

CHAPTER 1

The Southwest Network

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Abstract: This introduction gives a brief overview of what will be discussed in the following chapters of this book. It seeks to provide definitions to some key words, including network and a more precise definition of what Southwest Airlines terms its “focus cities”. From this need to define, four definitions emerged, and are detailed herein.

1.0 Introduction

The growth of Southwest Airlines' network has revolutionized the airline industry in terms of "traditional" airline models. While the hub-and-spoke model remains the predominant network model in the airline industry, Southwest has explicitly avoided adopting the hub-and-spoke route network. As part of this analysis, there will be a comparison between the traditional hub and spoke network of the Legacy Carriers (Northwest, American, United, US, Delta, and Continental) and the Southwest network, which utilizes what it calls "focus cities".

Further topics discussed throughout this paper will include: an overview of Southwest's marketing angles, its management, and its finances; a prediction of what cities and routes Southwest will enter next (Philadelphia? Pittsburgh?); a discussion of the presence of what has been termed "the Southwest Effect"; a determination of whether Southwest is indeed a point-to-point carrier, or whether it is rather a network carrier; the identification of common reasons for Southwest's absence from the top U.S. markets in terms of Passenger per Day Each Way (PDEW); an evaluation of the introduction of Southwest into new routes between the years of 1990 and 2002; the development of the Southwest Airlines route network, from the company's inception in 1971, through 2003 (city by city); an evaluation of fare structure; a comparison of operating efficiency of Southwest and the Legacy Carriers; and an analysis of Southwest's top 50 markets by comparing the fares that WN had to offer within those markets, in contrast to those offered by its competitors in that same market. .

Moreover, the rest of the introduction to this paper, below, will consist of definitions that are important for the consistency and flow of this study. It includes a discussion of defining what a network is, as well as a statistical representation that breaks down the term "focus city" into three detail-specific definitions that further represent how

the Southwest network functions. All definitions apply to the rest of the papers presented in this book.

2.0 Defining Network

There are hundreds of articles detailing networks, but most deal with computer networks rather than airline networks, although there are some on that topic. In addition to this lack of precise information, none of the articles found in researching this paper defined what a network actually is. Thus it is the aim of this part of the introduction to provide a definition that will be useful throughout the length of this study.

To begin with, it is important to note, as Darryl Jenkins said in his introduction to the *Handbook of Airline Economics* (2002),

All carriers are network carriers. Even Southwest, which started out doing linear service, is retreating to its hubs and flowing traffic over all of its focus cities. Outside of a network, there would be no service to small and medium-size cities. It is the concept of the network that makes the airline industry work, (pg. vii).

Interestingly enough, this states exactly what this paper seeks to prove, that Southwest is indeed a network carrier. However, the question still remains, what is a network?

In order to separate what different authors view as “making up” a network, what follows is a sampling of the information found in researching networks. To begin with, whenever seeking a definition it is always easiest to go to the source, the dictionary.

Accordingly, below please find a sampling of definitions found therein:

- To link computers together to make possible one or more of several functions, as the transfer of data, the sharing of processing capabilities or workloads, and accessibility from many locations;

- A piece of work having the form or construction of a net; a collection or arrangement resembling a net;
- A system of cables for the distribution of electricity to consumers, one in which interconnections is such that each consumer is supplied by more than one route (The Complete Oxford English Dictionary, 2000).

What is important to note about these definitions is the idea of being able to be interconnected. This is where it is important to make yet another distinction, and that is between connectivity and interconnectivity, “Connectivity exists when there exists a connection between two points. Interconnectivity involves at least three nodes,” (Button, 2002). In order to aid visualization, below are two diagrams, replicas of what Button shows in his article (2002), in defining the two terms and showing distinction:



Most articles researched for this study show the authors generally referring to a network as a hub-and-spoke model, or a point-to-point, but few other examples are given. For example, when discussing “network design concepts” and “network scheduling constraints”, Peter Berdy (2002), while not directly defining a network as a hub-and-spoke, does define a hub and a spoke while discussing networks. This is fine for the purposes of most carriers and most research; however, for the purpose of this study it limits the scope, as well as the usefulness of the term. Nonetheless, it is important to note that hub-and-spoke can be considered a TYPE of network; it just does not necessarily encompass all airlines, like Southwest. While there are many other articles that discuss networks, most of

them are representative of what has been discussed formerly, for a complete listing please see the “Reference” section for this portion of the paper.

What makes Southwest’s network different from that of the Legacy Carriers is that as routes are plotted out on a map, as can be seen later in this study, Southwest’s network activity closely resembles more of a spider-web configuration, while the Legacy Carriers clearly utilize the hubs-and-spoke system. Furthermore, it is important to remember, when defining the term network, that the purpose of a network is to increase connectivity (Jenkins, February 10, 2004). With this in mind, as well as all of the information discussed previously, for the purposes of this paper the definition of a network is, simply, **an interconnecting system of origin and destination nodes**. While it is true that by this definition there are many different types of networks found throughout the airline industry, what is most important for the parameters of this study is to give “network” a broad definition in order to be able to improve upon it.

3.0 Defining Focus Cities

The most difficult definition dealt with for this paper was the use of the wording that Southwest applies to define the cities in its market, the term “focus city”. The reason for the difficulty is straightforward: there is no useful definition for wording. The phrase is just what Southwest defines as its origin and destination nodes (O&D nodes), and it renders all cities Southwest supplies service identical. For the purposes of this paper, it was necessary to come up with a statistical way of defining each city, which is detailed below.

3.1. Methodologies

The first step in defining the focus cities is breaking the list of its O&D nodes down into some sort of statistical listing, an order, that will illustrate a clear separation between each, expectantly in a grouping. In order to accomplish this task, information was gathered on each, including average enplaned passengers for 2003 from each city (OnBoard database), and the average outbound, non-interline passengers for 2003 from each city (O & D Database). From this information, the percentage of connecting traffic was derived for each city, and several tests were run on the data in order to cluster it into three categories. The tests run included the Z-test, the F-test, and from there the *P* was extrapolated. After dissecting the results of each test performed, as well as reviewing the percentage of connectivity, the clusters were categorized into three areas of interest, which are discussed and defined below.

3.2. Results

The results of the first testing, the development of the Z-scores and thus the connecting percentages, are illustrated in Table 1, below:

Table 1: 2003 WN % Connect Airports

BASES	O & D 2003		% Connect	ONBOARD 2003		
	OUTBOUND, NON-INTERLINE	ENPLANEMENTS		Z-Out	Z-Emp	Z-Conn
ABQ	580260	742218	21.8%	-0.071636164	-0.193823821	-1.779916593
ALB	168020	168296	0.2%	0.738147276	0.720931276	0.777703432
AMA	112890	114025	1.0%	0.846441865	0.80743201	0.67951713
AUS	478240	535246	10.7%	0.128766772	0.136061934	-0.460720138
BDL	229840	230820	0.4%	0.61671119	0.621276362	0.746929949
BHM	232480	259666	10.5%	0.611525307	0.575299687	-0.439364929
BNA	717450	980237	26.8%	-0.341125273	-0.573194351	-2.368952929
BOI	178000	193370	7.9%	0.718543068	0.680966666	-0.141627565
BUF	155520	157271	1.1%	0.762701645	0.738503655	0.665585253
BUR	797520	808388	1.3%	-0.498410738	-0.299289973	0.638300069
BWI	1561960	2183497	28.5%	-2.000038074	-2.491030256	-2.564604551
CLE	254890	259188	1.7%	0.567504235	0.576061555	0.601234888
CMH	209040	210214	0.6%	0.65756966	0.654119577	0.731116049
CRP	69360	68506	-1.2%	0.931949999	0.879983223	0.944292382
DAL	1013390	1321347	23.3%	-0.922454866	-1.116878181	-1.955348354
DTW	207810	206114	-0.8%	0.659985809	0.66065443	0.894247241
ELP	314030	354882	11.5%	0.451332605	0.423538086	-0.562402497
FLL	535760	537396	0.3%	0.015777389	0.132635121	0.761118473
GEG	180440	183679	1.8%	0.713750055	0.696412827	0.588817308
HOU	1106660	1562549	29.2%	-1.105669744	-1.501321989	-2.648545006
HRL	162590	161416	-0.7%	0.748813694	0.731897078	0.882965093
IAH	48800	48426	-0.8%	0.972337024	0.911988064	0.888279385
IND	187200	188167	0.5%	0.700471053	0.689259554	0.736380053
ISP	330730	332978	0.7%	0.418527968	0.45845014	0.717340995
JAN	83610	82889	-0.9%	0.903958018	0.85705864	0.899796931
JAX	223460	245320	8.9%	0.62924374	0.598165297	-0.255275083
LAS	2437660	2841759	14.2%	-3.720218937	-3.540212061	-0.882281751
LAX	1530170	1603852	4.6%	-1.937591404	-1.56715346	0.254522615
LBB	160180	163179	1.8%	0.753547776	0.729087092	0.580024158
LIT	162190	166977	2.9%	0.749599434	0.723033586	0.458501293
MAF	133960	136107	1.6%	0.80505302	0.772236248	0.610779589
MCI	623670	775051	19.5%	-0.156908576	-0.246155242	-1.5095832
MCO	928890	1012152	8.2%	-0.756467333	-0.624062603	-0.174428287
MDW	1287970	1656150	22.2%	-1.461825953	-1.650509495	-1.828367985
MHT	326240	326260	0.0%	0.427347897	0.469157735	0.796347124
MSY	637700	724456	12.0%	-0.1844684	-0.165513563	-0.617187838
OKA	1753150	1863366	5.9%	-2.375602057	-1.980784153	0.098536515
OKC	200410	208823	4.0%	0.674521996	0.656336645	0.321282534
OMA	167000	168983	1.2%	0.740150913	0.71983629	0.658484512
ONT	773300	794555	2.7%	-0.450834193	-0.277242016	0.481150024
ORF	158230	158833	0.4%	0.757378258	0.736014036	0.752235988
PBI	145700	145351	-0.2%	0.781991557	0.757502545	0.825427324
PDX	436600	457158	4.5%	0.210562286	0.260523787	0.265995953
PHX	1859970	2508672	25.9%	-2.585433871	-3.009315822	-2.256744262
PVD	440480	441043	0.1%	0.20294061	0.286208947	0.781995671
RDU	293310	297663	1.5%	0.492033927	0.514737538	0.624365945
RNO	521730	561177	7.0%	0.043337212	0.094731379	-0.033076944
SAN	1240840	1280353	3.1%	-1.369246161	-1.051539214	0.432609539
SAT	498470	539558	7.6%	0.089027982	0.129189181	-0.102257276
SDF	214680	217783	1.4%	0.646490728	0.642055601	0.628803969
SEA	494930	523284	5.4%	0.095981779	0.155127766	0.157161957
SJC	894520	957924	6.6%	-0.68895264	-0.537630406	0.015394636
SLC	472590	517311	8.6%	0.139865347	0.164647931	-0.223871256
SMF	1079120	1130335	4.5%	-1.051571559	-0.812430537	0.261975424
SNA	426750	426150	-0.1%	0.229911129	0.309946402	0.813698695
STL	500150	630720	20.7%	0.085727875	-0.016110884	-1.647756409
TPA	708690	799862	11.4%	-0.323917571	-0.285700666	-0.549061504
TUL	213530	220021	3.0%	0.64874973	0.638488527	0.448662451
TUS	220990	225132	1.8%	0.634095683	0.630342275	0.579793809
Average % =			6.7%			

* Negative % Connect data due to erroneous O&D and Onboard data

AVG	543792	620612	0.0675
SD	509074.376	627405.086	0.085

Sources: O & D Database and OnBoard Database

From Table 1 and the resulting Z scores, the F-test and P were calculated in an effort to further disseminate between the cities. The resulting clustering is shown in Table 2, below:

From the data above, it was a necessary to further breakdown the cities into three groups:

Table 2: Results of clustering

BASES	Outbound Pax	Enplaned Pax	% Connect	F-test	P	Major connecting point?
ABQ	580260	742218	21.8%	2222.5%	0.133065	yes
ALB	168020	168296	0.2%	48976180.0%	0.000910	no
AMA	112890	114025	1.0%	1332777.0%	0.005514	no
AUS	478240	535246	10.7%	10535.9%	0.061827	no
BDL	229840	230820	0.4%	7398117.0%	0.002341	no
BHM	232480	259666	10.5%	10923.9%	0.060726	no
BNA	717450	980237	26.8%	1391.2%	0.166760	yes
BOI	178000	193370	7.9%	19460.1%	0.045558	no
BUF	155520	157271	1.1%	1064040.0%	0.006171	no
BUR	797520	808388	1.3%	728105.0%	0.007460	no
BWI	1561960	2183497	28.5%	1210.5%	0.178177	yes
CLE	254890	259188	1.7%	476807.5%	0.009219	no
CMH	209040	210214	0.6%	4248741.0%	0.003088	no
CRP	69360	68506	-1.2%	868385.6%	0.006831	no
DAL	1013390	1321347	23.3%	1915.9%	0.142989	yes
DTW	207810	206114	-0.8%	1986419.0%	0.004517	no
ELP	314030	354882	11.5%	8936.9%	0.067092	no
FLL	535760	537396	0.3%	14366280.0%	0.001680	no
GEG	180440	183679	1.8%	421208.1%	0.009808	no
HOU	1106660	1562549	29.2%	1142.7%	0.183107	yes
HRL	162590	161416	-0.7%	2539475.0%	0.003995	no
IAH	48800	48426	-0.8%	2252516.0%	0.004242	no
IND	187200	188167	0.5%	5021998.0%	0.002841	no
ISP	330730	332978	0.7%	2904401.0%	0.003735	no
JAN	83610	82889	-0.9%	1779660.0%	0.004772	no
JAX	223460	245320	8.9%	15329.0%	0.051308	no
LAS	2437660	2841759	14.2%	5689.5%	0.083911	no
LAX	1530170	1603852	4.6%	60304.4%	0.025910	no
LBB	160180	163179	1.8%	387606.3%	0.010225	no
LIT	162190	166977	2.9%	157613.8%	0.016032	no
MAF	133960	136107	1.6%	527420.3%	0.008765	no
MCI	623670	775051	19.5%	2845.8%	0.117970	no
MCO	928890	1012152	8.2%	18115.8%	0.047212	no
MDW	1287970	1656150	22.2%	2131.4%	0.135796	yes
MHT	326240	326260	0.0%	-	-	no
MSY	637700	724456	12.0%	8217.4%	0.069946	no
OAK	1753150	1863366	5.9%	35889.4%	0.033573	no
OKC	200410	208823	4.0%	78869.9%	0.022659	no
OMA	167000	168983	1.2%	956850.5%	0.006508	no
ONT	773300	794555	2.7%	181377.5%	0.014945	no
ORF	158230	158833	0.4%	9197750.0%	0.002099	no
PBI	145700	145351	-0.2%	23270160.0%	0.001320	no
PDX	436600	457158	4.5%	63003.0%	0.025350	no
PHX	1859970	2508672	25.9%	1511.8%	0.160261	yes
PVD	440480	441043	0.1%	81983310.0%	0.000703	no
RDU	293310	297663	1.5%	614296.4%	0.008122	no
RNO	521730	561177	7.0%	25120.9%	0.040113	no
SAN	1240840	1280353	3.1%	135717.6%	0.017276	no
SAT	498470	539558	7.6%	21274.8%	0.043578	no
SDF	214680	217783	1.4%	647425.1%	0.007912	no
SEA	494930	523284	5.4%	42985.6%	0.030682	no
SJC	894520	957924	6.6%	28453.9%	0.037697	no
SLC	472590	517311	8.6%	16331.9%	0.049714	no
SMF	1079120	1130335	4.5%	62036.9%	0.025546	no
SNA	426750	426150	-0.1%	66043140.0%	0.000783	no
STL	500150	630720	20.7%	2500.4%	0.125655	yes
TPA	708690	799862	11.4%	9125.9%	0.066399	no
TUL	213530	220021	3.0%	148704.3%	0.016505	no
TUS	220990	225132	1.8%	386675.9%	0.010237	no

Sources: O & D Database and OnBoard Database

connecting nodes, major connecting nodes, and non-connecting nodes. To begin with, in order to define what a connecting node is, the *P* was looked at to determine relevance, and it was determined that any city with a *P* of greater than (or equal to) 0.05 would be considered, for the purposes of this study, as a connecting node in the Southwest network. The reason for this determination is straightforward; the *P* in testing represents relevance, and in order to be considered relevant, it should be above (or equal to) 0.05, or five percent. There are, of course, different levels within the term relevance, which will be differentiated between presently, with the defining of a major connecting node. First, however, those cities that fall into the connecting node category are listed in Table 3, below:

Table 3: Connecting Node Cluster

BASES	Outbound Pax	Enplaned Pax	% Connect	F-test	P	City Conne to Major connecting point?
ABQ	580260	742218	21.8%	22.2	0.133065	yes
AUS	478240	535246	10.7%	105.4	0.061827	no
BHM	232480	259666	10.5%	109.2	0.060726	no
BNA	717450	980237	26.8%	13.9	0.166760	yes
BWI	1561960	2183497	28.5%	12.1	0.178177	yes
DAL	1013390	1321347	23.3%	19.2	0.142989	yes
ELP	314030	354882	11.5%	89.4	0.067092	no
HOU	1106660	1562549	29.2%	11.4	0.183107	yes
JAX	223460	245320	8.9%	153.3	0.051308	no
LAS	2437660	2841759	14.2%	56.9	0.083911	no
MCI	623670	775051	19.5%	28.5	0.117970	no
MDW	1287970	1656150	22.2%	21.3	0.135796	yes
MSY	637700	724456	12.0%	82.2	0.069946	no
PHX	1859970	2508672	25.9%	15.1	0.160261	yes
STL	500150	630720	20.7%	25.0	0.125655	yes
TPA	708690	799862	11.4%	91.3	0.066399	no

Sources: O & D Database and OnBoard Database

From within the defining of connecting nodes, it was evident that there were several cities that stood out in terms of passenger connectivity percentage. It seemed only appropriate to classify these cities separately from the common connecting nodes, and thus

have been specified as *major* connecting nodes. The defining characteristic of a major connecting node is its connecting percentage. For the purposes of this study, a major connecting node is defined to have a connecting percentage greater than (or equal to) 20 percent, as well as a *P* of greater than (or equal to) 0.05. Those cities that fall into this category are listed in Table 4, below:

Table 4: Major ConnectingNode Cluster

BASES	Outbound Pax	Enplaned Pax	% Connect	F-test	P-score	Major connecting point?
ABQ	580260	742218	21.8%	22.2	0.133065	yes
BNA	717450	980237	26.8%	13.9	0.166760	yes
BWI	1561960	2183497	28.5%	12.1	0.178177	yes
DAL	1013390	1321347	23.3%	19.2	0.142989	yes
HOU	1106660	1562549	29.2%	11.4	0.183107	yes
MDW	1287970	1656150	22.2%	21.3	0.135796	yes
PHX	1859970	2508672	25.9%	15.1	0.160261	yes
STL	500150	630720	20.7%	25.0	0.125655	yes

Sources: O & D Database and OnBoard Database

The last definition found via *P* was the non-connecting nodes. The non-connecting node is defined, for the purposes of this study, as cities that have a *P* of less than (not equal to) a 0.05, which means that its relevance is low in relation to the rest of the Southwest network. The cities that fall into this category are listed in Table 5, below:

Table 5: Non-Connecting Node Cluster

BASES	Outbound Pax	Enplaned Pax	% Connect	F-test	P	Major connecting point?
ALB	168020	168296	0.2%	489761.8	0.000910	no
AMA	112890	114025	1.0%	13327.8	0.005514	no
BDL	229840	230820	0.4%	73981.2	0.002341	no
BOI	178000	193370	7.9%	194.6	0.045558	no
BUF	155520	157271	1.1%	10640.4	0.006171	no
BUR	797520	808388	1.3%	7281.1	0.007460	no
CLE	254890	259188	1.7%	4768.1	0.009219	no
CMH	209040	210214	0.6%	42487.4	0.003088	no
CRP	69360	68506	-1.2%	8683.9	0.006831	no
DTW	207810	206114	-0.8%	19864.2	0.004517	no
FLL	535760	537396	0.3%	143662.8	0.001680	no
GEG	180440	183679	1.8%	4212.1	0.009808	no
HRL	162590	161416	-0.7%	25394.8	0.003995	no
IAH	48800	48426	-0.8%	22525.2	0.004242	no
IND	187200	188167	0.5%	50220.0	0.002841	no
ISP	330730	332978	0.7%	29044.0	0.003735	no
JAN	83610	82889	-0.9%	17796.6	0.004772	no
LAX	1530170	1603852	4.6%	603.0	0.025910	no
LBB	160180	163179	1.8%	3876.1	0.010225	no
LIT	162190	166977	2.9%	1576.1	0.016032	no
MAF	133960	136107	1.6%	5274.2	0.008765	no
MCO	928890	1012152	8.2%	181.2	0.047212	no
MHT	326240	326260	0.0%	-	-	no
OAK	1753150	1863366	5.9%	358.9	0.033573	no
OKC	200410	208823	4.0%	788.7	0.022659	no
OMA	167000	168983	1.2%	9568.5	0.006508	no
ONT	773300	794555	2.7%	1813.8	0.014945	no
ORF	158230	158833	0.4%	91977.5	0.002099	no
PBI	145700	145351	-0.2%	232701.6	0.001320	no
PDX	436600	457158	4.5%	630.0	0.025350	no
PVD	440480	441043	0.1%	819833.1	0.000703	no
RDU	293310	297663	1.5%	6143.0	0.008122	no
RNO	521730	561177	7.0%	251.2	0.040113	no
SAN	1240840	1280353	3.1%	1357.2	0.017276	no
SAT	498470	539558	7.6%	212.7	0.043578	no
SDF	214680	217783	1.4%	6474.3	0.007912	no
SEA	494930	523284	5.4%	429.9	0.030682	no
SJC	894520	957924	6.6%	284.5	0.037697	no
SLC	472590	517311	8.6%	163.3	0.049714	no
SMF	1079120	1130335	4.5%	620.4	0.025546	no
SNA	426750	426150	-0.1%	660431.4	0.000783	no
TUL	213530	220021	3.0%	1487.0	0.016505	no
TUS	220990	225132	1.8%	3866.8	0.010237	no

Sources: O & D Database and OnBoard Database

4.0 Summary

In concluding this part of the paper, it is important to outline, briefly, what was devised herein. What follows are the definitions that will be used throughout the whole of this study:

- *Network*: an interconnecting system of origin and destination nodes.
- *Connecting Node*: any city with a P of greater than (or equal to) 0.05.
- *Major Connecting Node*: any city that has a connecting percentage greater than 20 percent as well as a P of greater than (or equal to) 0.05.
- *Non-Connecting Node*: any city with a P of less than (not equal to) a 0.05.

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