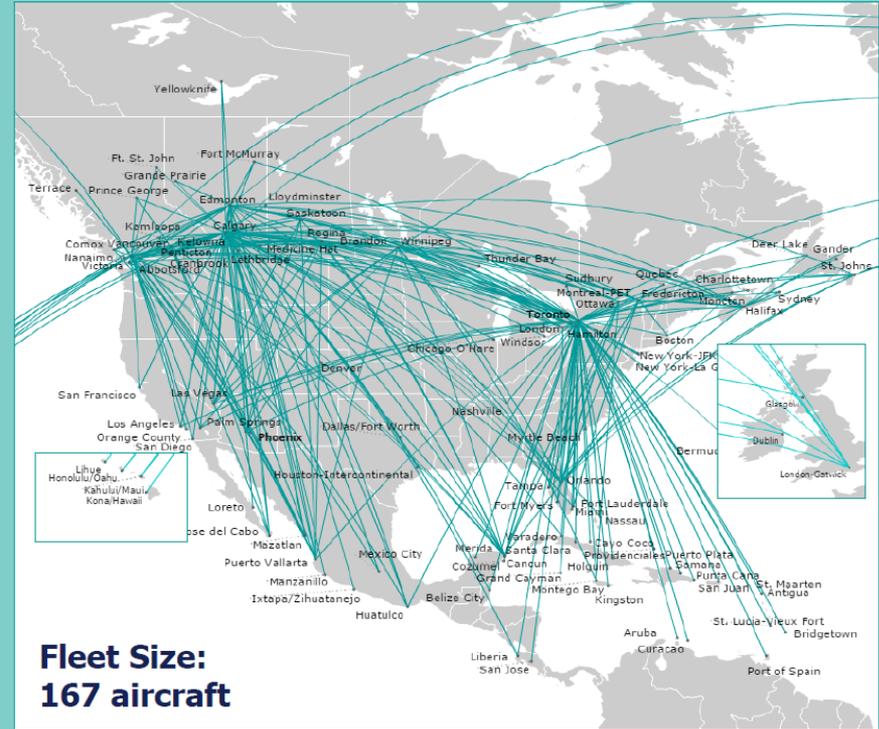
Where we fly

A history of successful growth

1996: 5 destinations



Today: over 100 destinations



Source: IATA SRS, WestJet internal systems

Our mission

To enrich the lives everyone in WestJet's world

Four key pillars for achieving our vision

1

Diversified,
sustainable
revenue
growth

2

Financial
strength

3

People &
culture

4

Operational
excellence

See it

2022

Future positioning:

A focused approach to market segmentation



Strategy: WestJet will evolve from a low-cost, point-to-point airline into a high-value, global network carrier; Swoop will win in the price-sensitive segment

787 Dreamliner

Opens up a world of possibilities



Future

The next chapter in our partnership journey



Network

Strategy based on four core tenets



Build our hubs

(e.g. coverage & frequency)



Improve schedule utility

(e.g. reliable hourly schedules in key markets)



Enhance connectivity & feed



Partnerships

Network simulator

- How does WestJet execute on its network strategy?
- What tools are in place to support this strategy?
- How does the network behave when we turn the dials?

Background

SPOT Safely perform on-time

SCHEDULED	ESTIMATED	FLIGHT	AIRLINE	FROM	TERMINAL	GATE	CAROUSEL	STATUS	NOTIFICATIONS
VIEW EARLIER FLIGHTS									
12:23	16:00	DL2804	Delta Air Lines	Salt Lake City	Main	E82	33	Delayed	NOTIFY ME
14:40	14:46	AC8573	Air Canada	Regina	Main	C41	4	Arrived	
14:51	14:40	WS1697	WestJet	Los Angeles	Main	E80	21	Arrived	
14:51	14:40	MU8250	China Eastern	Los Angeles	Main	E80	21	Arrived	
14:51	14:40	KE6559	Korean Air	Los Angeles	Main	E80	21	Arrived	
14:51	14:40	DL7171	Delta Air Lines	Los Angeles	Main	E80	—	Arrived	
14:55	14:51	WS145	WestJet	Calgary	Main	B13	1	Arrived	
14:59	14:48	WS3282	WestJet	Prince George	Main	A10	0	Arrived	
15:00	14:56	AC8109	Air Canada	Denver	Main	E86	25	Arrived	
15:03		AC243	Air Canada	Edmonton	Main	C45	6	On Time	NOTIFY ME
15:11	15:26	AC219	Air Canada	Calgary	Main	C31	6	Delayed	NOTIFY ME
15:11	15:12	AC8312	Air Canada	Comox	Main	C32	4	On Time	NOTIFY ME
15:15	15:11	WS1789	WestJet	Las Vegas	Main	E81	21	On Time	NOTIFY ME
15:15	15:11	DL7129	Delta Air Lines	Las Vegas	Main	E81	21	On Time	NOTIFY ME
15:15		9M591	Central Mountain Air	Campbell Riv	Main	B23	3	On Time	NOTIFY ME
15:20		8P206	Pacific Coastal	Powell River	South	G3	—	On Time	NOTIFY ME
15:20	15:57	WS23	WestJet	London Gatwick	Main	D53	20	Delayed	NOTIFY ME
15:22	17:00	AC8070	Air Canada	Victoria	Main	C42	4	Delayed	NOTIFY ME

- One of the primary metrics that WestJet uses to measure operational success is on-time performance, the level of success of the aircraft remaining on the published schedule.
- On-time performance, sometimes referred to as OTP is normally expressed as a percentage with a higher percentage meaning more aircraft are on time.
- Considered on time if flight arrives within 15 minutes of the scheduled arrival time. (industry standard)

WestJet schedule planning process

Flying the fleet to maximize time in the air

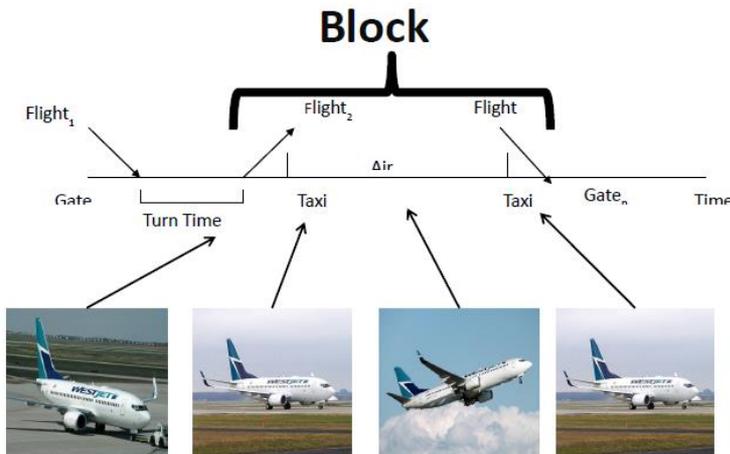


- Schedule build is twice a year;
- Goals of increasing aircraft utilization and maintaining on-time performance;
- A line of flying consists of the following processes:

- Block time – time between departure and arrival. Consists of taxi, air time.

- Aircraft turn time - Time required to unload an airplane after its arrival at the gate and prepare it for departure again

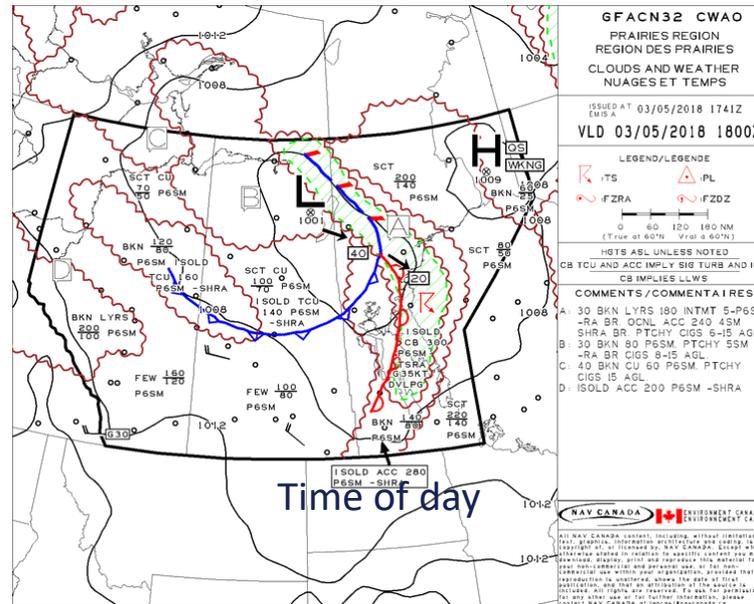
- Scheduled down time



Block time reliability

High variability within block time aircraft turn time

- Weather;
- Deicing;
- Maintenance;
- Crew scheduling;
- Guest connections;
- Air traffic control;
- Gate management;
- Aircraft performance.



Turn time

Critical path constantly shifting

ATW (Above the Wing):

Guest offload - load factor

Grooming - longer flights

Crew change – safety briefings

Guest onload

- Boarding strategy
- Specials handling
- Boarding compliance
- Load factor

Guest count

Doors Closed

Carry-on baggage

BTW (Below the Wing):

Baggage offload – load factor

Baggage onload – load planning

Connection baggage – hot or cold

Lavatory servicing – done at our hubs

Fueling – dispatching requirements

Potable water – number of aircraft

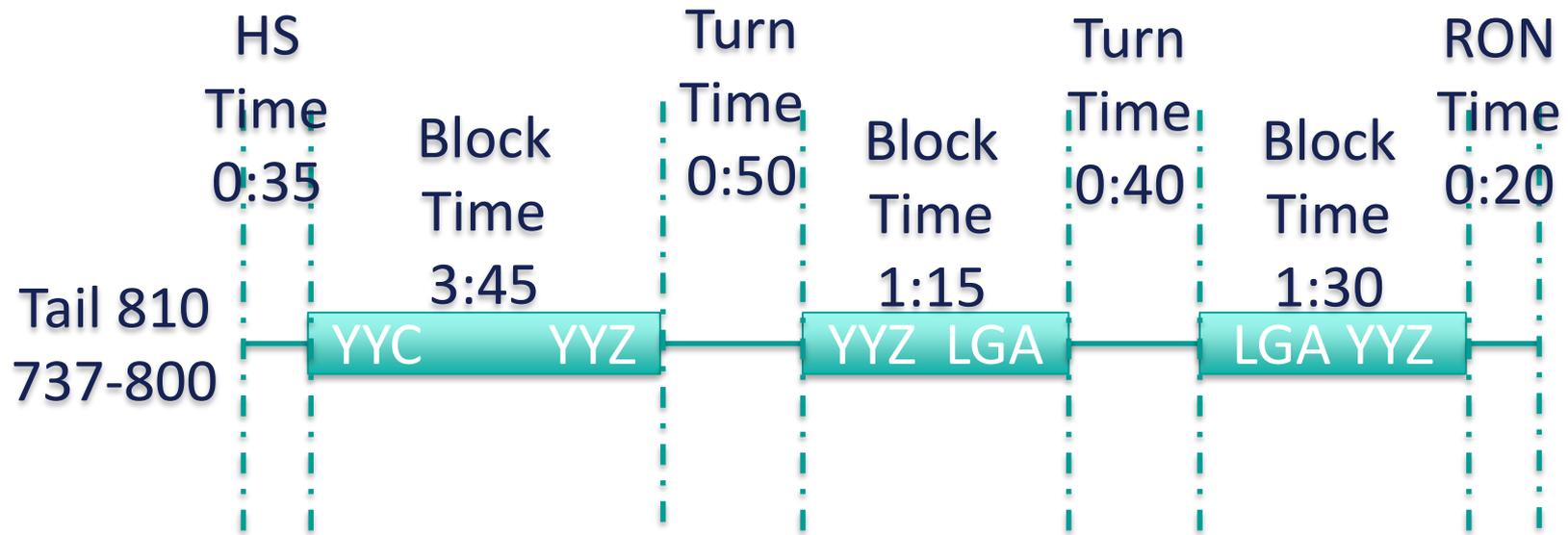
Catering- destination

Maintenance – unscheduled



Mickey's Day

A line of flying



HS-Head start

RON – Remain Overnight

Total Flight Hours:

6.5

Total Aircraft Hours:

7.75

The challenge

Build an airline network simulator to optimize aircraft utilization and on-time performance

Approach

Block/turn time analysis

1. Obtain data:

- Departure Control System
- Sabre Reservation System
- Flight Management Software

2. Group and analyzed by:

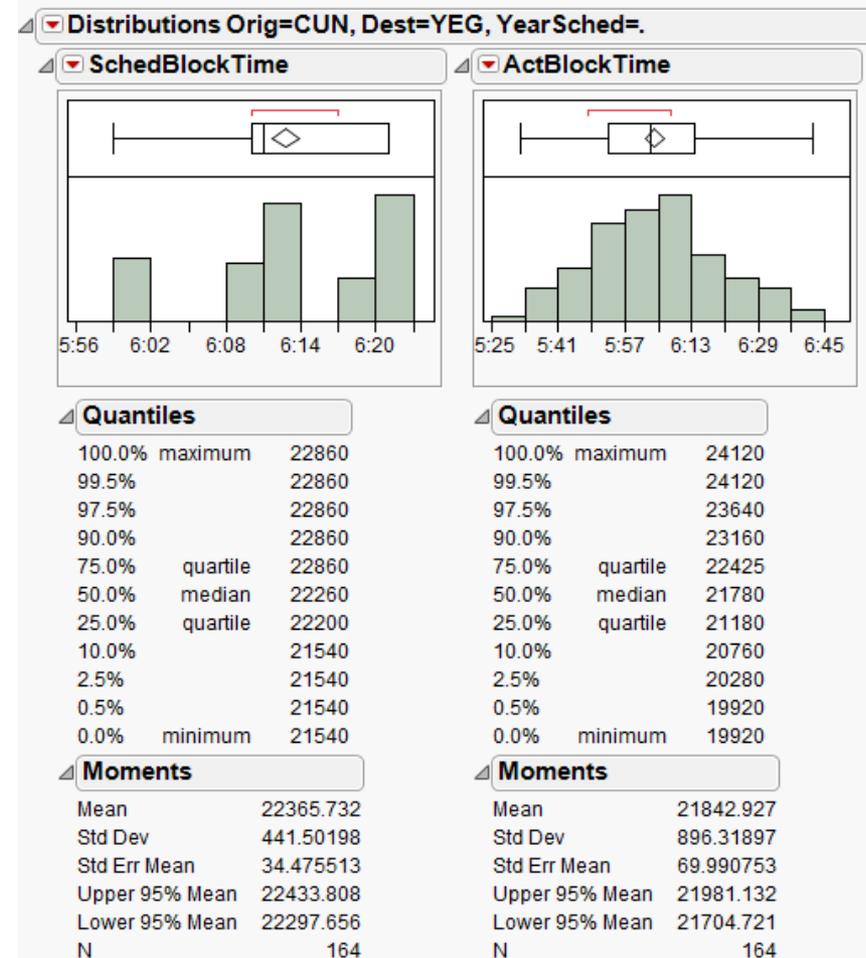
- Season (two seasons)
- City pair
- Aircraft type
- Time of day

3. Fit data using SAS JMP:

- Outlier and data cleanup

4. Import into Simio:

- Aircraft
- Leg
- Station Data



Block Time Analysis

How well did we do?

1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
	City Pair	Subseason	Number of SeasonYears	Number of Flights	Mean(ACI	Std Dev(A	Q50	Q51	Q52	Q53	Q54	Q55	Q56	Q57	Q58	Q59	Q60	Q61	Q62	Q63	Q64	Q65
11	BOSYUL	WR DH8 Mar PM	1	55	1:18	0:09:27	1:16	1:17	1:17	1:17	1:17	1:17	1:17	1:17	1:17	1:18	1:19	1:19	1:20	1:20	1:20	1:20
12	BOSYYZ	WR DH8 Mar PM	3	218	2:02	0:10:29	2:01	2:02	2:02	2:02	2:02	2:03	2:03	2:03	2:03	2:03	2:03	2:04	2:04	2:05	2:05	2:05
13	BZEYYC	WS 737 Mar PM	1	5	6:22	0:17:54	6:20	6:21	6:21	6:22	6:23	6:24	6:24	6:25	6:26	6:26	6:27	6:28	6:29	6:29	6:30	6:31
14	BZEYYZ	WS 737 Mar PM	2	23	4:22	0:11:07	4:22	4:22	4:22	4:23	4:23	4:23	4:23	4:24	4:24	4:24	4:24	4:24	4:25	4:25	4:25	4:25
15	CCCYZ	WS 737 Mar PM	4	35	3:33	0:08:08	3:33	3:33	3:33	3:34	3:34	3:34	3:34	3:35	3:35	3:35	3:35	3:36	3:36	3:36	3:36	3:36
16	CUNYEG	WS 737 Mar AM	3	13	6:02	0:10:52	5:59	5:59	6:00	6:00	6:00	6:01	6:01	6:02	6:02	6:03	6:03	6:04	6:05	6:05	6:05	6:06
17	CUNYEG	WS 737 Mar PM	4	83	6:10	0:14:18	6:08	6:08	6:09	6:09	6:09	6:09	6:10	6:10	6:11	6:11	6:12	6:12	6:13	6:13	6:13	6:14
18	CUNYHM	WS 737 Mar PM	3	12	3:33	0:04:31	3:33	3:33	3:33	3:33	3:33	3:34	3:34	3:34	3:34	3:34	3:34	3:34	3:34	3:34	3:35	3:35
19	CUNYHW	WS 737 Mar PM	4	34	4:35	0:13:23	4:35	4:35	4:36	4:36	4:36	4:36	4:37	4:37	4:37	4:37	4:37	4:38	4:38	4:38	4:38	4:38
20	CUNYLW	WS 737 Mar PM	4	36	6:22	0:14:31	6:20	6:21	6:21	6:22	6:22	6:23	6:23	6:24	6:25	6:25	6:26	6:26	6:26	6:26	6:27	6:27
21	CUNYOW	WS 737 Mar PM	4	58	4:06	0:13:04	4:06	4:06	4:06	4:07	4:07	4:08	4:08	4:09	4:09	4:10	4:10	4:10	4:11	4:11	4:12	4:12
22	CUNYQB	WS 737 Mar PM	2	8	4:15	0:04:35	4:16	4:16	4:16	4:17	4:17	4:17	4:17	4:17	4:18	4:18	4:18	4:18	4:18	4:18	4:18	4:18
23	CUNYQM	WS 737 Mar PM	3	12	4:31	0:11:07	4:28	4:28	4:29	4:29	4:29	4:29	4:29	4:29	4:29	4:29	4:29	4:30	4:31	4:32	4:33	4:33
24	CUNYQR	WS 737 Mar PM	4	42	5:14	0:10:42	5:13	5:14	5:14	5:14	5:14	5:15	5:15	5:15	5:15	5:16	5:16	5:16	5:17	5:17	5:18	5:18
25	CUNYUL	WS 737 Mar PM	4	47	4:14	0:11:42	4:13	4:14	4:14	4:14	4:15	4:15	4:15	4:16	4:16	4:16	4:17	4:17	4:18	4:18	4:19	4:19
26	CUNYVR	WS 737 Mar AM	1	5	6:35	0:12:56	6:37	6:37	6:38	6:38	6:39	6:39	6:40	6:40	6:41	6:41	6:42	6:42	6:43	6:43	6:44	6:44
27	CUNYVR	WS 737 Mar PM	4	97	6:37	0:12:53	6:36	6:36	6:37	6:38	6:38	6:39	6:39	6:40	6:41	6:42	6:42	6:43	6:43	6:43	6:44	6:44
28	CUNYWG	WS 737 Mar PM	4	63	4:54	0:11:05	4:56	4:56	4:56	4:56	4:56	4:56	4:57	4:57	4:57	4:57	4:58	4:58	4:58	4:59	4:59	4:59
29	CUNYXE	WS 737 Mar PM	4	36	5:40	0:14:23	5:38	5:39	5:39	5:40	5:41	5:41	5:42	5:42	5:43	5:43	5:44	5:44	5:44	5:45	5:45	5:45
30	CUNYXU	WS 737 Mar PM	1	9	3:29	0:06:17	3:29	3:29	3:30	3:30	3:30	3:31	3:31	3:31	3:31	3:32	3:32	3:32	3:32	3:32	3:32	3:32
31	CUNYYC	WS 737 Mar AM	2	14	6:01	0:14:47	5:58	5:58	5:58	5:59	5:59	5:59	5:59	6:00	6:00	6:00	6:00	6:01	6:01	6:01	6:01	6:01
32	CUNYYC	WS 737 Mar PM	4	206	6:04	0:16:03	6:01	6:02	6:02	6:02	6:03	6:03	6:04	6:04	6:05	6:05	6:06	6:06	6:06	6:07	6:07	6:08
33	CUNYYZ	WS 737 Mar PM	4	17	6:35	0:14:23	6:33	6:33	6:34	6:35	6:35	6:36	6:37	6:37	6:38	6:39	6:39	6:40	6:41	6:42	6:42	6:43
34	CUNYYZ	WS 737 Mar PM	4	244	3:56	0:12:21	3:55	3:55	3:56	3:57	3:57	3:58	3:59	3:59	3:59	3:59	3:59	3:59	3:59	4:00	4:00	4:01
35	CURYZZ	WS 737 Mar PM	4	17	5:24	0:13:47	5:27	5:27	5:28	5:28	5:29	5:30	5:30	5:31	5:31	5:32	5:33	5:33	5:33	5:33	5:33	5:33
36	CZMYZZ	WS 737 Mar PM	4	31	3:54	0:08:22	3:52	3:53	3:53	3:54	3:54	3:55	3:56	3:56	3:56	3:57	3:57	3:57	3:58	3:58	3:58	3:59
37	DENYYC	WS 737 Mar PM	1	24	2:22	0:09:06	2:21	2:21	2:21	2:22	2:22	2:23	2:23	2:23	2:23	2:23	2:23	2:23	2:23	2:23	2:23	2:23
38	FLLYHZ	WS 737 Mar PM	3	13	3:35	0:09:49	3:34	3:34	3:34	3:34	3:35	3:35	3:35	3:35	3:35	3:35	3:35	3:36	3:37	3:37	3:38	3:38
39	FLLYOW	WS 737 Mar PM	3	30	3:15	0:09:32	3:15	3:15	3:15	3:16	3:16	3:16	3:16	3:16	3:16	3:16	3:16	3:17	3:17	3:17	3:17	3:17
40	FLLYQB	WS 737 Mar PM	3	13	3:34	0:10:56	3:35	3:35	3:35	3:35	3:35	3:36	3:36	3:36	3:36	3:37	3:37	3:37	3:38	3:38	3:38	3:39
41	FLLYUL	WS 737 Mar PM	4	142	3:25	0:12:00	3:24	3:24	3:25	3:25	3:26	3:26	3:26	3:27	3:27	3:27	3:27	3:27	3:28	3:28	3:28	3:28
42	FLLYWG	WS 737 Mar PM	3	12	4:45	0:18:26	4:43	4:44	4:44	4:44	4:44	4:45	4:45	4:45	4:45	4:46	4:46	4:47	4:48	4:49	4:50	4:52
43	FLLYYC	WS 737 Mar PM	3	17	5:54	0:12:32	5:51	5:52	5:52	5:53	5:53	5:54	5:54	5:55	5:55	5:56	5:57	5:57	5:58	5:58	5:59	6:00
44	FLLYYZ	WS 737 Mar PM	4	233	3:10	0:11:07	3:10	3:10	3:10	3:10	3:11	3:11	3:11	3:11	3:12	3:12	3:13	3:13	3:13	3:13	3:14	3:14
45	GCMYYZ	WS 737 Mar PM	4	36	4:01	0:10:00	4:03	4:03	4:03	4:03	4:04	4:04	4:04	4:04	4:05	4:05	4:05	4:05	4:06	4:06	4:06	4:06
46	HNLYVR	WS 737 Mar PM	4	228	5:36	0:15:57	5:36	5:36	5:37	5:37	5:38	5:38	5:38	5:38	5:39	5:39	5:39	5:40	5:41	5:41	5:41	5:41
47	HNLYYC	WS 767 Mar PM	3	25	6:17	0:15:53	6:17	6:17	6:18	6:18	6:18	6:19	6:19	6:19	6:20	6:20	6:20	6:21	6:22	6:22	6:23	6:23
48	HNLYYJ	WS 737 Mar PM	2	10	5:21	0:19:26	5:23	5:23	5:24	5:24	5:25	5:25	5:26	5:26	5:27	5:27	5:28	5:28	5:29	5:29	5:30	5:30
49	HOGYYZ	WS 737 Mar PM	4	35	3:54	0:12:59	3:52	3:52	3:53	3:53	3:54	3:54	3:55	3:55	3:55	3:56	3:56	3:57	3:57	3:57	3:58	3:58
50	HUXYEG	WS 737 Mar PM	1	5	6:17	0:24:42	6:12	6:13	6:15	6:16	6:17	6:19	6:20	6:21	6:23	6:24	6:25	6:27	6:28	6:29	6:30	6:32



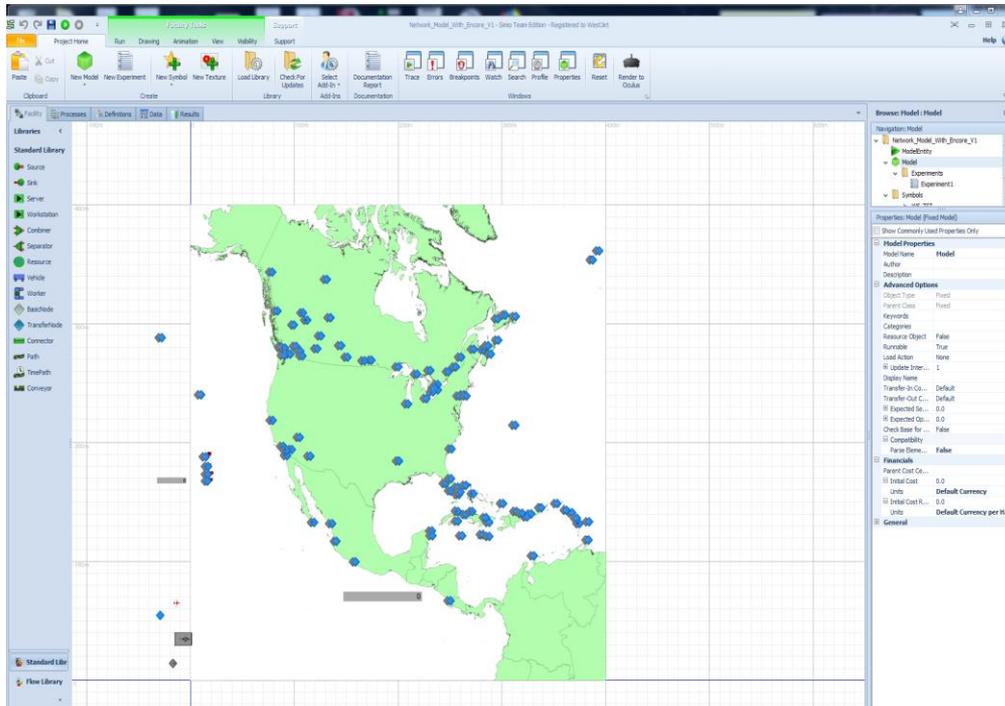
Import tables

Aircraft, leg, schedule data

Bound to Database: Access					
Tail ID	Reg	Start Time	Model	Capacity	
1	001	XXXX	0 800	174	
2	002	XXXX	0 800	174	
3	003	XXXX	0 800	174	
4	004	XXXX	0 800	174	
5	005	XXXX	0 700	136	
6	006	XXXX	0 700	136	
7	007	XXXX	0 400	75	
8	008	XXXX	0 600	119	
9	009	XXXX	0 600	119	
10	010	XXXX	0 700	136	
11	011	XXXX	0 700	136	
12	012	XXXX	0 700	136	
13	013	XXXX	0 800	174	
14	014	XXXX	0 700	136	
15	015	XXXX	0 800	174	
16	016	XXXX	0 800	174	
17	017	XXXX	0 400	75	
18	018	XXXX	0 600	119	
19	019	XXXX	0 400	75	
20	020	XXXX	0 700	136	
21	021	XXXX	0 600	119	
22	022	XXXX	0 800	174	
23	023	XXXX	0 800	174	
24	024	XXXX	0 800	174	
25	025	XXXX	0 700	136	
26	026	XXXX	0 700	136	
27	027	XXXX	0 700	136	
28	028	XXXX	0 700	136	
29	029	XXXX	0 800	174	

Bound to Database: Access									
Tail ID	Flight	Origin	Destination	Type	DepartureTime (Hours)	Block Time	Head Start	FlightTime (Minutes)	
1	0	Source	Input@YEG	700		0	0	0	
2	001	418.01	YEG	Input@YYZ	700	6.08	214.2		Random.LogNormal(5.37699,0.040...
3	001	324.01	YYZ	Input@YYT	700	11.33	166.2		Random.LogNormal(5.17384,0.050...
4	001	317.01	YYT	Input@YOW	700	14.88	192		Random.LogNormal(5.14994,0.061...
5	001	369.01	YOW	Input@YYZ	700	21	61.2		Random.LogNormal(4.13852,0.122...
6	001	369.02	YYZ	Input@YQR	700	23.33	199.2		Random.LogNormal(5.27139,0.046...
7	001	156.01	YQR	Input@YYZ	700	36.33	169.2		Random.LogNormal(5.15234,0.0431)
8	001	435.01	YYZ	Input@YEG	700	40	249		Random.LogNormal(5.50621,0.040...
9	001	438.01	YEG	Input@YYZ	700	44.83	214.2		Random.LogNormal(5.37699,0.040...
10	001	438.02	YYZ	Input@YHZ	700	49.42	121.8		Random.LogNormal(4.79364,0.045...
11	001	175.01	YHZ	Input@YYZ	700	57.67	138		Random.LogNormal(4.92773,0.054...
12	001	175.02	YYZ	Input@YWG	700	60.92	154.8		Random.LogNormal(5.02774,0.055...
13	001	175.03	YWG	Input@YCC	700	64.08	126		Random.LogNormal(4.83337,0.056...
14	001	556.01	YYC	Input@YKF	700	67.08	210		Random.LogNormal(5.36369,0.048...
15	001	557.01	YKF	Input@YYC	700	71.33	247.2		Random.LogNormal(5.49127,0.041...
16	001	557.02	YYC	Input@YLW	700	76.58	58.8		Random.LogNormal(4.14952,0.055...
17	001	132.01	YLW	Input@YYC	700	109.33	58.2		Random.LogNormal(4.0878,0.08494)
18	001	132.02	YYC	Input@YWG	700	111.5	109.8		Random.LogNormal(4.91546,0.095...
19	001	493.01	YWG	Input@YYC	700	114	126		Random.LogNormal(4.83337,0.056...
20	001	1578...	YYC	Input@ORD	700	118	190.8		Random.LogNormal(5.27863,0.068...
21	001	1623...	ORD	Input@YVR	700	133.75	268.8		Random.LogNormal(5.58679,0.030...
22	001	2152...	YVR	Input@PVR	700	139.33	303		Random.LogNormal(5.68389,0.037...
23	001	2153...	PVR	Input@YVR	700	145.25	292.8		Random.LogNormal(5.71309,0.047...
24	001	9999	YVR	Input@Sink1	700	240	0		0
25	002	0	Source	Input@YYC	800	0	0		0
26	002	734.01	YYC	Input@YXU	800	6.58	205.8		Random.LogNormal(5.33302,0.039...
27	002	735.01	YXU	Input@YYC	800	10.98	241.2		Random.LogNormal(5.46908,0.032...
28	002	447.01	YYC	Input@YVR	800	16.33	85.2		Random.LogNormal(4.4438,0.07217)
29	002	174.01	YVR	Input@YYC	800	18.5	79.8		Random.LogNormal(4.37504,0.085...
30	002	670.01	YYC	Input@YYZ	800	20.75	217.8		Random.LogNormal(5.40139,0.048...
31	002	675.01	YYZ	Input@YYC	800	25.83	253.8		Random.LogNormal(5.51729,0.043...
32	002	1402...	YYC	Input@PHX	800	40.75	183		Random.LogNormal(5.17805,0.058...
33	002	1403...	PHX	Input@YYC	800	44.58	175.2		Random.LogNormal(5.1816,0.0585)
34	002	536.01	YYC	Input@YHM	800	48.92	214.2		Random.LogNormal(5.37905,0.046...
35	002	585.01	YHM	Input@YYC	800	58.75	250.2		Random.LogNormal(5.50428,0.042...
36	002	538.01	YYC	Input@YHM	800	63.92	214.2		Random.LogNormal(5.37905,0.046...
37	002	539.01	YHM	Input@YYC	800	68.33	250.2		Random.LogNormal(5.50428,0.042...

Model Approach

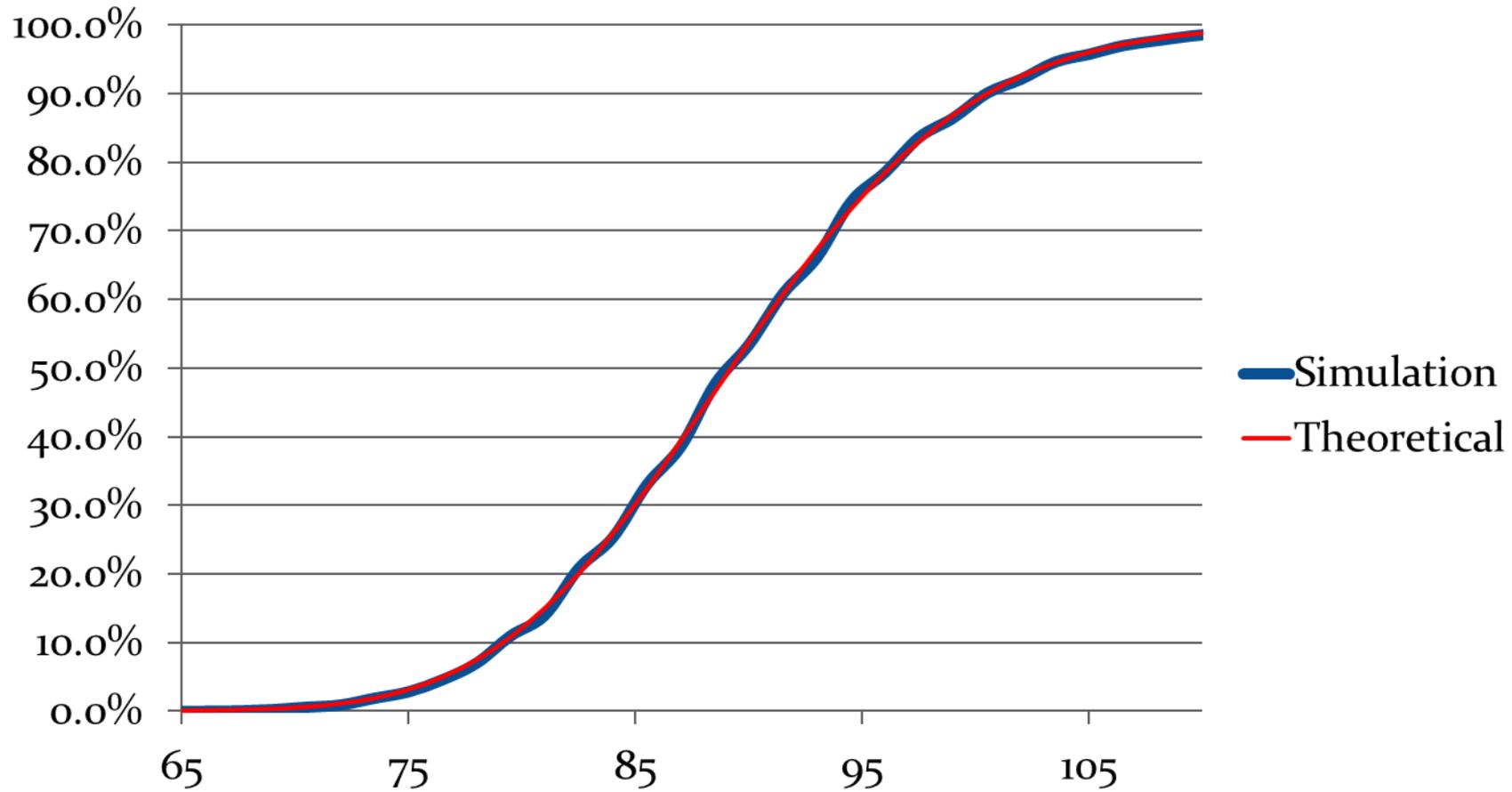


Model simplicity drives agile results

1. Servers represent cities
2. Aircraft travel in free space
3. Processes to determine whether the turn time is under stress
4. All data is table based
5. Aircraft are classified by color to identify anomalies in on-time performance
6. Results are exported into a .CSV for further analysis , by various WestJet teams.

Model Calibration

737-700 YYC-YVR



Animation

Visual results



Outputs

What can we look at?

- We can examine any delay distribution
- System, aircraft type, station, arrivals, departures, etc.
- We can answer the questions:
- What should we expect the A15 performance to be next winter?
- What will be our worst performing flight?
- How will our head starts perform?

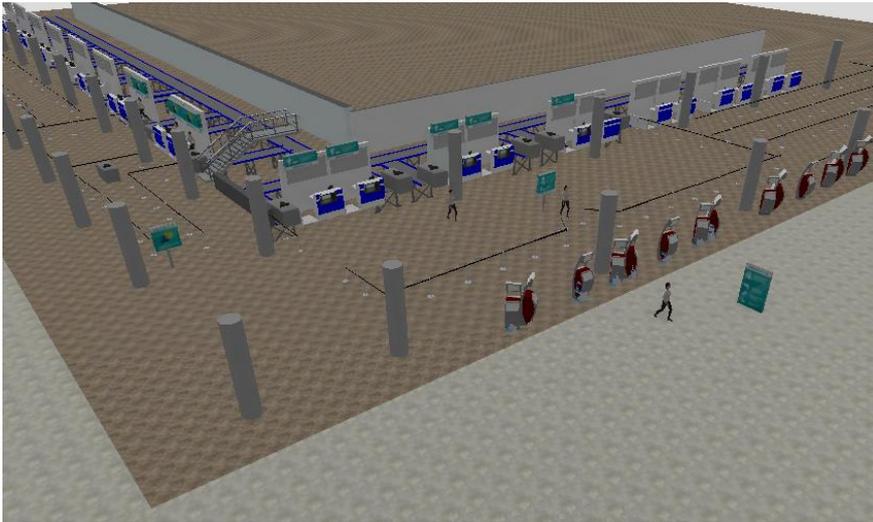
Results and recommendations

1. Testing network strategies such as the addition of “circuit breakers” (break in continuous aircraft line of flying) to reduce cascading delays. Results showed circuit breakers are less effective on aircraft that fly longer block times versus aircraft with shorter flying;
2. Adjusted block and turn time activities from aircraft flying in and out of hub cities such as YYZ. Increasing turn time/block time following on the leg following a headstart (beginning of the day flights) showed significant impact in reducing cascading delays;
3. “Flying the block” or slowing down specific flights/aircraft types to eliminate block time variability has resulted in a significant fuel savings to WestJet’s Bombardier Q400 fleet;

Simio continues to enable WestJet to rapidly model a complex network of flights, enabling agile responses to changing operational conditions as the airline continues to expand.

Simio at WestJet

Continues to be an essential tool in planning



YUL Montreal Self Bag Tagging



YHZ Self Bag Tagging

Questions?

