CHAPTER FOUR
IDENTIFICATION OF BARRIERS TO SUCCESS FOR NONTRADITIONAL PARTICIPANTS IN AVIATION MAINTENANCE CAREERS

4.0 INTRODUCTION

The challenge to improve air safety through employment and retention of an appropriate maintenance work force is extremely diverse. Many factors determine the composition of any air carrier's maintenance team. These factors include Federal Aviation Administration (FAA) regulations, area demographics, pay scales, union rules, and availability of personnel, to name a few. The FAA Office of Aviation Medicine, in conjunction with Aviation Education Consultants, has compiled the information in this report in an effort to ensure that a plentiful supply of appropriately qualified persons will be available to meet anticipated Aviation Maintenance Technician (AMT) needs into the 21st century. For the purpose of this investigation, an Aviation Maintenance Technician (AMT) is any person directly involved with the repair or restoration of aircraft. AMT personnel includes Airframe and Powerplant (A&P) technicians, Avionics technicians, non-certified technicians employed by repair stations and does not include supervisory, educational, or administrative personnel.

It is anticipated that highly skilled blue collar workers will become increasingly in demand by various trades; therefore, the aviation industry may find it difficult to employ those persons needed for many specialized maintenance operations such as non-destructive testing, composite refabrication, and electronics troubleshooting and repair. The changing role of the U.S. military may also have a dramatic impact on the availability of AMTs. Current data from research studies suggests that the supply of white male workers, who have traditionally populated this field, will prove grossly to meet future work force needs. It will be important, therefore, not only from an equity perspective, but also because of employment demands, to emphasize recruitment, training, and placement of nontraditional populations for AMT careers.

4.1 THE OBJECTIVES

The primary objective of this study was to delineate effective strategies for meeting the emerging AMT work force needs through recruitment, training, placement, and retention of nontraditional workers. Research has shown that historically underrepresented populations such as females, blacks, Hispanics, displaced homemakers, and reeducated older workers, while representing the greatest hope for meeting work force shortfalls, present unique employment challenges. In most cases, individuals in these populations lack adequate training and/or FAA certification to allow them to enter an AMT career.

In order to prepare effective strategies for meeting the emerging needs of the aviation industry, demographic data was collected to determine the populations most in need of assistance. This portion of the study was also used to predict future supply and demand for AMT employees. The methodology was an extensive demographic review of currently employed AMT s, Bureau of Labor Statistics, FAA and census data, as well as various industrial sources. The historic demographic composition of the AMT work force can also have a profound effect on future employees. Historically, AMT career fields have been dominated by white males, but, by what percentage and are those percentages changing? The demographic portion of this study examines both the composition of the AMT work force, now and in the future, as well as the predicted number of AMTs available to fill the emerging positions in the aviation maintenance industry.

In order to identify effective strategies to combat the lack of employment diversity in the aviation maintenance fields, one must first identify the barriers which inhibit nontraditional populations from choosing aviation maintenance as a career. During this study, the research team conducted a thorough literature review and site visitations to AMT schools and work facilities. Barriers to nontraditional employment and existing recruitment and retention strategies in airline, general aviation institutions, training, and other related environments were identified and cataloged. With assistance from a commercial airline, the International Association of Machinists, and the Aviation Technical Education Council, information was gathered to identify other delimiters to AMT career selection, retention, and post-training articulation into AMT career fields. The research team was able to identify several strategies which are potentially helpful in encouraging nontraditional individuals to choose AMT careers, succeed in training, and then to entice them to remain in the field.

4.2 DEMOGRAPHIC PROJECTIONS

This section of the report re-examines the results of the 1991 *Working Paper* (FAA, 1993) on Aviation Maintenance Technician (AMT) shortages prepared by the Federal Aviation Administration. The 1991 paper produced projections of pilot and AMT work force needs in Civilian Aviation for 1992-2003. This section of the report addresses only the projections of future AMT work force needs. A re-examination of civilian commercial pilot work force projections is beyond the scope of this project. A summary of the complete demographic study is in Appendix 4.

4.2.1 Background

The re-examination of future AMT work force needs was called for in response to questions from aviation officials, union leaders, and others about the large shortages of AMTs that were projected in the 1991 working paper. The 1991 working paper states that "numerous sources predict that there will be a need for 100,000-120,000 AMTs by the year 2000. This number is based on the current number of technicians combined with new positions related to new aircraft and increased attention to continuing airworthiness of older aircraft." The 1991 report projects the shortage of AMTs to be between 65,000 and 85,000 new AMTs by the year 2000. Many felt that the shortfalls were too large; others, that the projected shortfalls were too conservative.

The shortages projected were accompanied by supporting information and arguments that seemed to provide a rationale for the expected large shortfalls. In the report, the projected decline of the population in the 16-24 and 25-34 age groups by the year 2000, a declining pool of potential AMTs coming from the military, a low retention rate of AMTs in the aviation industry (only 45% of AMT school graduates remain in aviation after 2 years), and other reasons are offered to explain why the supply of AMTs is not expected to keep up with demand. All of these reasons and rationales focus on the supply of AMT work force into the aviation industry. However, the FAA report does not offer specific yearly projections of AMT work force supply to accompany their detailed yearly projections of AMT work force demand. As a result, precise yearly shortages remain unclear.

This study examines the report's projection of AMT work force need. The projections are re-calculated using much of the original study's methodology but with some variation where the assumptions of the original projections have been questioned. These variations in assumptions and methodology are described in Appendix 4. This study also offers yearly projections of work force supply using data that was not used in the working paper study. This study projects supply by using FAA data on estimated active AMTs reported in the *FAA Statistical Yearbooks.* The yearly projections of AMT work force supply and demand can be compared to produce projected yearly shortages or surpluses.

4.2.2 Projected Demand and Supply of AMTs

The projections of AMT demand from Tables 4A-4, 4A-5, and 4A-6 (Appendix 4) are combined with projections of AMT supply from Tables 4A-8 and 4A-9 (Appendix 4). Projections of AMT shortages can be calculated by comparing the supply and demand projections. Only where 40% of active AMTs are employed in aviation and where it is assumed that 14 AMTs/transport category aircraft, 4.2 AMTs/commuter aircraft and .15 AMTs/general aviation aircraft are needed do we find that there will be substantial AMT shortages (see Figure 4.1). However, for circumstances where greater than 40% of active AMTs remain employed in aviation and where fewer AMTs are needed to maintain each class of aircraft, we do not project shortages (Figure 4.1). In general, the supply of AMTs will meet the aviation industry's demand.

	Large Jets[1]				Net	Commuters[4]			
Year	Aircraft	Technicians	Attrition[2]	Transfers[3]	Vacant	Aircraft	Technicians	Attrition[5]	Transfers[6]
1980	2538	35532	2487	1912	575	1094	4595	919	680
1981	1630	26820	2577	2047	530	1319	5540	1108	691
1982	2717	38038	2663	2094	569	1373	5767	1153	701
1983	2841	39774	2784	2136	648	1423	5977	1195	709
1984	2993	41902	2933	2182	751	1475	6195	1239	719
1985	3180	44520	3116	2231	885	1531	6430	1286	730
1986	3383	47362	3315	2277	1038	1595	6699	1340	737
1987	3575	50050	3504	2332	1172	1680	7056	1411	743
1988	3743	52402	3668	2389	1279	1757	7379	1476	752
1989	3917	54838	3839	2418	1421	1787	7505	1501	759
1990	4032	56448	3951	2448	1503	1815	7623	1252	766
1991	4237	59318	4152	2497	1655	1878	7888	1578	775
1992	4304	60256	4218	2536	1682	1923	8077	1615	782
1993	4336	60704	4249	2577	1672	1965	8253	1651	793
1994	4499	62986	4409	2630	1779	2032	8534	1707	803
1995	4597	64358	4505	2684	1821	2095	8799	1760	814
1996	4781	66934	4685	2728	1957	2139	8984	1797	825
1997	4960	69440	4861	2764	2097	2167	9101	1820	836
1998	5192	72688	5088	2799	2289	2188	9190	1838	848
1999	5366	75124	5259	2840	2419	2214	9299	1860	862
2000	5494	76916	5384	2884	2500	2253	9463	1893	874
2001	5665	79310	5552	2923	2629	2278	9568	1914	887
2002	5817	81438	5701	2958	2743	2294	9635	1927	901
2003	5930	83020	5811	3000	2811	2322	9752	1950	915

	Net	General Aviation[7]			Combined with other Attrition[9]	Total	Added from	Total Net	Total
Year	Vacant	Aircraft	Technicians	Other[8]		Technicians	Last Year	Vacant Positions	Attrition
1980	239	208918	31338	36670	6801	108135		7615	10207
1981	417	211325	31699	37404	6910	111463	3328	7857	10595
1982	452	213061	31959	38152	7011	113916	2453	8281	10827
1983	486	213498	32025	38914	7094	116690	2774	8228	11073
1984	520	214886	32233	39693	7193	120022	3332	8663	11365
1985	556	216420	32463	40487	7295	123900	3878	8910	11697
1986	603	215819	32373	41297	7367	127731	3831	9008	12022
1987	668	214240	32136	42140	7428	131382	3651	9268	12343
1988	724	214479	32172	43000	7517	134953	3571	9520	12661
1989	742	213245	31987	43860	7585	138190	3237	9748	12925
1990	759	212601	31890	44737	7663	140698	2508	9925	13139
1991	803	212610	31892	45631	7752	144729	4031	10210	13482
1992	832	211938	31791	46543	7833	146667	1938	10347	13666
1993	858	212174	31826	47473	7930	148256	1589	10460	13830
1994	904	212352	31853	48422	8028	151795	3539	10711	14144
1995	946	213267	31990	49390	8138	154537	2742	10905	14403
1996	972	213979	32097	50377	8247	158392	3855	11176	14729
1997	948	214808	32221	51384	8361	162146	3754	11442	15042
1998	990	216056	32408	52411	8482	166697	4551	11619	15408
1999	998	218127	32719	53459	8618	170601	3904	12035	15737
2000	1019	219340	32901	54528	8743	173808	3207	12262	16020
2001	1027	220708	33106	55618	8872	177602	3794	12528	16338
2002	1026	222505	33376	56730	9011	181179	3577	12780	16639
2003	1035	224366	33655	57864	9152	184291	3112	12998	16913

Table 4A-4

	Large Jets[1]				Net	Commuters[4]			
Year	Aircraft	Technicians	Attrition[2]	Transfers[3]	Vacant	Aircraft	Technicians	Attrition[5]	Transfers[6]
1980	2538	26649	1865	1617	248	1094	3446	689	602
1981	2630	27615	1933	1722	211	1319	4155	831	612
1982	2717	28529	1997	1761	236	1373	4325	865	621
1983	2841	29831	2088	1796	292	1423	4482	896	629
1984	2993	31427	2200	1835	365	1475	4646	929	639
1985	3180	33390	2337	1876	461	1531	4823	965	648
1986	3383	35522	2487	1915	572	1595	5024	1005	656
1987	3575	37538	2628	1960	668	1680	5292	1058	662
1988	3743	39302	2751	2007	744	1757	5535	1107	671
1989	3917	41129	2879	2033	846	1787	5629	1126	679
1990	4032	42336	2964	2059	905	1815	5717	1143	687
1991	4237	44489	3114	2101	1013	1878	5916	1183	696
1992	4304	45192	3169	2135	1028	1923	6057	1211	704
1993	4336	45528	3187	2170	1017	1965	6190	1238	713
1994	4499	47240	3307	2214	1093	2032	6401	1280	723
1995	4597	48269	3379	2260	1119	2095	6599	1320	734
1996	4781	50201	3514	2298	1216	2139	6738	1348	745
1997	4960	52080	3646	2330	1316	2167	6826	1365	755
1998	5192	54516	3816	2361	1455	2188	6892	1378	767
1999	5366	56343	3994	2397	1597	2214	6974	1395	780
2000	5494	57687	4038	2435	1603	2253	7097	1419	792
2001	5665	59483	4164	2470	1694	2278	7176	1435	805
2002	5817	61079	4275	2502	1773	2294	7226	1445	818
2003	5930	62265	4359	2540	1819	2322	7314	1463	831

	Net	General Aviation[7]			Combined with other Attrition[9]	Total	Added from	Total Net	Total
Year	Vacant	Aircraft	Technicians	Other[8]		Technicians	Last Year	Vacant Positions	Attrition
1980	87	208918	23503	36670	6017	90268		6352	8571
1981	219	211325	23774	37404	6118	92948	2680	6548	8882
1982	244	213061	23969	38152	6212	94975	2027	6692	9074
1983	267	213498	24018	38914	6293	97245	2270	6852	9277
1984	290	214886	27175	39693	6387	102941	5696	7042	9516
1985	317	216420	24347	40487	6483	105047	2106	7261	9785
1986	349	215819	24279	41297	6558	106122	1075	7479	10050
1987	396	214240	24102	42140	6624	109072	2950	7688	10310
1988	436	214479	24129	43000	6713	111966	2894	7893	10571
1989	447	213245	23990	43860	6785	114608	2642	8078	10790
1990	456	212601	23918	44737	6865	116708	2100	8226	10972
1991	487	212610	23919	45631	6955	119955	3247	8455	11252
1992	507	211938	23843	46543	7039	121635	1680	8574	11413
1993	525	212174	23870	47473	7134	123061	1426	8676	11559
1994	557	212352	23890	48422	7231	126003	2942	8881	11818
1995	586	213267	23993	49390	738	128251	2248	9043	12037
1996	603	213979	24073	50377	7445	131389	3138	9264	12307
1997	610	214808	24166	51384	7555	134856	3467	9481	12566
1998	611	216056	24306	52411	7672	138125	3269	9738	12866
1999	615	218127	24539	53459	7800	141315	3190	10012	13189
2000	627	219340	24676	54528	7920	143988	2673	10150	13378
2001	630	220708	24830	55618	8045	147087	3099	10369	13644
2002	627	222505	25032	56730	8176	150067	2980	10576	13896
2003	632	224366	25241	57864	8311	152684	2617	10762	14133

Table 4A-5

	Large Jets[1]				Net	Commuters[4]			
Year	Aircraft	Technicians	Attrition[2]	Transfers[3]	Vacant	Aircraft	Technicians	Attrition[5]	Transfers[6]
1980	2538	17766	1244	1322	-78	1094	2297	459	523
1981	2630	18410	1289	1397	-108	1319	2770	554	533
1982	2717	19019	1331	1429	-98	1373	2883	577	541
1983	2841	19887	1392	1457	-65	1423	2988	598	549
1984	2993	20951	1467	1488	-21	1475	3098	620	558
1985	3180	22260	1558	1520	38	1531	3215	643	567
1986	3383	23681	1658	1522	6	1595	3350	670	575
1987	3575	25025	1752	1588	164	1680	3528	706	582
1988	3743	26201	1834	1625	209	1757	3690	738	591
1989	3917	27419	1919	1648	271	1787	3753	751	599
1990	4032	28224	1976	1671	305	1815	3812	762	607
1991	4237	29659	2076	1705	371	1878	3944	789	616
1992	4304	30128	2109	1734	375	1923	4038	808	624
1993	4336	30352	2125	1763	362	1965	4127	825	634
1994	4499	31493	2205	1799	406	2032	4267	853	644
1995	4597	32179	2253	1836	417	2095	4400	880	654
1996	4781	33467	2343	1867	476	2139	4492	898	664
1997	4960	34720	2430	1896	534	2167	4551	910	675
1998	5192	36344	2544	1924	620	2188	4595	919	686
1999	5366	37562	2629	1954	675	2214	4649	930	698
2000	5494	38458	2692	1987	705	2253	4734	946	710
2001	5665	39655	2776	2018	758	2278	4784	957	722
2002	5817	40719	2850	2046	804	2294	4817	963	734
2003	5930	41510	2906	2079	827	2322	4876	975	747

	Net	General Aviation[7]			Combined with other Attrition[9]	Total	Added from	Total Net	Total
Year	Vacant	Aircraft	Technicians	Other[8]		Technicians	Last Year	Vacant Positions	Attrition
1980	-64	208918	15669	36670	5234	72402		5092	6937
1981	21	211325	15849	37404	5325	74433	2031	5238	7168
1982	36	213061	15980	38152	5413	76034	1601	5351	7321
1983	49	213498	16012	38914	5493	77801	1767	5477	7483
1984	62	214886	16116	39693	5581	79858	2057	5622	7668
1985	76	216420	16232	40487	5672	82194	2336	5786	7873
1986	95	215819	16186	41297	5748	86514	4320	5849	8076
1987	124	214240	16068	42140	5821	86761	247	6109	8279
1988	147	214479	16086	43000	5909	88977	2216	6265	8481
1989	152	213245	15993	43860	5985	91025	2048	6408	8655
1990	155	212601	15945	44737	6068	92718	1693	6528	8806
1991	173	212610	15946	45631	6158	95180	2462	6702	9023
1992	184	211938	15895	46543	6244	96604	1424	6803	9161
1993	191	212174	15913	47473	6339	97865	1261	6892	9289
1994	209	212352	15926	48422	6435	100108	2243	7050	9493
1995	226	213267	15995	49390	6539	101964	1856	7182	9672
1996	234	213979	16048	50377	6643	104384	2420	7353	9884
1997	235	214808	16111	51384	6749	106766	2382	7518	10089
1998	233	216056	16204	52411	6862	109554	2788	7715	10325
1999	232	218127	16340	53459	6982	112100	2546	7889	10541
2000	236	219340	16451	54528	7098	114168	2068	8039	10736
2001	235	220708	16553	55618	7217	116610	2442	8210	10950
2002	229	222505	16688	56730	7342	118954	2344	8375	11155
2003	228	224366	16827	57864	7469	121077	2123	8524	11350

Table 4A-6

Table 4A-8 Projected Number of Active Aviation Maintenance Technicians (AMTs) 1980-2003

Year	Estimated #	Added from last year	Estimated AMTs in Aviation[1]	Estimated AMTs in Aviation[2]
1980	251330	11340	113099	100532
1981	263249	11919	118462	105300
1982	278278	15029	125225	111311
1983	280121	1843	126054	112048
1984	284428	4312	127993	113771
1985	288376	3948	129769	115350
1986	293193	4817	131937	117277
1987	297279	4086	133776	118912
1988	310419	13140	139689	124168
1989	323677	11258	145655	129471
1990	334666	10989	150599	133866
1991	344535	9869	155040	137814
1992	353504	8968	159077	141402
1993	357202	3698	160741	142881
1994	362098	4896	162944	144839
1995	365756	3658	164590	146302
1996	368454	2698	165804	147382
1997	373106	4652	167898	149242
1998	381002	7896	171450	152401
1999	389925	8923	175466	155970
2000	399950	10025	179978	159980
2001	411208	11258	185044	164483
2002	421055	9847	189475	168422
2003	425353	4298	191409	170141

Table 4A-8

Table 4A-9 Projected Demand and Supply of AMTs in Non-Miltary Aviation, 1980-2003

Year	Supply Active AMTs in Aviation		Demand AMTs needed in Aviation		
1980	113099[1]	100532[2]	108135[3]	90268[4]	72502[5]
1981	118462	105300	111436	92948	74433
1982	125225	111311	113916	94978	76034
1983	126054	112048	116690	97245	77801
1984	127993	113771	120022	102941	79858
1985	129769	115350	123900	405047	82494
1986	131937	117277	127731	106122	86514
1987	133776	118912	131382	109072	86761
1988	139689	124168	134953	111966	88977
1989	145655	129471	138190	114608	91025
1990	150599	133866	140698	116708	92718
1991	155040	137814	144729	119955	95180
1992	159077	141402	146667	121635	96604
1993	160741	142881	148256	123061	97865
1994	162944	144839	151795	126003	100108
1995	164590	146302	154537	128251	101964
1996	165804	147382	158392	131389	104384
1997	167898	149242	162146	134856	106766
1998	171450	152401	166697	138125	109554
1999	175466	155970	170601	141315	112100
2000	179978	159980	173808	143988	114168
2001	185044	164483	177602	147087	116610
2002	189475	168422	181179	150067	118954
2003	191409	170141	184291	152684	121077

Table 4A-9

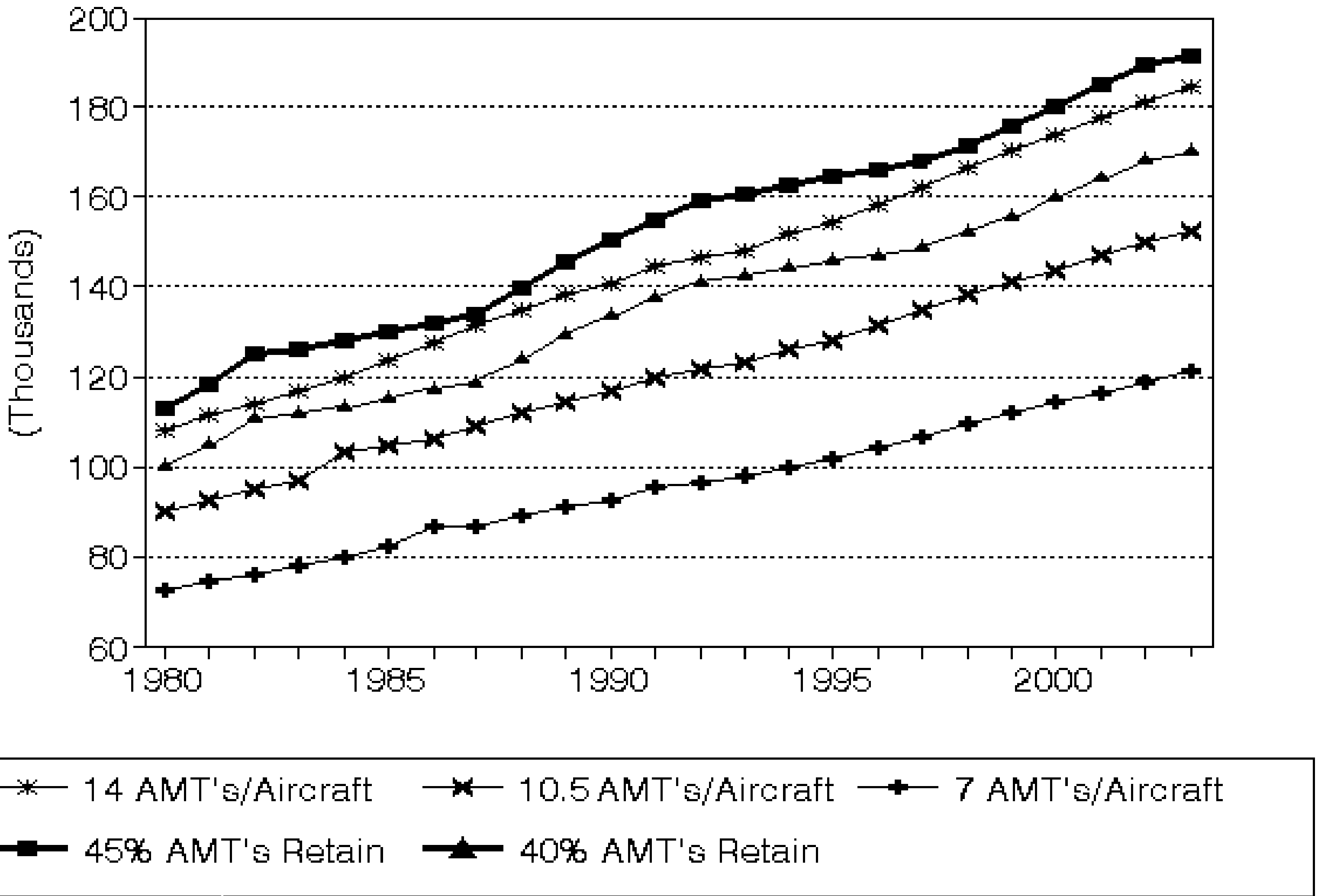

Figure 4.1 AMT Supply & Demand

Another factor to be considered when projecting future shortages is the large pool of AMTs who are certified but who are not employed in aviation. These AMTs could return to aviation employment at some point if circumstances warrant it. However, it is to the aviation industry's advantage not to draw upon this supply of AMTs. It is much more cost-effective to continue to fill positions with entry-level AMTs, rather than to pay higher wages to more senior people. The comparatively low wages, nighttime work schedules, and uncertain job security in the aviation industry create retention problems within the industry, especially for more experienced and senior workers.

There may be short-term shortages of entry-level AMTs in the aviation industry, given the cyclical nature of increase in the number of annually certified AMTs who remain active in aviation maintenance each year (see Figure 4.2). Short-term shortages in the industry may indeed be the stimuli that AMT schools and prospective students react to, at least until it becomes difficult for newly trained AMTs to find jobs. The schools then react by reducing the scope of their programs. Individuals then may also become less interested in AMT training due to a perceived or real lack of jobs in the industry. Given the nature of the aviation industry, it seems to be quite difficult to create any long-term balance between the training of new AMTs and the availability of jobs. Assuming that the aviation industry is tied to the overall economy, in the long-term (more than a few years), the number of AMTs needed will continue to show cyclical changes as the economy goes through its typical upturns and downturns.

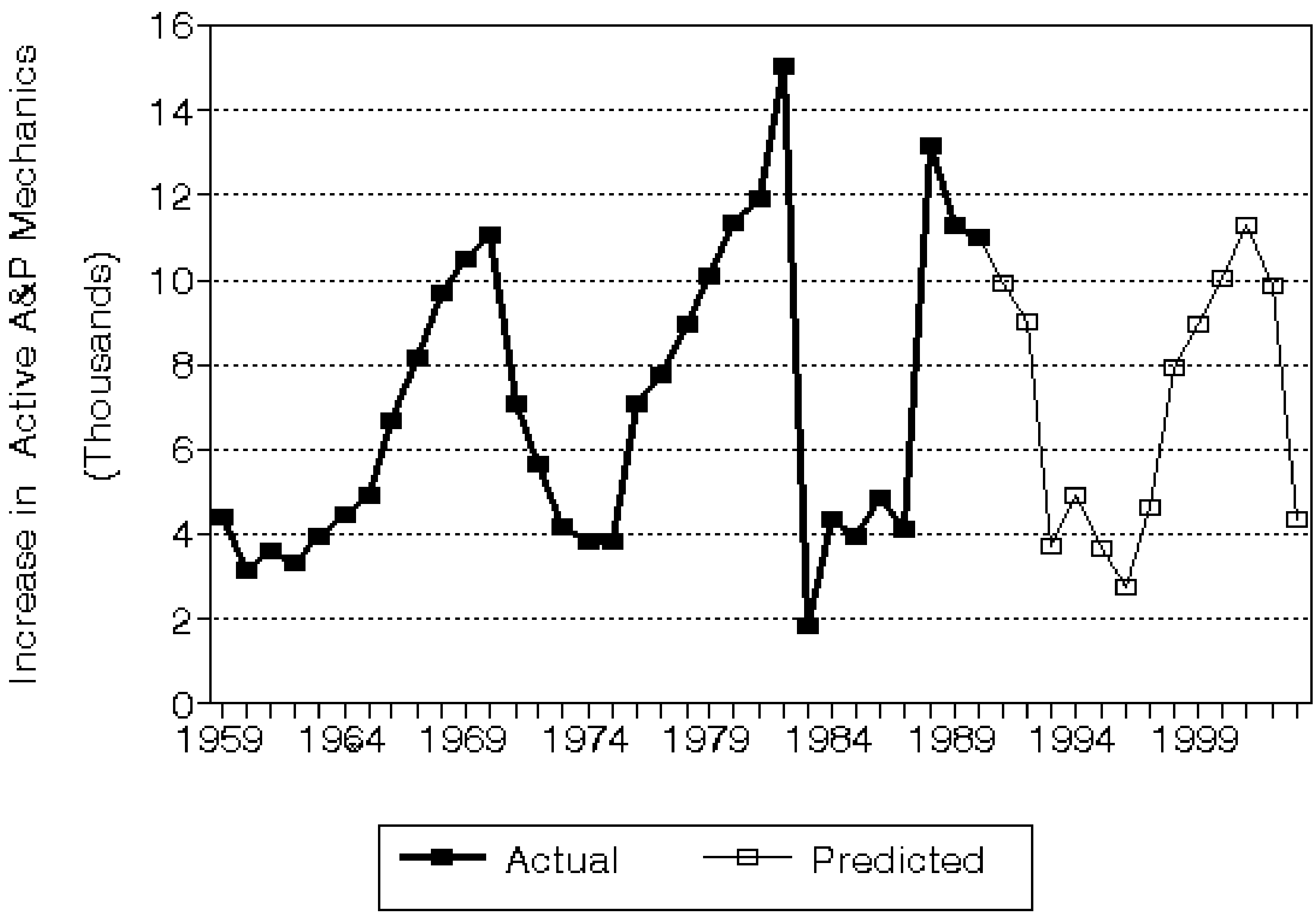

Figure 4.2 Change in Active A&P Mechanics

Another trend that may substantially reduce demand for AMTs in the U.S. aviation industry is the movement of aviation maintenance facilities to foreign countries. As more of these facilities become realities, the growth in the number of jobs available to AMTs trained in the United States will slow.

The overall conclusion of these analyses is that AMTs are available to meet today's demand and that future shortages seem unlikely. There may be short-term shortages of entry-level AMTs as the aviation industry fluctuates with the economy. However, the massive shortages suggested by the working paper seem unlikely. For a more detailed look at the demographic portion of this study, see Appendix 4.

4.3 BARRIERS AND MOTIVATORS TO NONTRADITIONAL CAREER INVOLVEMENT

In order to prepare effective strategies for meeting the emerging employment needs of the aviation industry, barriers which inhibit the recruitment and retention of nontraditional populations into the AMT work force must be identified and cataloged. Successful motivators which encourage diversity in aviation work force populations must also be examined. Ultimately, the federal government and the aviation industry must strive to ease the barriers and increase the motivators which will stimulate the involvement of nontraditional populations in AMT careers.

4.3.1 Review of Previous Research

The research literature and previous studies of nontraditional employees in aviation suggest that there are many reasons that women and minorities fail to select aviation careers. From an expansive view, these delimiting factors can be grouped into several general categories: societal and cultural indoctrinations and expectations; disparity of treatment; individual development; vocational awareness; and real or perceived discrimination and bias. The summative effect of these variables is central to an individual's predisposition to select and his or her ability to survive and prosper in nontraditional careers.

The literature suggests that minorities and women with an interest in nontraditional careers place as much emphasis on career goals as do white males (Bianchi, 1990; Goldberg & Shiflett, 1981). What, then, discourages women and minorities from entering white male dominated career field preparation and pursuits? The literature suggests that there are many barriers limiting or discouraging these individuals from selecting nontraditional activities. Factors such as the individual's socioeconomic status, the amount and type of parental encouragement the individual received, the aspirations of peers, and the employment status of their close friends and family members are a few contributing variables (Carr & Mednick, 1988; Ott et al., 1979). The literature groups delimiters limiting the entry of women and minorities into traditional white male occupations into three distinct barrier types: institutional, situational, and dispositional (Denbroeder & Thomas, 1980; Thomas et al., 1979).

4.3.1.1 Institutional Barriers

Institutional barriers are those delimiters which are intrinsic to white male dominated educational or industrial organizations into which female or minority integration is desired. Examples of institutional barriers are admission policies, financial aid policies, institutional regulations and policies, and staff attitudes (Bianchi, 1990; Denbroeder & Thomas, 1980; Thomas et al., 1979). Many educational, industrial, and societal factors influence and limit career aspirations and success for minorities and women in white male dominated training or career fields.

4.3.1.1.1 Industrial Bias

Legislative mandate has substantially reduced institutional barriers for women and minorities. Federal laws such as the Equal Pay Act, the Civil Rights Act, the Equal Employment Opportunity Act, and the Equal Rights Amendment establish industrial guidelines aimed at integrating minorities and women into historically underrepresented career fields (Aburdene & Naisbitt, 1992; Biles & Pryatel, 1978). Thus, many institutional barriers associated with educational and industrial policies have been removed for females and minorities interested in nontraditional pursuits.

The imposition of Congressional mandate does not assure equal treatment in the work place. The literature suggests that women and minorities in supervisory positions are viewed by their subordinates less favorably than white males in those positions, despite the subordinates' race or gender (Faludi, 1991; Haccoun, Haccoun, & Sallay, 1978). Research also indicates that minorities and women generally perceive that they are discriminated against as a population. However, when these same individuals were asked if they themselves were discriminated against, they generally indicated that they were not (Crosby, 1984; Eiff, 1989). Many institutional barriers can and have been successfully addressed and controlled through legislation in order to equalize vocational opportunities for men and women of all races (Thomas et al., 1979). In the current study, workers of both genders and various races reported that many industrial barriers, biases, and discriminatory activities have been controlled or neutralized by legislation or by fear of legal action precipitated by judicial precedent.

4.3.1.1.2 Educator Bias

Institutional barriers associated with educational organizations have proven formidable to the process of integrating equitable numbers of minorities and women into white male dominated career fields. While the Civil Rights Act and Title IX of the Education Amendments propose to ensure the elimination of bias and race- and sex-role stereotyping in both employment and career preparation, both overt and covert bias remain entrenched in our educational institutions (AAUW, 1992; Denbroeder & Thomas, 1980). Unfavorable comments and behaviors by teachers, counselors, and peers have been shown to be discouraging influences on women and minority students with nontraditional interests (Bianchi, 1990; Eko & Brown, 1981). Legislative mandate has neutralized most overt forms of discrimination in educational institutional admissions, financial aid, and regulations policies (Orr, 1983). However, successful remediation of biases associated with staff attitudes and actions has not been realized. The influences of teacher, counselor, and textbook biases on minority and female students still pervade our educational institutions (AAUW, 1992; Cronenwett, 1983).

Teachers and counselors consciously and/or unconsciously convey bias to students by "sending verbal and non-verbal messages to students" discouraging the selection of a nontraditional career field (Cronenwett, 1983; Stitt, 1988). Since counseling experiences seem to influence career decision-making in young people, counselors must question the quality and equity of the service they provide (Sauter, Siedl, & Karbon, 1980). The literature shows that counselors hold sex-and race-stereotypical attitudes and often show disapproval toward students with an interest in nontraditional or, as they perceive it, "deviant" program or career interests (Bianchi, 1990; Ott et al., 1979). Most agree that counselor bias and awareness level are important variables in the pursuit of an equitable counseling experience (Sauter et al., 1980). Most also agree that counselors need to reduce their open and subtle biases in an effort to facilitate equity in educational programs and career pursuits (Lewis et al., 1976; Stitt & Stitt, 1990).

The literature implies that counselors are "agents of conformity, rather than vehicles of change" (Hawley, 1972; Stitt, 1988). Research indicates that counselors tend to suggest only traditional options to undecided students and discourage nontraditional interests. Teachers in areas like technology are somewhat reluctant to include nontraditional students in their courses. While these influences may be presented most subtly, they can effectively discourage nontraditional choice among underrepresented populations (Harrison, 1980). Attitudes among educators toward the suitability of vocational courses for various individuals were demonstrated to be associated with the educator's sex and educational level, but not their race or teaching longevity (Handley & Walker, 1978). Male teachers were more influential than female teachers in female students' decisions to select nontraditional courses and careers. Female teachers tended to encourage female students to maintain a traditional educational and career interests. White educators, both male and female, are more biased regarding nontraditional work preferences of men and women than are black educators (AAUW, 1992; Handley & Walker, 1978).

Educational institutional barriers must be changed from within. The key to implementing such changes is the teacher (Farris, 1980). Research indicates that teachers exhibit differential treatment of students according to the student's race and gender (AAUW, 1992; Ott et al., 1979). It is suggested that this treatment disparity occurs because teachers ascribe different characteristics to gender and race and prefer certain types of behavior in members of certain populations (Ott et al., 1979; Stitt, 1988). While teaching faculty have not been implicated as directly influencing traditional choices in students' majors, they seem to have an indirect influence through classroom experiences (Bianchi, 1990; Carr & Mednick, 1988; O'Donnell & Andersen, 1978). Teachers and counselors disclose that they do not encourage or discourage students' consideration of nontraditional career interests. They do indicate, however, that when a student indicates a nontraditional interest they "probe" to insure that the student's interest is genuine. This "probing" could discourage many students from pursuing nontraditional interests (Lewis et al., 1976; Stitt, 1988).

4.3.1.1.3 Educational Material Bias

While teachers and counselors may covertly convey bias, there are many overt forms of bias in the educational environment. Chief among these influences are instructional language and textbook bias. Subtle forms of racist or sexist language significantly affect students' social perceptions. (Briere & Lanktree, 1983; Stitt, 1988). The use of guidance materials (Eiff, 1989; Rohfeld, 1977) and textbooks which project overt or covert sex- or race-stereotyping or utilize racist or sexist language can greatly deter students' consideration of nontraditional interests (Lewis et al., 1976; Stitt & Stitt, 1990).

Research suggests that a student's perception of career attractiveness and his or her willingness to move into specific career fields follows sex- and race-stereotypical directions as a function of the degree of exposure to racist and sexist language. These findings support recent demands for non-sexist and non- racist language in guidance material and textbooks. (Briere & Lanktree, 1983; Faludi, 1991). In addition to language bias, textbooks have also been found to project stereotypical race and gender attributes. Textbooks often present females as passive, fearful, or incompetent. Males are often portrayed as active, brave, and resourceful (Ott et al., 1979). Minorities are often projected to be criminal, lazy, or offensive. In order to remove biases generated by educational materials, it is imperative that teachers and counselors guard against the use of sex- or race-typed material (Lewis et al., 1976).

4.3.1.2 Situational Barriers

While legislation and programmatic changes have alleviated many institutional barriers, neutralizing institutional barriers will not, in and of itself, result in greater representation of women and minorities in white male dominated career fields. There remains a sizable array of personal-social barriers which create conflicts for minorities and women who would like to enter nontraditional careers (Thomas et al., 1979). Among these barriers are influences related to the individual's environmental and life contextual limitations. Situational barriers are those constraints experienced by the individual due to the circumstances in which they find themselves. Situational barriers include family responsibilities, financial needs, and societal pressures (Denbroeder & Thomas, 1980; Leach & Roberts 1988; Thomas et al., 1979). An individual's social and family context has a significant impact on his or her career aspirations.

4.3.1.2.1 Career Training Costs

Principle among situational delimiters is the cost of training necessary for career participation. Many minorities and women require more career preparation in order to enter many white male dominated fields than do white males. Weak prerequisite skills in mathematics and science often dictate additional training in these disciplines before entering career training. Many women and minorities fail to consider nontraditional career fields because of their need for career preparation and the cost of that training (Drake, 1990; Rodriguez, 1986). In aviation career fields, career preparation training costs are a barrier which must be surmounted before minorities and women can enter these nontraditional careers. Socioeconomic background may predispose low aspirations among these individuals if they perceive parental reluctance or inability to support career-preparation costs (Carr & Mednick, 1988; Danziger, 1983). Despite a desire to pursue such training, these individuals may also find it difficult to secure loans for training and often lack information on how to obtain money for career training (Bianchi, 1990; Thomas et al., 1979). In order for individuals from low-income backgrounds to have an opportunity to enter nontraditional careers, it is necessary for them to identify sources of money for training costs (Bianchi, 1990; Fralick, 1984). These individuals often find it difficult to secure financial aid due to their special needs (Thomas et al., 1979).

4.3.1.3 Dispositional Barriers

Legislative removal of institutional barriers has not changed pervading attitudinal barriers preventing students from choosing nontraditional career pursuits (Albrecht, 1976; Duo & Yuen, 1985; Leach & Roberts, 1988). Dispositional barriers are those attitudinal attributes of an individual which preclude his or her involvement in nontraditional careers. Individual dispositions may create dispositional barriers such as the fear of failure, fear of success, attitudes toward intellectual activities, role preference, level of aspiration, dependence, and feelings of inferiority (Denbroeder & Thomas, 1980; Thomas et al., 1979). For many minorities and women, race- and sex-role stereotyping, occupational race- and sex-typing, and self-concept have a significant impact on their occupational aspirations (Eiff, 1991; Ruble et al., 1984). Attitudinal barriers effectually eliminate serious consideration of nontraditional career pursuit. It has been shown that an individual's level of education affects the impact of such barriers on career aspirations. Lower levels of education in combination with socialization presents an ominous barrier for nontraditional career aspirations. The "lack of an adequate education which would prepare one for certain occupations combines with attitudes developed during socialization that, in effect, define these occupations as inappropriate choices anyway" (Albrecht, 1976).

4.3.1.3.1 Self-Esteem

Research has indicated that there appears to be a significant relationship between an individual's self- esteem and whether or not the individual's attitudes are nontraditional or traditional (Harrison et al., 1981). The literature reports that many women and minorities have a lower self-concept than white males in the realm of occupational performance. This may lead to lower self-confidence and an expectancy of failure (Sleeter, 1991; Soldwedel, 1989; Thomas et al., 1979). Women are more self-conscious and, therefore, more vulnerable to criticism than males, especially in occupationally related terms (Faludi, 1991; Rosenberg & Simmons, 1975). Women facing the reality of pursuing male-dominated careers agree that they are discouraged by their lack of self-confidence (Eko & Brown, 1981). Women with higher self- esteem are more likely to pursue nontraditional occupations (Harrison et al., 1981).

4.3.1.3.2 Fear of Success

Females and minorities who gain success in environments where their employment is considered traditional or where there is an equality of representation elicit favorable white male reaction. When the success is associated with careers or actions considered "deviant" for minorities or females, these same males react punitively. Successful nontraditional workers may manifest a "motive to avoid success" in an effort to avoid disfavor among white male peers (Lockheed, 1975). Thus, women and minorities may become underachievers when competing with white males, especially in environments where white males dominate, in order to avoid a perceived compromise in their relationship with these men (Carr & Mednick, 1988; Dole, 1989; Thomas et al., 1979).

4.3.1.4 Socialization

The effects of social expectations are most apparent in the career and life aspirations of women. Women are socialized into diverting their attention away from themselves as workers and toward seeking identity from their spouse or potential spouse (Thomas et al., 1979). Socializing forces not only inhibit the development of women but also impede the national interest to maximize human resources (Aburdene & Naisbitt, 1992; O'Donnell & Andersen, 1978). Socialization is a process "whereby implicit standards of social conduct are conveyed to and acquired by children" (Bearison, 1979). As an example, parents, teachers, and media socialize women from infancy to seek their fulfillment in the wife/mother role and at the same time motivate men toward occupational success (Orr, 1983). Social scientists assert that this differential in socialization patterns exists throughout an individual's life, guiding males and females in different directions (Carr & Mednick, 1988; Rosenberg & Simmons, 1975). Traditional societal sex-role socialization promotes achievement motivation in men but is antagonistic to the development of such motives in women (Carr & Mednick, 1988).

Members of minority populations are similarly affected by cultural and social expectations dictated by their backgrounds. These influences give stark evidence that paramount among socializing forces is the family. The family is the first and foremost influence in our lives (Auster & Auster, 1981; Eiff et al., 1986). Research indicates that the socialization process within the family was the greatest factor affecting the occupational choices of women and minorities (Eko & Brown, 1981). As the primary agent of socialization, the family's influence on career choice is a result of a complex interplay of active and passive, formal and informal, social, psychological, and economic factors. Career choice among women is influenced by such family socioeconomic factors as parental education levels and occupational status, income, and number, birthing order, and sex of siblings (Auster & Auster, 1981) as well as parents' attitudes toward traditional roles (Leach & Roberts, 1988; Thomas et al., 1979).

The literature indicates that despite their racial or ethnic background, parents differentially socialize sons and daughters (Bearison, 1979; Carr & Mednick, 1988). Seemingly benign behaviors by parents can translate into covert sex-role stereotyping. Factors such as the type and frequency of handling in infancy, the numbers and kinds of toys, and the encouragement of dependence or independence can have dramatic implications on children's sex-role perceptions (Schlossberg & Goodman, 1972). The classic "Baby X" research demonstrated the pervasive and inadvertent nature of parental sex-role socialization. By using the same baby and representing it as male or female, researchers were able to demonstrate that adults interact different with the same infant in accordance with the child's perceived sex (Seavey, Katz, & Zalk, 1975). Thus, the literature suggests that women from all backgrounds are adversely affected by familial socializations.

Many family attributes and constraints also affect the career aspirations of minorities and women. The educational levels of parents, especially that of the mother in the case of women aspirants, and the work history of parents have been strongly implicated as factors in an individual's nontraditional career pursuit (Crawford, 1978; Danziger, 1983; Drake, 1990; O'Donnell & Andersen, 1978; Sauter et al., 1980). Both boys and girls appear to be influenced by the occupation of the opposite sex parent (Kane & Frazee, 1989; Nelson, 1978). The financial resources of the family are also linked to parental expectations and individuals' aspirations. Families with limited financial resources may be more sensitive to the cost and duration of career preparation and the uncertainty of occupational returns (Bianchi, 1990; Danziger, 1983).

Other prominent socializing forces are the influences of race- and sex-typing in the media and advertising. Television abounds with sex- and race-typed information concerning role appropriateness in its program and advertising content. The media, including magazines, songs, newspapers, and radio, reinforce traditional sex and race roles (Schwartz & Markham, 1985). Children learn about jobs and work settings from television, but such programming strongly promotes the "appropriate" race and sex of the worker (O'Bryant & Corder-Bolz, 1978; Stitt & Stitt, 1990).

The race- and sex-typing of toys has also contributed to role socialization. Such socializations are strongest for females. Toys "for girls" are strongly oriented toward domestic pursuits and do not encourage construction and manipulation like "boys' toys" do (Schwartz & Markham, 1985). Toy advertisements project the toy's appropriate sex, thus promoting sex-role socialization. Research has demonstrated that toy advertisers portray their toys with "appropriate" sex children in the pictures (Schwartz & Markham, 1985). In toy use experiments, however, researchers have found that there is no significant relationship between a child's sex and the use of boys' or girls' toys (Karpoe & Olney, 1983). Children, instead, universally used the toys by toy-defined criteria, rather than by perceived sex-typing.

Another example of sex-typed expectations are those predicting that women are not mechanically inclined and lack the ability, strength, dexterity, and aptitude to perform many maintenance-related tasks. Research studies of mechanical skills demonstrate that this perception is contrary to demonstrated abilities. When tested for technical aptitudes and abilities, women were found to excel in six aptitudes: finger dexterity, graphorrhea, ideaphoria, observation, silograms, and abstract visualization. Men excelled over women in only two areas, grip and structural visualization. (Orr, 1983). Thus, commonly held beliefs that women are not adept or capable of performing mechanical tasks as well as men have been demonstrated to be erroneous.

4.3.1.4.1 Role Stereotyping

Role stereotyping is one of the most frequently cited sources of bias in the literature (Faludi, 1991; Ruble et al., 1984). Role stereotypes are oversimplified judgments about people's capabilities and interests based on their race, ethnic background, or sex (Farris, 1980, p. 19). Role stereotyping is a deeply rooted and pervasive aspect of our culture which affects career, educational, and occupational choices (Aburdene & Naisbitt, 1992; Faludi, 1991; Alden & Seiferth, 1980). Sex- and race-role identification is a central aspect of the social learning process and has profound effects on a child's expectations, self-image, and behavior (Schwartz & Markham, 1985).

Traditionally, masculinity and femininity have been viewed as dichotomous (Yanico, Hardin, & McLaughlin, 1978). It has been a cultural precept that if an individual endorses a position which projects masculinity, there is simultaneous non-endorsement of femininity (Faludi, 1991; Urbonas-Bendikas, 1981). The analysis of sex-roles brings with it a perception of threat since it asks us to question our own personal sense of identity. This is because our identities have been based upon socialization as males or females through constant and frequent overt and covert reinforcements of sex-stereotyped characteristics (Farris, 1980). Sex-role socializations are problematic in that they block human understanding, communication, and potential (Alden & Seiferth, 1980).

The acquisition of sex- and race-role identities are usually attributed to one of three factors: innate biological differences, cognitive-developmental parameters, or social influences (Bardwell, Cochran, & Walker, 1986). The third factor is derived from social learning theory and, thus, is central to the current study. The process of stereotyping involves classifying or categorizing groups or individuals according to dispositional traits, attitudes, or intentions (Carr & Mednick, 1988; Ruble et al., 1984). In the current context, a stereotype centers around normative role expectations. Relative to gender, for men, these normative expectations are that they will be economically independent, that they will work all their adult lives, and that they will be the principle breadwinner and achiever. Women, on the other hand, are expected to be successful in marriage, to assign their priorities to child rearing and homemaking, and are less exposed to social pressure to achieve. Career pursuits and economic independence are conceived of as secondary considerations for women (Danziger, 1983). Socialization of women turns them toward being pleasing to others; socialization of men turns them to accomplishment and achievement (Stitt & Stitt, 1990; Rosenberg & Simmons, 1975).

Society identifies certain traits as representative of male and female attributes. The male is considered to be independent, active, objective, confident, ambitious, assertive, logical, and aggressive (Ruble et al., 1984; Shinar, 1975). Female attributes include gentleness, emotionality, interpersonal sensitivity, tactfulness, neatness, and quiet (Ruble et al., 1984; Shinar, 1975). When compared to men, women are considered less competent, less independent, less objective, less logical, and less organized (Broverman, Vogel, Broverman, Clarkson, & Rosenkrantz, 1972; Rosenberg & Simmons, 1975).

Individuals acquire role stereotyping from a variety of social forces: parents, schools, peers, and the media (Schwartz & Markham, 1985). Since stereotyping begins at infancy, it is set by the age of three and defined by the age of six. Parents are the first and primary source of role-bias (Duo & Yuen, 1985). The role stereotypes imposed by parents during early childhood become a formidable barrier during later years (Thomas et al., 1979). Parents subconsciously pass sex- and race-role traditions on to their children through both overt and covert actions and language. Parents teach children to play with race- and sex- appropriate toys, assign them sex-appropriate household tasks, and treat them differently (Ott et al., 1979). Many times, differential treatment is conscious and deliberate (Seavey et al., 1975). During adolescence, parental expectations that daughters will marry and have children is an important barrier to career pursuit (Carr & Mednick, 1988; Thomas et al., 1979).

Many other social forces contribute to role expectation reinforcement. Schools nurture stereotypical behavior through their expectations of different behaviors for boys and girls, and for members of different races. Girls are expected to be obedient, docile, and dependent; boys, to be aggressive, active, achieving, and independent (Carr & Mednick, 1988; Faludi, 1991). Another influence on role identification is the bias imparted by television (O'Bryant & Corder-Bolz, 1978). In general, women are portrayed in less liberal, more sex-role differentiated roles in television commercials than is the case in real life. Television commercials generally depict women in maternal, housekeeping, and aesthetic roles (Mamay & Simpson, 1981).

4.3.1.4.2 Occupational Stereotyping

Occupations and professions are highly segregated by race and gender (Bielby, 1978). Occupational race- and sex-stereotypes are developed in much the same way as individual stereotypes (Ruble et al., 1984) and are extensions of the generalized segregation which characterizes all aspects of Western society (Lipman-Blumen, 1976). These stereotypes are but one reflection of a pervasive society-wide system of sex and race differentiation which manifests itself in differing roles, temperaments, and opportunities (Faludi, 1991; Mason, 1976; Schlossberg & Goodman, 1972). As with other Western cultures, occupational segregation has been a constant feature of the work place in the United States throughout its entire history (Deaux, 1984; Duo & Yuen, 1985).

Two methods of occupational sex- and race-typing are apparent in the literature: 1) the use of the race or gender ratio of workers in an occupation and, 2) by a classification of the nature of the work (Standley & Soule, 1974). Research suggests that the most commonly held perceptions of occupational stereotyping relate to the majority sex or race working in a career being perceived as the occupation's appropriate sex/race (Krefting, Berger, & Wallace, 1978; Ruble et al., 1984; Thomas et al., 1979). Often, minorities and women are discouraged from seeking employment in white male dominated careers because of such occupational stereotyping (Drake, 1990; Kane & Frazee, 1989; Thomas, 1981).

Historically, there has been a tendency to channel women and minorities into a few socially acceptable, low-status, traditional occupations (Leach & Roberts, 1988). Segregation by race- and sex-typed occupation constitutes a major waste of natural talent (Aburdene & Naisbitt, 1992). Despite purported efforts to infuse greater numbers of women into nontraditional occupations, research indicates that occupational segregation by sex is nearly as prevalent today as it was almost one-hundred years ago (Alden & Seiferth, 1979). An individual's perception of occupational sex- and race-appropriateness has been found in early childhood (Rosenthal & Chapman, 1982). Studies suggest that students in elementary grades limit their career interests to race- and sex-typed career fields (Alden & Seiferth, 1980; Papalia & Tennent, 1975; Tremaine, Schau, & Busch, 1982). Career aspiration gains in liberality through pre- adolescent (Tremaine et al., 1982). Females express more varied, nontraditional, and sophisticated vocational preferences during pre-adolescence than they do when entering college (Eiff, 1989). By the time women enter college, they exhibit clearly defined perceptions of sex-typed occupations (Shinar, 1975). These perceptions of race- and sex-appropriate career fields prevent many minorities and women from considering white male dominated occupations.

4.3.1.5 Informational Barriers

Informational barriers have proven to be a major force working to limit the involvement of women and minorities in white male dominated aviation career fields. Research has repeatedly demonstrated that a generalized lack of awareness and the unavailability of career information and career guidance with regards to atypical careers are significant factors in the discouraging the nontraditional participant from entering white male dominated career fields.

4.3.1.5.1 Lack of Awareness

Many minorities and women fail to perceive the myriad of nontraditional career opportunities as viable career options simply because they are unaware of them. A campaign of general publicity and efforts to inform high school counselors has been listed as the most important strategy to improve the representation of nontraditional workers in white male dominated occupations (Deaux, 1984; Leach & Roberts, 1988; Occupational Competencies, 1991).

Race and socioeconomic status are important factors in career awareness. Occupational knowledge is associated with an individual's socioeconomic status, family size, and race. Race, in particular, has been demonstrated consistently to have a dramatic impact on an individual's occupational knowledge (Howell, 1978). Blacks are less familiar with job titles than other populations and have a more restrictive view of occupational possibilities. They also have a lower inclination to explore career possibilities (Alden & Seiferth, 1980).

Women are generally less aware than men of both the availability of nontraditional careers and of information about employment openings (Drake, 1990; Leach & Roberts, 1988; Stitt, 1988). In aviation career fields, specifically, the general lack of awareness among women and minorities concerning the diversity of aviation career opportunities was cited as the single most important reason for the low levels of representation by these populations in aviation career fields (Eiff, 1989; Occupational Competencies, 1991). It has been suggested that making these individuals aware of atypical career opportunities and encouraging them to explore those opportunities will have a dramatic impact on the integration of women and minorities into white male dominated careers (Drake, 1990; Harrison, 1980; Leach & Roberts 1988).

4.3.1.5.2 Lack of Career Information

Many women and minorities to select traditional careers because they do not have access to information concerning atypical occupational opportunities (Kane & Frazee, 1989; Stitt & Stitt, 1990). Individuals and counselors lack important information about nontraditional careers which would enable minorities and women to make intelligent choices with regards to occupational selection and preparation (Eko & Brown, 1981; Stitt, 1988). Information concerning career preparation, potential salaries, job opportunities, working conditions, and promotional opportunities is critically lacking (Lewis et al., 1976).

4.3.1.5.3 Lack of Career Guidance

The literature indicates that there is a dramatic need for greater career counseling for women and minorities (Alden & Seiferth, 1980; Leach & Roberts 1988). When workers were asked if career counseling was influential in their nontraditional career decision, many indicated that it was of little or no help (Eiff et al., 1986; Rohfeld, 1977). It has been suggested that this may indicate that counselors either do not have adequate information about individuals in nontraditional occupations or that their own biases regarding race- and sex-roles directly limit the information they offer women and minorities. In either case, it is important that counselors increase their knowledge about career opportunities for women and minorities, as well as their awareness of and sensitivity to bias (Drake, 1990; Occupational Competencies, 1991).

4.3.2 Nontraditional Career Motivators

The literature also gives insight as to what factors influence or motivate minorities and women to consider nontraditional careers. Motivation is a function of two elements: expectancy and value. Expectancy is "the individual's subjective sense of probability that a certain event will occur" (Laws, 1976). Value can be viewed, from the cognitive perspective, as the "positive or negative incentive value a particular event has for the individual" or, from a behavioral perspective, "in terms of an organism's tendency to approach or avoid a given state of affairs" (Lewis et al., 1976). Together, expectancy and values are the framework of an individual's aspirations and career motivations. Aspiration, from a psychological or social learning theory perspective, is "an integral part of a dynamic cycle involving goal-setting, effortful striving, events that provide feedback about success or failure, and the adjustment of aspirations" (Lewis et al., 1976). Some of the more important motivating influences encouraging women and minorities to choose nontraditional careers include the promise of economic gain, the presence of role models, interactions with career professionals, visits to job sites, experiential career experiences, and appropriate career information.

4.3.2 Nontraditional Career Motivators

In career selection and pursuit, several factors influence the decision process. Salary, social prestige, nature of the work, individual characteristics of the job seeker, and educational and skill levels are concomitants of occupational preferences (Aburdene & Nausbitt, 1992; Dole, 1989; Ruble et al., 1984). Earning potential is a major influence in career decision making (Cronenwett, 1983). Women and minorities in traditional careers have consistently made less money than men in traditional white male career fields. This persistent 60% ratio in female to male earnings exerts pressure on many women to pursue higher-paying career opportunities (Deaux, 1984). Often, nontraditional career consideration is directly related to an individual's perception of better earning potential (Walshok, 1976). A motivation to maximize earning potential causes many minorities and women to avoid or leave traditional careers in favor of nontraditional career opportunities (Scott, 1980).

4.3.2.2 Role Models

The influence of "significant others" has been attributed a paramount importance in career decision making (Eiff et al., 1986; Eko & Brown, 1981; Handley & Walker, 1978). Significant others include parents, teachers, and influential role models (Handley & Walker, 1978). The shortage of female and minority role models in nontraditional career fields, it has been suggested, results in nontraditional workers being afraid to enter white male dominated fields (Orr, 1983; Thomas et al., 1979).

Research indicates that material which portrays minorities and women in white male dominated jobs reduces female and minority reluctance to enter those fields (O'Bryant & Corder-Bolz, 1978; Orr, 1983; Stitt & Stitt, 1990). Identifying role models actively employed in underrepresented fields can help overcome their habitual feelings of self-doubt and self-defeat (Fletcher, 1980). Women and minorities are less likely to aspire to an occupation when the representation of same race and same gender workers in that field is low. Evidence of few role models in a career field gives the impression that the career is "off- limits" (Deaux, 1984). Career information and activities involving role models "who are actually doing it" can be an effective tool in neutralizing barriers to alternate careers (Alden & Seiferth, 1980; Burge, 1983; Dolan, 1980; Eko & Brown, 1981; Lewis et al., 1976; Ott et al., 1979; Stitt & Anderson, 1980).

Career information and posters should display nontraditional role models (Carney & Morgan, 1981), eliminate race- and sex-restrictive labels, and drop sex-biased semantic markers for traditional, stereotyped occupations (Rosenthal & Chapman, 1982). Many researchers have suggested that, as the number of minorities and women in a career field grows, the numbers of nontraditional workers who aspire to that career will increase (Jackson, 1978; Ruble et al., 1984). One researcher has even speculated that the entry of more women and minorities into white male dominated career fields will have a "snowballing effect," resulting in greater numbers of these populations aspiring to that field (Thomas et al., 1979). The more frequently females and minorities can be portrayed as incumbents in jobs previously held primarily by white males, the more likely the sex- and race-type assessment of the occupation is to change (Krefting et al., 1978; Soldwedel, 1989).

4.3.2.3 Meeting Career Professionals

Many studies have indicated the importance of personal contact with role models (Eko & Brown, 1981). Programs which allow for a free and unstructured information exchange between women and minorities in nontraditional careers and individuals aspiring to those careers will provide for successful neutralization of barriers to career involvement (Brunner, 1981). Men realize early in life that they will spend the majority of their adult lives in paid employment. Men, therefore, consciously or unconsciously build informal mentoring relationships which help them to develop requisite skills for success (Lynch, 1980). Women, on the other hand, limit their involvement in such networks.

Meeting and discussing career concerns with professionals from aviation career fields would allow minorities and women interested in nontraditional aviation careers with a quasi-mentoring environment. Such a mentoring environment should provide knowledge about the specific conditions encountered in the field, provide the opportunity to meet people who might be able to provide career and occupational preparation information, and to provide support in matters relative to career decision making (Lynch, 1980). These mentoring activities give interested individuals the opportunity to develop an individual, personal perception of what it is like to be in that particular career (Eiff, 1989; Eiff et al., 1986). Participants find it very helpful to discuss career opportunities with someone who can "tell it like it is." Some participants, after a candid and close examination of the career, may decide the occupation is not for them (Fowler, 1981). An optimal mentoring program maintains the age difference between the mentor and the participants at a half-generation, roughly 8 to 15 years (Lynch, 1980).

4.3.2.4 Job Site Visitation

Another technique suggested by previous research as motivating nontraditional career selection is for individuals to visit job sites not traditionally occupied by minorities or women. Visitation of career facilities which allow students to meet and observe workers was rated "very helpful" by high school students (Eiff et al., 1986; Leach & Roberts, 1988; Rohfeld, 1977). Research indicates that minorities and women with traditional interests participate in job site visits more than those with nontraditional career interests (Orr, 1983). Such visits promote a clearer understanding of what the career entails and a more realistic picture of the working environment (Harrison, 1980). During such visits, nontraditional employees should be evident in order to promote role models which are associated to the specific occupation (Lewis et al., 1976). Examples of involvement of women and minorities in nontraditional careers will project the career field's movement toward a more balanced race and sex ratio within the field. This perception will encourage greater numbers of nontraditional persons to consider the exhibited career field (Heilman, 1979).

4.3.2.5 Experiential "Hands-on" Experiences

Career exploration utilizing experiential work simulation has proven to be very effective. Studies have demonstrated the effectiveness of having individuals learn about career opportunities through experiential activities related to actual career tasks or in actual career environments. Students seldom have the opportunity to engage in realistic, hands-on experiences. Performing realistic work tasks using real tools provides an environment in which work-related skills and interests may be tried and explored (Fifield & Petersen, 1978). Viewed as a learning experience, hands-on training activities optimize knowledge acquisition: "According to the American Audio-Visual Society, people remember only 11% of what they hear, 30% of what they see, 50% of what they see and hear, and 70% of what they *do*" (Bradley & Friedenberg, 1986). Hands-on experiences emphasize the application of skills, rather than a vicarious skill experience. The experiential aspects of the experience are uniquely effective at capturing the interest of participants and motivating them to learn (Fifield & Petersen, 1978). Cognitive learning, participants' attitudes about the job, participants' interest, and participants' valuation of work all increase significantly (Fifield & Petersen, 1978). This success appears to be linked to the fact that students tend to perceive themselves as actually involved in authentic work problems. This perception results in a higher degree of motivation and facilitates a realistic exploration of the participant's interests, aptitudes, and special abilities (Eiff et al., 1986; Fifield & Petersen, 1978).

The use of experiential "hands-on" activities generates intense occupational interest. Participants in hands- on activities report that they felt particularly positive about the activity. Educators report that such experiential activities result in a high degree of student motivation. This motivation causes the student to seek additional information about the career. Educators have found that hands-on experiences are extremely interesting and effective ways for students to learn about occupations and to increase their interest in the world of work in general and the career explored in particular (Fifield & Petersen, 1978).

4.3.2.6 Career Education and Information

The literature is emphatic about the need to re-examine career guidance and education if equitable numbers of women and minorities are to be integrated into white male dominated career fields. The quality and availability of career information is critical to neutralizing barriers against involvement of women and minorities in nontraditional occupations. One of the most important influences on students is information about careers; career literature is a major influence in perceived career attainability and in occupational selection (Sauter et al., 1980; Stitt, 1988). Unfortunately, much of the career information currently available contains racially and sexually biased information (Yanico, 1978) and categorizes occupations as race- and sex-role appropriate (Ott et al., 1979). Great care must be taken to select or generate career guidance information which is not sex-stereotyped (Lewis et al., 1976).

Studies indicate a need for an intensive effort to provide career information addressing career issues and to make that information available to parents, students, teachers, and counselors (Alden & Seiferth, 1980; Occupational Competencies, 1991). To be effective, such information should include trends in the world of work, realistic information on working conditions, potential for employment, and earnings potential (Cronenwett, 1983). Material must be developed to increase the visibility of white male dominated occupations and awareness among minorities and women of nontraditional opportunities (Orr, 1983). This material should provide a more egalitarian perspective on the role of women and minorities and should provide a non-stereotyped representation of career opportunities (Sauter et al., 1980).

4.4 SPECIFIC AVIATION CAREER BARRIERS

While the research literature identifies many generalizable barriers for women and minorities seeking to pursue nontraditional careers, central to the concerns of this study are those specific to aviation career pursuits. Also, the last decade has seen aggressive efforts by the aerospace industry to encourage the participation of greater numbers of nontraditional workers in various aviation careers. Recent research studies indicate that these efforts have begun to result in increased numbers of women and minorities selecting and pursuing nontraditional aviation professions. Therefore, an important facet of the study was to review efforts currently used by aviation industries, schools, and organizations in order to determine what programs and methodologies are best at causing women and minorities to consider aviation career pursuits.

4.4.1 Career Selection Barriers

The research literature indicates that the generalized lack of awareness among women and minorities concerning nontraditional career opportunities is a major reason that few of these individuals select those careers. Earlier research demonstrated that most young people and high school career counselors are unaware of the diversity of aviation career opportunities available to potential employees. The same study indicated that these individuals do not understand the requisite knowledge and skills necessary for entry into such careers or know how or where to obtain career training (Eiff et al., 1986).

The generalized lack of familiarity of aviation career opportunities remains the single most prominent barrier to diversifying the aviation work force. Numerous research efforts have demonstrated that individuals from all age groups have almost no understanding of the workings of aviation commerce and the variety of careers it represents (Eiff et al., 1986). This has been proven to be especially true among young people. When questioned about aviation careers, few young people exhibited a knowledge of career opportunities other than those of pilot and air traffic controller (Occupational Competencies, 1991). This leaves little doubt as to why these particular careers have realized the greatest gains in nontraditional workers over recent years.

From discussions held with various administrators within the aviation industry, it appears that there have been significant gains in the representation of minority populations, other than women, in aviation maintenance careers. This improved minority hiring appears especially true within major industrial settings. An evaluation of this trend suggests that the dramatic increase in numbers of minority workers in aviation maintenance professions is most attributable to aggressive education and recruitment efforts by the military, major airlines, government agencies, and other aviation and educational organizations.

4.4.1.1 The Military Influence

One of the most significant factors influencing the current trend toward more equal representation of nontraditional aerospace maintenance professionals has been the relatively successful diversification of the military. The dramatic success by all branches of the military in recruiting, training, and placing large numbers of women and minorities in aerospace career fields has had a dramatic residual effect on civilian industries. When aviation maintenance technicians currently working in the industry were asked where they received their training, military training and experience constituted the greatest source of career preparation for Blacks, Hispanics, and women (see Tables 4.1 and 4.2 and Figures 4.3 and 4.4).

Table 4.1 Aircraft Mechanics and Technicians Career Preparation by Gender

Population	Military	FAA 147	Work Exp	Other	N
Females (Aggregate)	6 30%	5 25%	5 25%	4 20%	20
Males (Aggregate)	73 37%	92 46%	23 12%	10 5%	198

Table 4.1 Aircraft Mechanics and Technicians Career Preparation by Gender

Table 4.2 Aircraft Mechanics and Technicians Career Preparation by Race

Population	Military	FAA 147	Work Exp	Other	N
Asian	2 17%	8 67%	1 8%	1 8%	12
Black	12 46%	9 35%	5 19%	0	26
Hispanic	6 67%	1 11%	1 11%	1 11%	9
Caucasian	57 35%	76 47%	19 12%	11 6%	163

Table 4.2 Aircraft Mechanics and Technicians Career Preparation by Race

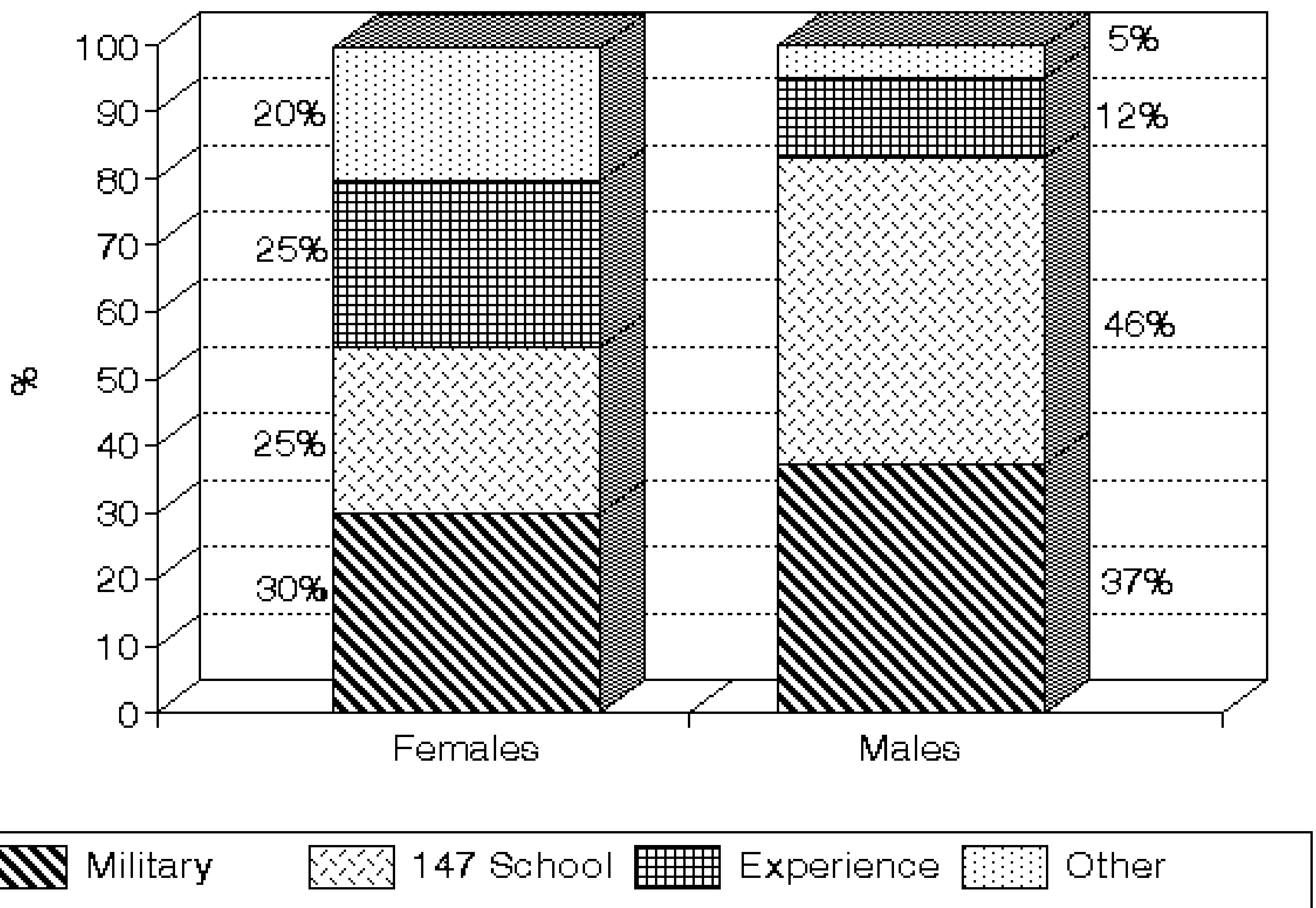

Figure 4.3 Career Preparation by Gender

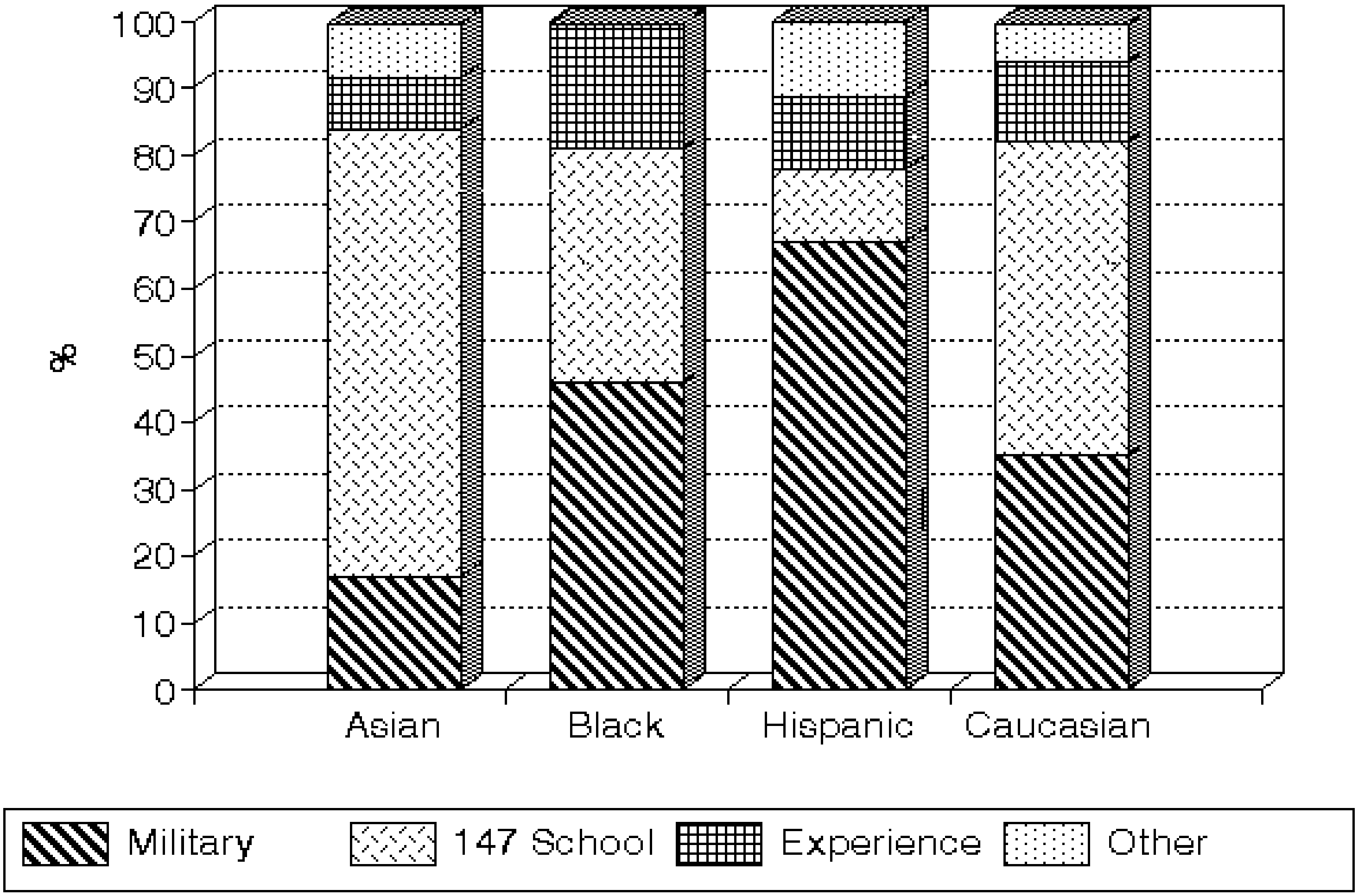

Figure 4.4 Career Preparation by Race

The military has a long history of successful outreach programs. Active recruitment in high schools, technical schools, and colleges has been a mainstay for diversity in today's military. Youth activities such as the Civil Air Patrol, Young Astronauts Program, Star Base, and Boy and Girl Scout groups have been a keystone for diversity recruitment efforts. The military has also played an important role in supporting aerospace education efforts at numerous grade levels throughout the country. College tuition programs have also proven instrumental in drawing minority populations into military aerospace fields.

In an effort to provide for an all-volunteer military, all branches of the armed services have engaged in aggressive recruitment and advertising programs. To a large extent, armed services' advertising projects an unbiased and gender- and race-fair image of aerospace professionals. Their extensive use of race and gender role models in advertising fosters larger participation by underrepresented populations.

The movement toward greater world peace and the demise of the Soviet Union has precipitated a feeling among many that the military in many areas has become obsolete. Increasing concerns over the national deficit will most assuredly result in dramatic reductions in the defense budget. These reductions in military spending promise to limit, if not curtail, many of the beneficial spin-offs reaped by civilian aerospace industries. Reduced budgets will most likely result in diminished support of educational and youth activities. The predicted reduction in technical staffing in the military will result in fewer trained minority aviation professionals for articulation into civilian careers. Most importantly, the military's aggressive gender- and race-fair advertising of aerospace careers will most likely be reduced dramatically.

In light of the fact that working aviation maintenance technicians indicate that the largest percentage of women and minority workers received their career interest and training through the military, the reduction of military spending and the downsizing of our military forces will most assuredly affect the representation of nontraditional workers in aviation technical careers. According to working AMTs questioned in this study, 27% of the female, 46% of the Black, and 75% of the Hispanic maintenance professionals now employed in civil aviation industries were trained in the military. In each case, this number represents the largest contributor to the representation of each population. As the military loses its much needed influence, it is incumbent upon the civil aviation industry and schools to renew their efforts to recruit and retain women and minorities in aviation professions.

4.4.1.2 Other Government Agency Efforts

Several other governmental agencies have promoted aerospace career and education outreach programs as a part of their activities. Prominent among these agencies are the FAA and the National Aeronautics and Space Administration (NASA). Both agencies have devoted significant resources to developing educational material and programs, as well as sponsoring educational grants and projects. Many of these efforts have proven quite successful.

The FAA has developed a wide variety of aviation career education materials. The most significant are documents which discuss various aviation career opportunities, the education and training necessary to qualify for each career, and the need for such professionals in today's aerospace industry. The care and effort expended to make these documents race- and gender-fair has resulted in career brochures which, for the most part, are not only fair but project an atmosphere which encourages women and minorities.

The FAA has also developed an extensive array of education materials, videos, and programs which promote aviation and aviation careers. Much of this material is designed to be integrated into educational environments as supplemental materials for normal educational activities from elementary to high school and college. In an effort to distribute these materials, each FAA region has an aviation education specialist who serves as a contact point for individuals seeking assistance with aviation education materials. In addition, the FAA has established a network of aviation education resource centers. Teachers and other individuals interested in obtaining educational materials or assistance in materials or program preparation can utilize the centers' vast array of materials. The FAA also promotes programs such as aviation art contests, Aviation and Space Education Conferences, and state, regional, and national awards for aviation educators.

While the FAA has expended considerable effort and resources in preparing and distributing aviation educational materials and in developing educational programs and awards, these efforts have not attained their maximum effectiveness for several reasons. First, regional aviation education specialists are normally collateral duty assignments. These individuals perform educational activities in addition to other duties. Often, their other responsibilities take precedence over educational matters, resulting in reduced effectiveness. Most prominent among the reasons that the FAA programs have not realized their potential is a lack of continuity and follow-through. Frequent changes in administration result in shifting focuses and changes in programmatic emphasis, as well as wide fluctuations in funding for such programs.

The FAA Administrator's Award for Aviation Education Excellence is a prime example of an exemplary concept developed by the FAA which has fallen by the wayside. For two years, the FAA awarded state, regional, and national "Excellence in Aviation Education" awards to individuals who had made significant contributions to aviation education. This award caused a great deal of excitement among educators and aerospace education proponents, resulting in many individuals' renewed efforts to develop and promote aviation education projects. Unfortunately, just as the award was realizing significant results, the awards were discontinued.

NASA has committed significant funds, personnel, and facility space to developing, producing, storing, and disseminating public educational materials. Unfortunately, NASA's narrow focus on math and science subject material has limited the materials' effectiveness at generating greater awareness for aerospace career opportunities among nontraditional populations. This intense focus is also reflected in their educational grant programs. National Space Grant Consortium programs are generally aimed at high school and college math and science students who have already demonstrated an interest in and an aptitude for these subjects.

4.4.1.3 Aviation Industry Out-Reach

Due to the declining aviation industry economy, industry-sponsored programs have been scarce over the past troubled decade. In times past, major aviation and aerospace companies expended considerable effort and resources in promoting aviation education and career awareness. Beech, Cessna, and Piper aircraft companies each had very active aviation education programs several decades ago, producing many types of career and general education materials promoting aviation concepts. As aviation suffered from its rapid decline in the late 1970's, one of the first areas to receive significant cuts were the aviation education programs. As a result, much of this material is unavailable at the present time.

Currently, Beech Aircraft is the only manufacturer distributing aviation educational material. The Aircraft Electronics Association recently formed an Education Foundation to help promote aviation education. The General Aviation Manufacturers Association prepares and distributes material in behalf of aircraft manufacturers. One of the most significant efforts to be fronted by the aviation industry in recent years is the renewed efforts by the Experimental Aircraft Association and the Aircraft Owners and Pilots Association. The Young Eagles program, for example, is a breath of fresh air in an otherwise mostly stagnant aviation education environment.

4.4.1.4 Aerospace Education Out-Reach

As has been noted, governmental agencies and aviation industry corporations and organizations have and continue to produce quality aerospace educational materials for infusion in regular class subjects. Recent research, however, demonstrated that most educators are not aware of this material and are not using it in their educational activities (Eiff et al., 1986). Despite efforts by these agencies and the establishment of networks of resource centers, the material is just not getting to most educators.

In an effort to help alleviate this problem, aerospace educators have initiated a series of out-reach programs to make educators aware of the abundant material available to them for aviation and space education and to provide aviation and space examples for regular class. Numerous packaged aviation and space programs, such as "Come Fly With Me," "Back to Basics Through Aviation," and "Fantastic Flight," have been developed in a "teacher-ready" format for use in public school classrooms. Teacher education classes have been offered throughout the nation in order to provide encouragement and guidance to teachers wishing to utilize aviation materials in their classrooms. Most of these programs have been highly successful.

4.4.1.5 Early Aerospace Education

Research literature suggests that most individuals make generalized career decisions by the time they leave elementary school. Therefore, one of the best long-term strategies for encouraging young people to consider aerospace careers is to use aviation and space examples in learning activities starting in kindergarten and continuing through all elementary grades. Iris Harris promoted this concept in the "Fantastic Flight" program developed in Alabama and subsequently promoted by the FAA.

A similar concept started in Illinois, known as the "Harvard Park School" project, has demonstrated that it can not only enhance the learning of regular subject material but also stimulate and motivate both teachers and students. The program includes a teacher education class that provides teachers with "instruction-ready" material and explores innovative instructional methodologies. A central element of the teacher education program is an in-depth exploration and demonstration of how aviation materials meet state mandated goals for learning and produce increased learning and student motivation.

The adoption of the concept in a school-wide program offered an invaluable opportunity to measure the concept's effectiveness. A post-unit evaluation of the program showed significant increases in student motivation and learning. An unforeseen benefit was the reported motivation of teachers who used the material. Additional benefits of the program included increased parental participation in learning activities and measurable increases in community, industrial, and school administrative support and involvement. In its fourth year, school officials report that the program is still producing measurable gains in motivation and learning. More importantly with regards to this study, students have demonstrated a pronounced increase in their understanding of the aviation industry and aviation careers.

4.4.1.6 Lack of Visible Role Models

The literature strongly identifies the need for like-race and like-gender role models in encouraging nontraditional populations to select underrepresented career opportunities. Aviation advertisement and literature significantly lacks these types of role models.

Researchers reviewed aviation advertising in trade journals, popular publications, on travel posters, in career placement advertisements, and on television. The vast majority of the material projected strongly traditional role models. Notable exceptions included military advertisements and FAA public service announcements. Unfortunately, the beneficial impact of these exceptions was dramatically reduced by the fact that military advertisement is becoming less prevalent and that FAA public service announcements are often played during broadcast periods when few impressionable young people are watching.

The importance of a significant other or role model is evidenced by the fact that almost 90% of the women maintenance professionals interviewed for this study had a family member or close friend active in aviation. Most minorities also identified same-race individuals in aviation as influential in their selection of an aviation career. While numerous informal race/gender role model strategies have been used to encourage nontraditional workers to enter underrepresented careers, little has been done to formalize role modeling or networking activities with one notable exception.

In 1990, Dr. Peggy Baty held the first of what has become an annual conference for women in aviation careers. The National Women in Aviation Conference has been held each year since 1990 and has enjoyed a dramatic increase in participation every year. The conference is a highly effective means of promoting female aviation role models and providing a network for women pursuing aviation careers. As such, it represents a vehicle which could prove very beneficial at encouraging women to enter nontraditional aviation careers.

4.4.1.7 Changing Aviation Environment

Dramatic changes in the aviation environment over the past several decades have contributed significantly to limiting the visibility of aerospace careers and access to information concerning career preparation. Much of the difficulty currently experienced in encouraging young people to consider aviation careers is directly attributable to barriers resulting from changes in the aviation environment. The reduction in the per capita pilot population, declining numbers of airports, reduced access to airport facilities and workers, increased cost of career preparation, and increased exposure and sensitivity to liability issues are among the most notable barriers delimiting the recruitment of new aviation workers from diverse populations.

Discussions with numerous aerospace workers who have been working in aviation careers for more than 10 years revealed that many became interested in aviation careers through early exposure to aircraft or aviation enthusiasts at local airports. Many said that as youth they frequently visited local airports and freely wandered about the facilities. This open accessibility allowed them to meet and interact with many aviation professionals and hobbyists with varied backgrounds and interests. Such encounters provided these individuals with much of the information necessary to stimulate their aerospace career interests and provide the necessary background information to chart the path of aviation career preparation.

For many aviation professionals, their spark of aviation interest was kindled by observing activities at local airports. Stories of walking ramp areas or airport hangars and talking to pilots or mechanics were common among these professionals. Many related how they were allowed to help "rib stitch" wings, wash and wax airplanes, or participate in other aviation activities. Today, young people have little opportunity to participate in such learning activities since airport security provisions have virtually "locked-out" all unauthorized individuals from airport facilities. Gone are the opportunities for young people with an aviation interest to visit airport facilities and cultivate their own aviation contacts. This "lock-out" has progressed to such a level that at most airports individuals with a sincere desire to observe airport operations are kept at such a distance that meaningful observation is impossible. Airport observation decks and areas have, for the most part, disappeared. Most individuals who attempt to gain access to airports for individual or group observation of aviation operation and career activities reported receiving "hostile" receptions and "extreme negativism" from airport managers and facilities operators.

The initiation to aviation for many aviation enthusiasts and professionals often involved a chance encounter with an individual or a relationship with a friend who is a pilot. Such relationships often result in "first flight" opportunities and significant exposure to aviation operations, careers, and airport environments. Recent Experimental Aircraft Association (EAA) statistics suggest that the opportunity for such encounters may be declining. The shrinking fleet of general aviation aircraft coupled with the reduced population density of pilots will inexorably mean fewer opportunities for individuals to be introduced to aviation in this traditional fashion. According to a recent EAA publication, in 1953, there was one pilot for every 262 people in the United States. Today, there are now fewer than one pilot for every 371 individuals. When this trend is viewed within the context of the drastically reduced access to airport facilities precipitated by the airport security "lock-out," the few individuals fortunate enough to have such encounters or acquaintances will most likely not be from the diverse populations targeted by this study. Probability would imply that aviation mentors would most likely be white males and access would be limited to traditional populations. The result is a perpetuation of the same populations in aviation professions.

Compounding the effects of reduced access to existing airports and the dwindling numbers of pilots is the dramatic reduction in the number of local airports and small aviation business operations. Severe shifts in aviation commerce over the past few decades have resulted in the disappearance of many smaller airports and operations. For example, the Chicago area boasted 52 airports immediately following the Second World War. By the mid-eighties, only 26 of those airports remained in operation. The economics of aviation commerce at many smaller airports make it impossible to support maintenance and flight operations. In Illinois alone, more than 40 of the 135 airports throughout the state have no operator on the field. Illinois is not alone in this dramatic reduction of airport operations. A review of aviation business statistics indicates that the number of airports and aviation businesses throughout the country are significantly lower than those of two decades ago. As the cost of maintaining and operating aircraft increases exponentially and the number of general aviation aircraft and pilots dwindles, small aviation operations are finding it increasingly more difficult to remain in business.

Another factor limiting access to airport facilities, aviation professionals, and opportunities for flight experiences is the increased concern about liability. Discussions with individuals and organizations which attempt to provide aviation education and career experiences for young people, teachers, and potential aviation professionals indicate a pronounced reluctance on the part of aviation industries, organizations, professionals, and hobbyists to provide such experiences. When approached to provide tours or opportunities to meet and observe aviation professionals in their work environment, many aviation businesses cite liability concerns as precluding their participation. Many youth, teacher education, and aviation education groups try to provide opportunities for program participants to fly in general aviation aircraft as a learning experience. Providing an opportunity to participate in a flight experience was once relatively easy to arrange. Most groups now report, however, that national organizational restrictions or concerns by potential pilots over liability issues make such opportunities nearly impossible to arrange.

Another factor which limits the consideration of aviation careers by prospective professionals is the rapidly rising costs of career preparation. Most notable among aviation career costs are those for flight career preparation. It is not uncommon for individuals to spend upwards of $20,000 to obtain the necessary flight ratings to obtain the minimum qualifications necessary to begin a professional flight career. Even individuals aspiring to aviation maintenance professions find career training and tool costs a formidable barrier to career consideration. Since many minority populations come from economically disadvantaged backgrounds, these career preparation costs may severely limit the involvement of these target populations. In fact, tool and career training costs were identified by both males and females of all populations as a barrier to aviation career selection in this study.

4.4.2 Technical School Bias

Central to the research study was an evaluation of the preparedness of aviation maintenance and technical programs to foster the recruitment, retention, and placement of women and minorities in aviation maintenance professions. Also of concern was the ability of technical programs to promote a learning environment where bias and discrimination against members of these populations was minimized.

4.4.2.1 Recruitment and Retention

Several previous research studies have indicated an imperative for informational and recruitment strategies in order to encourage more women and minorities to pursue aviation careers (Eiff et al., 1986; Rodriguez, 1986; Eiff, 1991). FAA certified mechanics schools were questioned in an effort to determine their level of involvement in recruitment and retention efforts. As show in Figure 4.5, only about one- third (34.6%) of the schools questioned had recruitment programs of any type. Of the schools with recruitment programs, the vast majority (65.4%) of the programs consisted of a broad-based strategy aimed at encouraging both women and minorities to pursue aviation maintenance careers. Approximately a quarter (26.9%) of the schools with recruitment programs had strategies structured primarily for recruiting women. Only 7.7% of the programs were exclusively aimed at minority populations other than women.

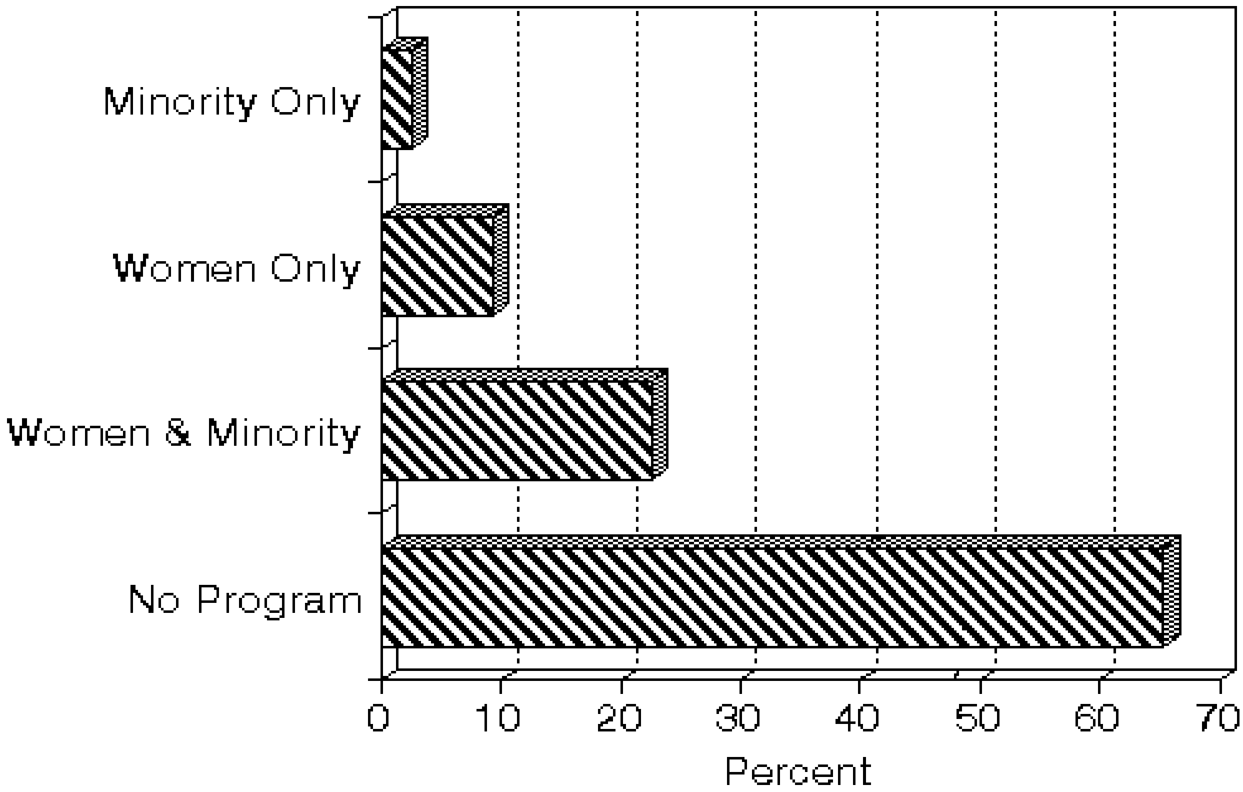

Figure 4.5 Schools with Recruitment Programs (by type of program)

A principle concern of the research team was that many FAA certified Mechanic Schools may present a hostile learning environment for female and/or minority students. Attitudinal concerns include perceptions of school administrators and faculty concerning the potential success of minority and female students. Environmental concerns centered around possible race- and gender-bias of textbooks, instructional bias, institutional barriers, discriminatory materials and language, and the generalized lack of support to remediate skill, tool familiarity, and knowledge requisite expectations.

School officials and faculty were questioned to determine their perception of the likelihood for successful completion of aviation technical training programs by women and minority students. Seventy-six (76) FAA Part 147 certified Mechanic Schools were questioned to determine the representation of women and minorities in their student population (Figure 4.6). Results indicated that minority students represented 24.9% of the aggregate student body, while women constituted only 3.4% of the total number of students enrolled in aviation maintenance career preparation.

Figure 4.6 Make-up of Student Body (in FAA-approved mechanic schools)

When asked to predict the average success rate for their women and minority students, school officials and faculty in these programs reported widely different completion rates. As an aggregate, the schools felt that women and minority students were about equally likely to succeed in maintenance training programs. On the average, they felt that 77.3% of the minority students would complete their training. Women were thought to be successful 78.6% of the time.

These same schools were asked to report the number of students who graduated from their schools in 1992 and to project the number of 1993 graduates. Of the 5,783 students graduated from these schools in 1992, 570 (9.9%) were minority students and 200 (3.4%) were female students. The predicted number of students to graduate in 1993 was 5,394. Of these, 667 (12.4%) were minority students and 454 (8.4%) were women. On close examination, these figures constitute a paradox. While school officials and faculty predict that women and minority students possess an equal probability of success from their programs, in actuality, this equality is not evident in completion rates.

If the reported population representations are compared with the 1992 graduation statistics, we note some interesting relationships. In the case of minority students, only 40% of the students graduated. Women, on the other hand, graduated in the same proportion as their representation in the population. Predictions for the 1993 graduation of these populations suggest that school officials predict that women and minorities will have twice the representation in the graduating class as they did during the previous year.

While these statistics could be attributable to specific class representation anomalies, they could also indicate subtle bias on the part of school officials and faculty at aviation technical schools. The 1992 graduation statistics and predicted success for women in 1993 suggests that perhaps women are more successful than these school representatives perceive. This could indicate a subliminal belief by school officials and faculty that women will not be successful in aviation maintenance careers and training. A similar evaluation of the statistics for minority populations suggests that perhaps these same officials are overly optimistic about their success rate.

It is interesting to note that some of the schools studied predicted completion rates as low as 20% for female students. The lowest predicted completion rate for other minority students was only 33%. In 20.7% of the reporting schools, the same school reported that the success rate for females was much lower than for minorities. In several cases, the difference between completion rates for the two populations was predicted to be as great as 50% and 70%. On the average, these schools indicated that women were 28% less likely to complete the program than their minority male peers. These predictions do not seem to be supported by the graduation statistics. This difference may indicate bias against female students participating in these particular training programs because school officials and faculty believe that women are not successful in aviation maintenance training.

With the perception that women and minorities are less successful than white male students in aviation maintenance training programs, one would think that the schools would establish strong programs designed to promote retention of these populations. To identify the level of support offered by certified mechanic schools for female and minority students, reporting schools were asked if they had special retention programs for students. Only one-third of the schools had any retention program at all. Of those schools with programs, 72% were generic programs designed for all populations including, both female and minority students (see Figure 4.7). Of the reported retention programs 22% were structured to address the specific needs of minority populations. Only 16% of the schools with programs (5% of the reporting school aggregate) had special retention programs designed especially for female students' needs. Thus, the researchers conclude that little is being done to meet the specific retention needs of women and minority students in aviation maintenance training.

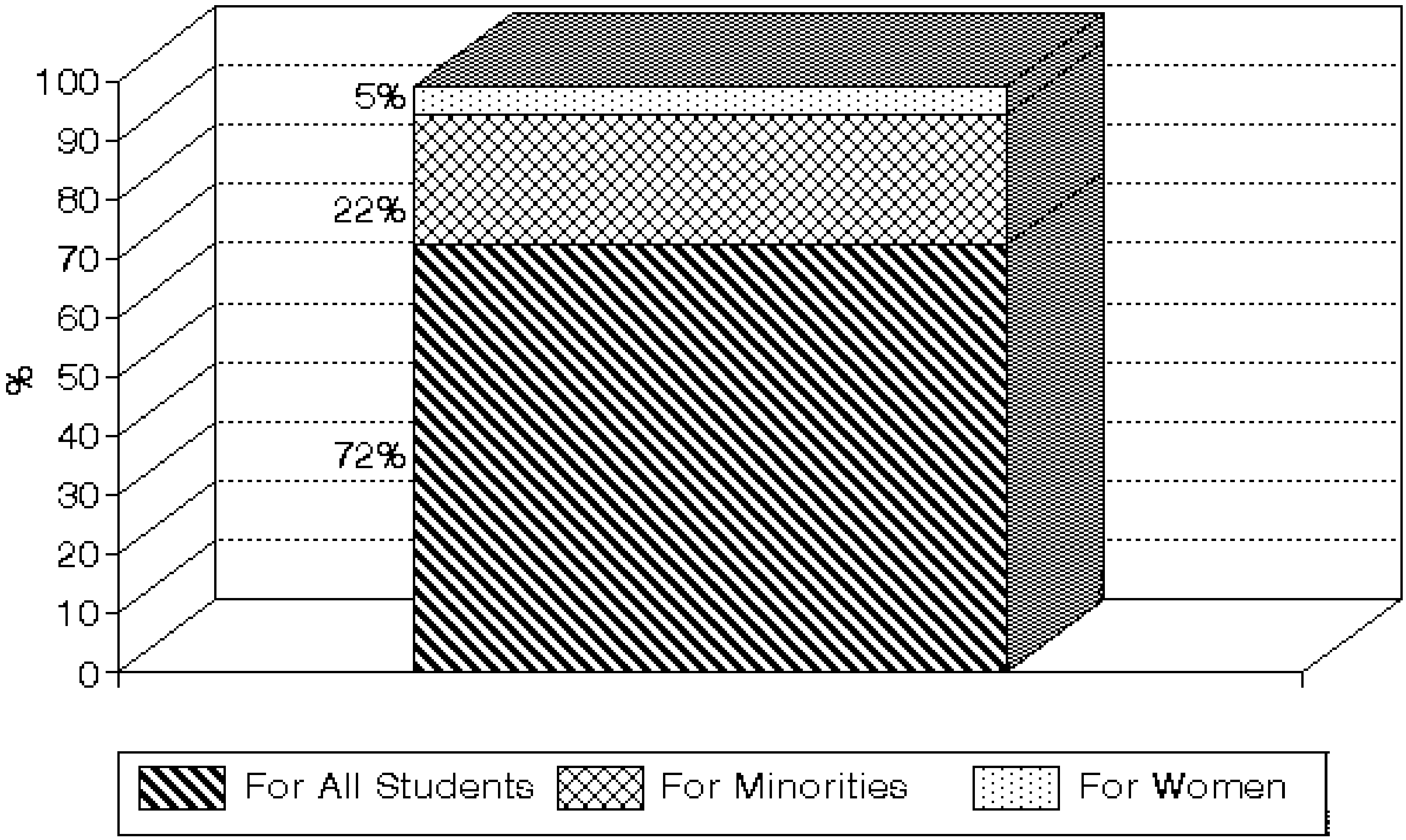

Figure 4.7 Type of Student Retention Programs

4.4.2.2 Learning Environment

School site visitations by researchers identified what appeared to be a genuine interest by school officials and most faculty in providing a bias- and discrimination-free environment for female and minority learners. However, while many of the most blatant and overt forms of bias and discrimination were not evident in the vast majority of schools visited, the researchers identified many subliminal and covert barriers to learning.

A review of the most popular aviation maintenance textbooks demonstrated that little has been done to project a race- or gender-fair image of aviation maintenance professionals. Pictures almost always depict white male maintenance professionals. Even line drawings and "stick people" project a male persona. Much of the textbook material reflects material used in older military manuals. Little has been done by current authors and publishers to remove the strong male engenderment of this material.

The proliferation of male attributes throughout aviation literature, communications, and terminology has a dramatic impact on women aspiring to aviation careers. These terms are so entrenched in the aviation environment that it becomes difficult, if not impossible, to communicate without being bombarded by gender specific terms, including the use of gender-specific terminology by governmental agencies. Most significant among these influences is the gender specific terminology used in the Federal Aviation Regulations (FARs). Terms such as "repairman" project to women aspiring to these positions that they are outsiders, anomalies, or aberrations. The FAA is slowly rectifying these deficiencies which will have a lasting effect on improving the equity in the AMT industry. We applaud these efforts.

Historically, aviation environments have been inundated with pictures, posters, calendars, and cartoons with ethnic, racial, and sexual overtones. This discriminatory and harassing material was offensive and detrimental to members of these populations who worked in such environments. The diversification of the aviation work force coupled with the enactment of legislation and fear of litigation has precipitated the general elimination of much of this material. Researchers engaged in school site visitations were especially vigilant in seeking materials which might be offensive to minority and female students. While material which might be perceived as demeaning or offensive to minority populations was not evident in any school visited, many had sexually suggestive or degrading materials. Most of these materials were tool or parts suppliers' advertising posters or calendars. While these materials were not nearly as suggestive or offensive as material common throughout the environment a decade ago, the message was still very clear.

Some specific examples include the following. A postcard with a woman sun bathing topless was taped to the wall above the desk of the faculty member responsible for the development and retention programs for female students in an aviation maintenance technology program. Another school's flight maintenance department had two posters mounted in the work area which depicted women clad in small bikini swimwear holding the advertiser's tools. At another school, a toolbox sported the large poster for an aircraft parts distributor which showed a woman "mechanic" in front of what appears to be her toolbox holding a wrench. This could have been a positive image of a woman aviation professional except that the woman was wearing a small bikini nightgown. Such portrayal of women undermines the perception of women as maintenance professionals and reinforces their perception as sexual objects. Objectionable material leaves many women wondering if they will be respected and accepted should they select aviation maintenance careers. Each of these examples depicts a demeaning attitude toward females in aviation maintenance and is likely to have a negative effect on self perception and esteem of female students.

Researchers were also cognizant of institutional barriers impeding the success of minorities and women in maintenance career preparation. The facilities of most visited schools were not adequate for female students. Inequality of facilities, especially the lack of adequate restroom facilities, was evident at all of the schools. Many schools were trying to cope with their changing student populations, but their attempts have, in most cases, fallen short.

For example, one of the schools visited has been training aircraft mechanics for over 25 years and is a well-respected technical program associated with a major university. An evaluation of the building's restroom facilities for students found that the main "men's" restroom had 2 showers, 35 lockers for students to store a change of clothes or tools in, 15 urinals and stalls, and 5 sinks with heavy-duty, mechanic's hand cleaner dispensers. The women's restroom had one stall, one sink, and no lockers, shower, or hand cleaner dispensers. These differences send the message that women are not expected to be at this school as aircraft maintenance personnel who use tools or get dirty hands.

4.4.2.3 Classroom Interactions

During site visitation, researchers observed classroom and laboratory instructional sessions whenever possible. The researchers sought to evaluate the content and presentation methodology for biases, discrimination, or disparity in learning activities for affected populations. While the researchers found little in the form of open discrimination or bias, a strong subliminal bias and disparity of educational treatment was noted for both minority and women students.

Aviation educators may not realize that despite their best intentions, not all students are receiving equal instruction in their classrooms. There is considerable research supporting the contention that teachers may unconsciously display behavior limiting the nontraditional students. This may be even more likely to occur where the instructor has generally worked with traditional (white male) students. When this trained cultural influence colors teacher attitudes toward students, then teacher expectation begins to mold student behavior to fit the expectation (Sadker & Sadker, 1982).

Gender bias manifests itself in unintentional differential treatment of students based on teacher expectation. It is important to note that differences in teacher interactions toward students based on their gender was found by the Klein (1985) study to occur in both male and female teachers, regardless of their race, at all levels of education from kindergarten through college instruction. Site visits indicated a strong, verbalized support from teachers to the researchers for the minority and female student, but closer observation proved that the these students received little teacher attention. They were often found working alone, not interacting with the teacher or other students. According to a recent report from the American Association of University Women (AAUW, 1992), researchers report that females receive significantly less attention from classroom teachers than do males, and African American females have fewer interactions with teachers than do white females. Teachers also were reported to call on male students in class eight times as often as on female students. And, according to Sadker (1986), when the males talk, teachers listen. Clearly, at visited sites, the males were doing the talking both with the teacher and with each other.

The kinds of tasks and groupings teachers assigned are often based on stereotyped notions about appropriate female and male behavior. Therefore, males are asked to perform more strenuous or mechanical tasks while females are asked to do simpler tasks involving cleaning up or note taking. A study of science classes found that when teachers needed assistance in carrying out a demonstration, 79% of the demonstrations were carried out by male students (Tobin & Garnett, 1987). Similarly, at visited sites, the researchers noted that the male students appeared to be completing teacher-requested tasks during open lab times. The female students, on the other hand, appeared to be relegated to observation, note taking, or clean-up chores and not included in the maintenance-related laboratory tasks under consideration.

A possible cause for disparity of educational treatment among white, minority, and female students may be a generalized lack of awareness on the part of the instructional staff that such differences are occurring. This could be due, in part, to the fact that few of the instructors in aviation maintenance training programs have formal training in the educational process. Unfamiliarity with the precepts of educational psychology and instructional methodologies may leave well-intentioned instructors with the feeling that they are treating all students equally while, in fact, they are discriminating against some populations.

Few of the schools examined require their instructors to be well-versed in the foundations of the learning process. In fact, 36% of the schools reported that they had no requirement for faculty to have any formal education or degree at all (Figure 4.8). A few schools (6%) required a local or state vocational teaching certificate but no college education. About a quarter of the schools (26%) required prospective instructors to have an Associate Degree in any discipline. An additional 25% of the schools indicated that they require a Bachelors Degree. Only 7% of the schools require a Masters Degree. In each case, the degree could be in any discipline. None of the schools reported that they required training beyond a Masters Degree or that the degrees earned must be in an educational discipline.

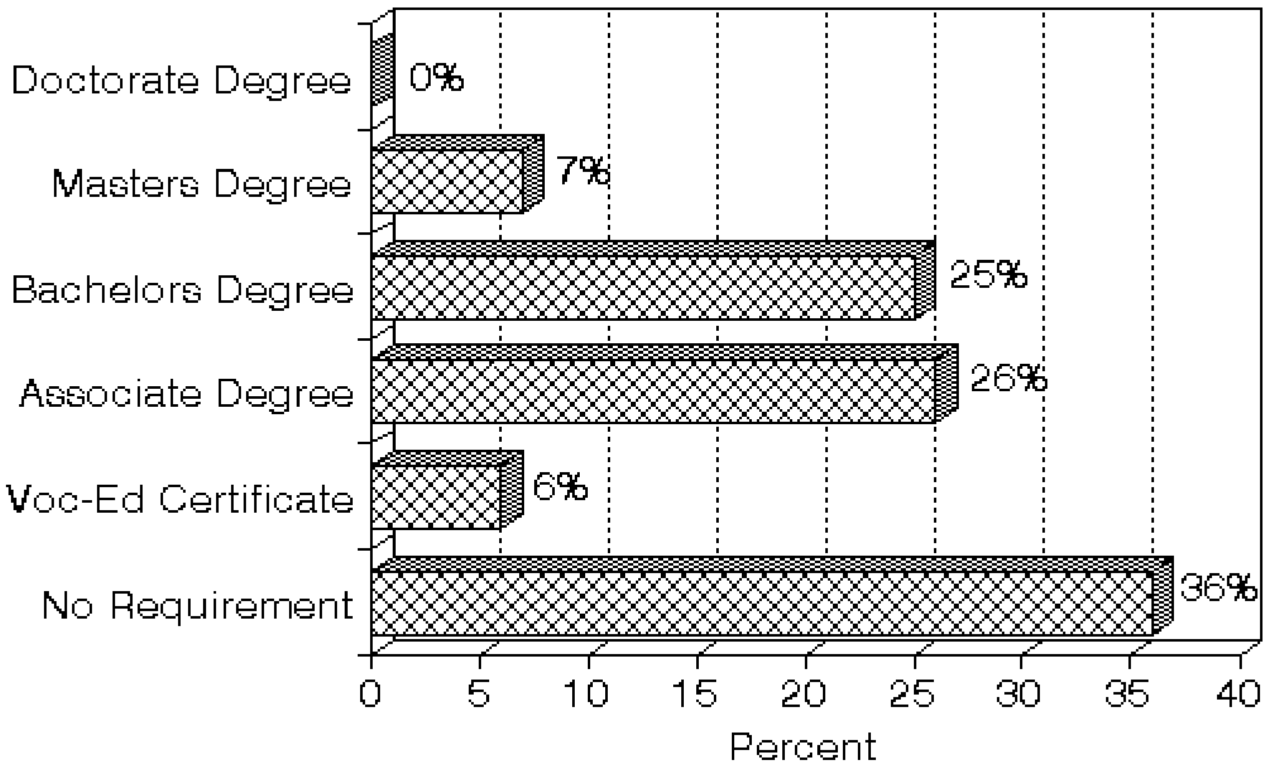

Figure 4.8 Formal Education Requirements for Instructional Staff at A&P Schools

The research team was also interested in the level of representation of minorities and women on school faculty. Research in related nontraditional career fields suggests that gender and race "role models" are very important for recruiting and retaining nontraditional students. The schools in this study were asked how many of their A&P certified faculty were women and minorities. The schools employed a total of 759 A&P certified instructors. As shown in Figure 4.9, 66 were minorities (8.6%) and 14 were females (1.8%). Close examination of the data revealed that female faculty had been on the job for an average of only 3.8 years. Obviously, recruitment of women for faculty positions is a relatively new concept. In fact, of the 14 female faculty reported to be on the instructional staff of these schools, 12 had been on the job for 5 years or less.

Figure 4.9 Composition of A&P Faculty (at FAA-approved mechanic schools)

The research literature strongly suggests that role models among the faculty of nontraditional programs greatly enhances both the recruitment and the retention of underrepresented students in such programs (Eliason, 1981). For this reason, schools should recruit as many minorities and women into faculty positions as possible. As a facet of the research project, 214 active aviation mechanics working in aviation maintenance fields were questioned to explore the availability of women with the educational and work experience requirements necessary to qualify as instructional faculty in maintenance training programs. Of the female mechanics who responded to the study, 68.8% responded that their highest level of educational preparation was a high school certificate. An additional 25% of the female respondents indicated that they had attained a college Associate Degree. Only 6.3% of the working female mechanics and supervisors indicated that they had achieved a Bachelors Degree in a college program. None of the respondents indicated education beyond a Bachelors Degree.

The limited educational backgrounds of working minority and female mechanics has the potential to severely limit their qualification to serve as faculty in many schools. When schools were asked if they were willing to "waive or defer" some educational requirements for otherwise qualified female or minority faculty candidates, 22.7% of the schools reported that they would consider such a waiver or deferment.

Although the literature indicated that faculty and minority role models increased nontraditional students' recruitment and retention, the question remained as to whether or not this would be true of aviation maintenance nontraditional students. The representation of minorities in aviation maintenance training programs seemed little affected by the presence of minority faculty. The average number of minority students in aviation maintenance training for all of the schools sampled was 39.4 students per school. For schools with minority instructors, the average number of students was 39.8 per school. This lack of correlation among student representation and the presence of an instructor role model did not hold true for females, however. For the schools sampled in this study, the presence of a female instructor seemed to have a dramatic effect on the participation rates of female students. Viewing the aggregate school sample, the average number of female students participating in aviation maintenance career preparation was 5.4 females per school. When compared to the average number of female students in schools with female faculty, the contrast was dramatic. Schools with female faculty averaged 13 female students per school, more than twice the average for schools with no female faculty. Though not conclusive, these figures strongly suggest that the presence of female faculty increases participation by women interested in pursuing an aviation maintenance career.

Work place role models are also very beneficial in encouraging nontraditional students to pursue under-represented careers. Many schools have promoted or established close working relationships with industry which may include work experience or cooperative education opportunities for students. The schools were asked if their students had an opportunity to participate in work experience or cooperative education programs as a part of their educational experience. About one third (34%) of the schools reported that students in their programs have opportunities to participate in work experience or cooperative education programs with aviation industries. Of those schools reporting such opportunities, only 19% reported making any attempt to place the students in a work environment with appropriate race and gender role models. As a result, few nontraditional students have the opportunity to experience same-race or same- gender mentors as they prepare for their chosen career.

Finally, national research on educational environments has reported that incidents of males sexually harassing females in schools are increasing at a high rate. One study by Kane and Frazee (1989) found that 65 percent of female high school students in nontraditional courses reported harassment by male classmates and by some teachers. Researchers found no evidence of sexual harassment during site visits. However, candid discussions with female graduates of aviation maintenance programs disclosed several instances of peer and instructor harassment. It is important to remember that despite its frequency, sexual harassment is rarely reported, tallied, investigated, or systematically documented (AAUW Report, 1992).

4.4.3 Work Place Barriers

Key to retaining women and minorities in the aviation maintenance work place is determining what barriers might deter these populations from completing training or remaining in an aviation career. A survey instrument was developed and distributed by a U.S. air carrier and the International Association of Machinists; the research team provided assistance in analyzing the results of the survey. The focus of the instrument was to determine the perceptions of AMTs concerning various possible barriers to successful employment as aircraft technicians.

The barriers were categorized as economic, physical, social, emotional, life experience/education, and work-related. Respondents were asked to describe the degree to which the items listed in each category were perceived to be a barrier for women and minorities seeking training or employment as AMTs. Barriers were assigned a value of 5 for "a high degree;" 4, "some degree;" 3, "undecided;" 2, "a small degree;" and 1, "not to any degree." In all, 65 barriers were listed for evaluation with a space for optional comments. The barriers were selected based on their identification by other researchers conducting studies with nontraditional workers (*No way out*, l989; Cho, l983; Stitt & Stitt, l990; Deaux et al., l984).

A total of 242 aircraft maintenance employees responded to the survey. Analyses of the data were done by race and by sex. Some of the respondents did not complete all parts of the survey; therefore, there were missing data in the analyses.

Of the total sample, listed in alphabetical order there were 13 (5.4%) Asian, 27 (11.2%) Black, 165 (68.2%) Caucasian, 10 (4.1%) Hispanic, 11 (4.5%) Other. Sixteen (6.6%) did not identify their race. Of the total sample, 20 (8.3%) respondents identified themselves as Female, 216 (89.3%) as Male, and 6 (2.5%) did not identify their gender. The majority of the respondents were male Caucasians. Females constituted less than 10 percent of the total sample. Although the majority of respondents were Caucasian males, their responses were important because they were asked for **their perceptions of possible barriers to women and minorities pursuing AMT training or employment**. This permitted comparison of what Caucasian males perceive to be barriers with what women and minorities perceive as barriers.

The factors used as dependent variables in the analyses were Economic Barriers, Physical Barriers, Social Barriers, Emotional Barriers, Life Experience/Education Barriers, and Work-Related Barriers. Race and sex were the only independent variables analyzed.

Table 4.3 and Figure 4.10 show the average responses by race for each of the six categories of barriers. The higher the score, the more often employees of that race identified the items in that category as significant barriers to training or employment as aircraft maintenance employees.

Table 4.3 Average Response for Each Barrier Category by Race

Category	Asian	Black	Caucasian	Hispanic	Other
Economic	2.60	2.51	2.51	3.05	2.27
Physical	2.06	1.62	2.18	2.42	2.07
Social	1.87	2.50	2.09	2.37	2.06
Emotional	1.89	2.38	2.19	2.46	2.28
Life Exp./ Education	1.65	2.45	2.40	2.77	2.11
Work-Related	2.31	2.83	2.80	3.24	2.44

Table 4.3 Average Response for Each Barrier Category by Race

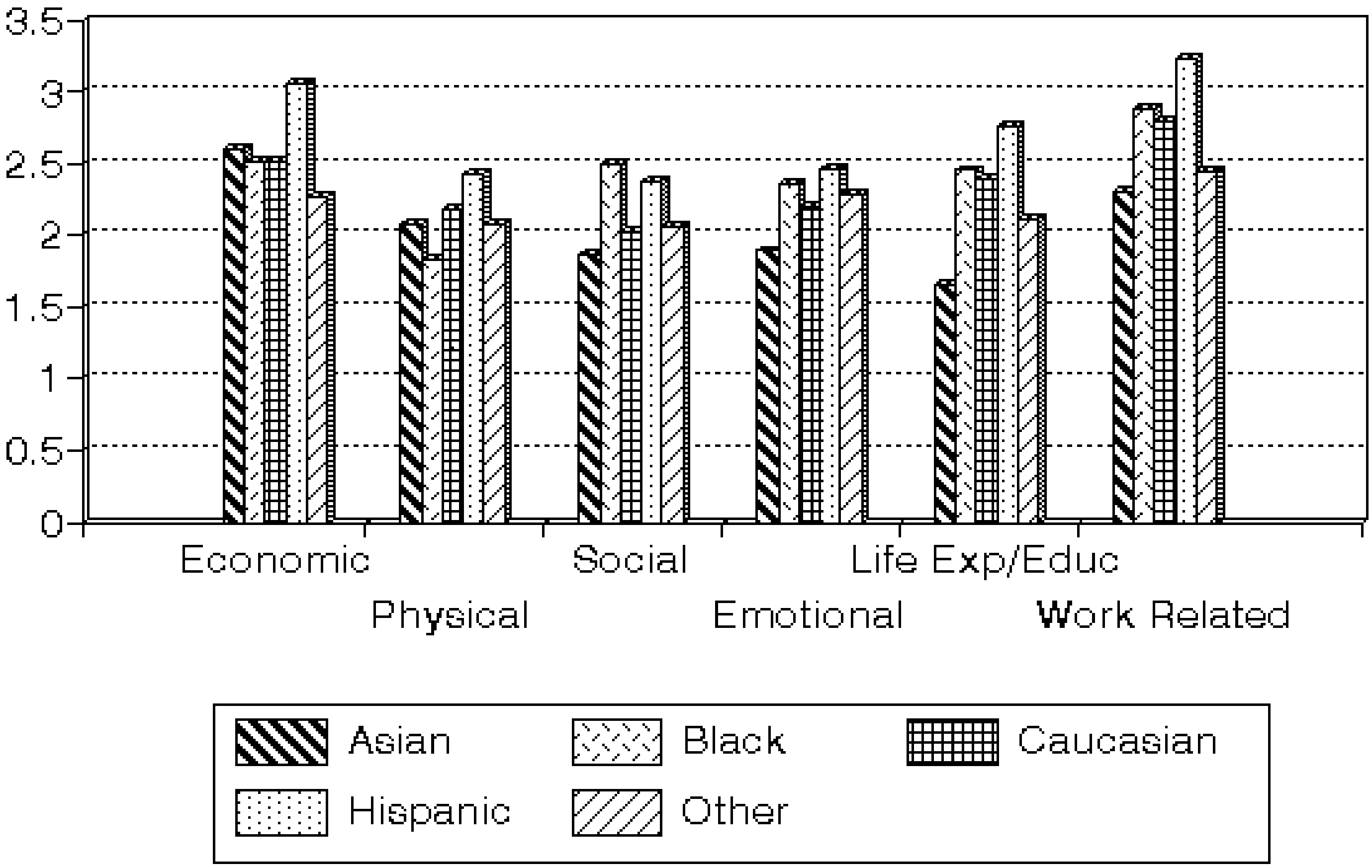

Figure 4.10 Response for Barrier Categories by Respondent's Race

It is important to note that respondents were asked to identify items that are possible barriers to minorities. Therefore, the Caucasian responses were reports of their perception of barriers for minorities, not for themselves. The Hispanic race scores were the highest in each category of barrier items. These respondents indicated that they perceive barriers in every category except Social more frequently than Asian, Black, or Caucasian races. The categories with the highest scores by the Black respondents were Economic, Social, and Work-Related Barriers. The Black race response to Social Barriers was the only score higher than the Hispanic race response. The category with the highest score by the Asian respondents was Economic Barriers. Black, Caucasian and Hispanic respondents saw Life Experience/Education Barriers more frequently than Asian respondents.

Similarly, Table 4.4 and Figure 4.11 give the response among male and female aircraft maintenance employees on the six categories of barriers. The scores displayed in the table indicates by category the frequency that items in that category were perceived as significant barriers.

Table 4.4 Average Response for Each Category by Gender

Category	Females	Males
Economic	2.40	2.50
Physical	1.90	2.15
Social	2.40	2.07
Emotional	2.20	2.18
Life Experience/ Education	2.50	2.35
Work- Related	2.28	2.70

Table 4.4 Average Response for Each Category by Gender

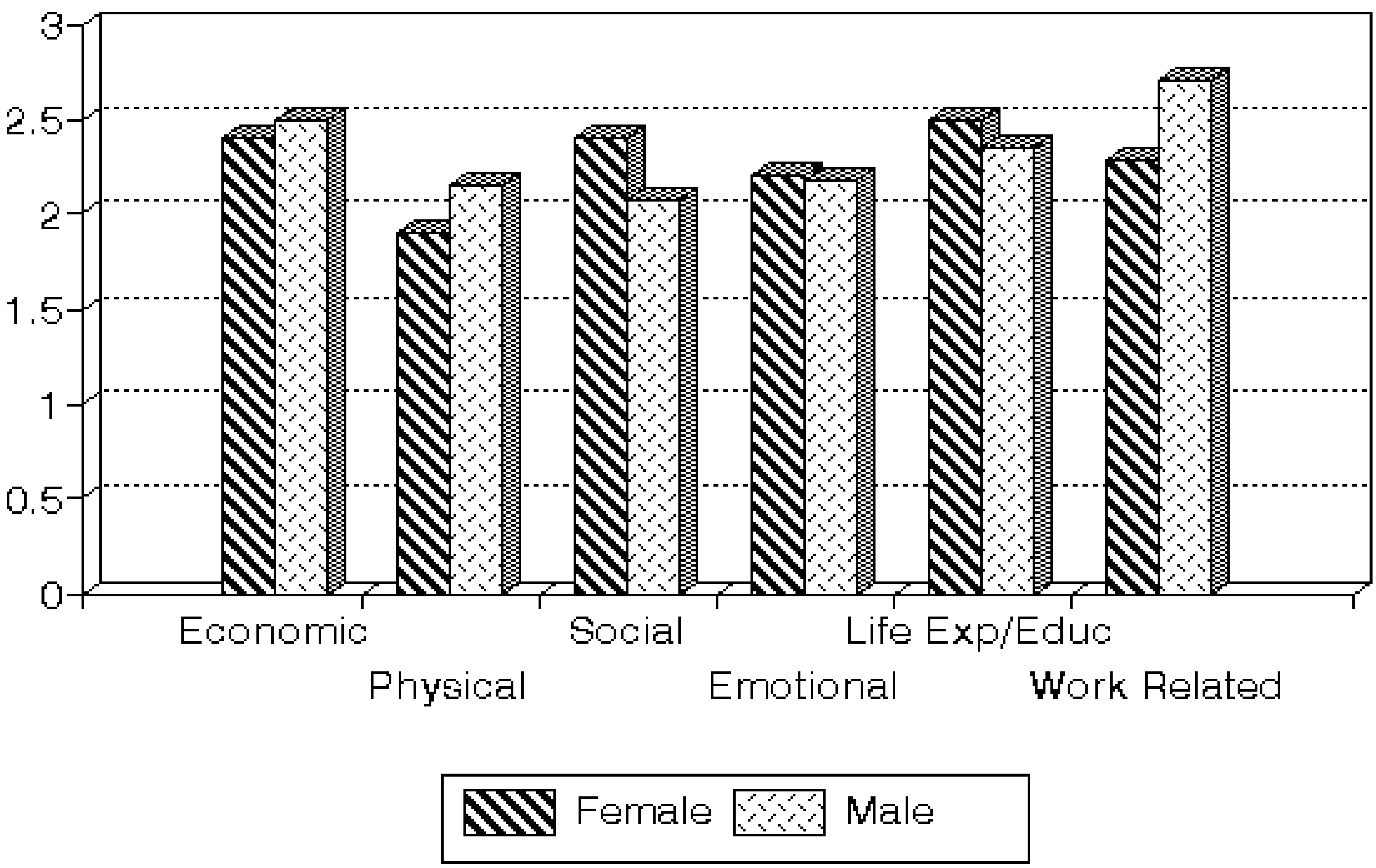

Figure 4.11 Response for Barrier Categories by Respondent's Gender

Work-Related Barriers were identified with the highest frequency by males as possible barriers to females. This category also had the greatest difference in frequency between male and female respondents. In other words, females disagree with males more frequently concerning this barrier. Economic Barriers were frequently identified by both males and females. Equally significant by females were Social Barriers and Life Experience/Education Barriers. Physical Barriers were identified by females least frequently.

Analysis of Variance (ANOVA) were carried out to determine if there were differences by race and gender on the various factors (Economic Barriers, Physical Barriers, Social Barriers, Emotional Barriers, Life Experience/ Education Barriers and Work Related Barriers). The results of the analysis showed significant differences by both race and gender at the .05 level of significance. However, there was only one category of barriers identified as significant for race and one category for gender. The Life Experience/ Education category was identified as significantly different (.02) by race. In other words, there were significantly different responses among races in their perceptions of Life Experience/Education Barriers for females pursuing an AMT career. This category of barriers included the following items among others:

Know nontraditional employees

Concern about level of verbal and writing skills

Concern about level of math and technical skills

Familiarity with tools

Solid level of self-confidence

Time and stress management skills.

Work-Related Barriers was the only category identified as significantly different (.02) by gender. Female respondents differed in their perceptions of work-related barriers from male respondents. This indicates that males perceive more barriers than females did for females pursuing AMT careers. This category of barriers included the following items among others:

Concern about getting a job

Concern about keeping a job

Concern about moving up on the job

Travel requirements

Concern about working outside in inclement weather

Dislike for late shift work schedule.

The level of significance was set at an Alpha of .10 for the remainder of the analysis. An Alpha of .10 (rather than .05) is commonly preferred when there is no control group in the study. It should be noted that at a significance level of .05 there were only minimal differences by gender and race.

The results of the analyses showed that there were differences among the races on Social Barriers, Life Experience/Education Barriers and Work Related Barriers. Table 4.5 shows the average response among the different races to the individual items in the Social Barriers category.

Table 4.5 Individual Item Response of Social Barriers by Race

	Caucasian	Black	Hispanic	Asian	Other
Communicating with peers of the opposite sex or other race or culture.	2.1	2.3	2.5	1.5	2.5
Cooperating with peers of the same sex, race or culture.	1.9	2.0	2.1	1.7	1.8
Being the only person of your race or sex in a work team.	2.0	2.6	2.3	1.5	1.8
Hazing or being teased by peers.	1.9	2.1	1.6	1.5	2.4
Availability to socialize with peers and feeling accepted socially by peers.	2.0	2.4	2.5	2.0	1.7
Being accepted by and feeling a part of the work team.	2.3	3.0	2.9	2.2	1.7
Sex or race discrimination in training or on the job.	2.1	3.3	2.7	2.7	2.5

Table 4.5 Individual Item Response of Social Barriers by Race

The barrier items listed in Table 4.5 were significant in the ANOVA analysis. The specific Social Barrier items that received the most frequent identification as possible barriers to training or employment were:

Being the only person of your race or sex in a work team

Being accepted by and feeling a part of the work team

Sex or race discrimination in training or on the job.

The Black and Hispanic races reported the highest number of responses in these items. The Asian race responded with a high frequency (2.7) on only the item involving discrimination.

Table 4.6 shows the average response to individual items in the Life Experience/Education Barriers category.

Table 4.6 Individual Item Response of Life Experience/Education Barriers by Race

	Caucasian	Black	Hispanic	Asian	Other
Know people who are in nontraditional jobs.	1.9	2.3	3.3	1.7	1.8
Concern about level of verbal and writing skills.	2.4	2.4	2.4	1.9	2.0
Concern about level of math and technical skills.	2.6	2.5	2.8	1.8	2.3
Familiarity with tools.	2.5	2.4	2.9	1.5	2.2
Solid level of self-confidence.	2.6	2.3	3.1	2.0	2.0
Played with kids of opposite sex as a child.	1.7	2.1	2.0	1.2	1.4
Familiarity with the aircraft maintenance occupation.	2.6	2.6	3.3	1.5	2.0
Time and stress management skills.	2.5	2.7	3.4	1.8	2.8
Physical health.	2.8	2.3	3.2	1.7	2.7
Personal contacts (important contacts in the field).	2.4	2.8	2.7	1.7	2.5
Knowledge of job openings and fringe benefits.	2.9	2.9	3.0	2.0	2.4
Family or friends employed in aviation industry.	2.1	2.2	2.2	1.4	1.6
Jobs in aircraft maintenance require a good understanding of math and science.	2.9	2.7	2.6	1.8	2.5
Had a same-sex or same-race role model.	1.8	2.4	2.1	1.4	1.6

Table 4.6 Individual Item Response of Life Experience/Education Barriers by Race

There was agreement among the Caucasian, Black, and Hispanic respondents that knowledge of job openings and fringe benefits was perceived as a possible barrier to minorities. The frequency of response was consistent (2.9, 2.9, 3.0). Asian respondents did not identify that item with as much frequency (2.0). Both Black and Hispanic respondents identified personal contacts as a possible barrier with scores of 2.8 and 2.7. However, there were no other items where there was agreement among the respondents by race as to the level of significance of a barrier item. The most obvious information to draw from this table is the high number of items that were identified as possible barriers by Hispanic respondents. These items were:

Know people who are in nontraditional jobs **(3.3)**

Concern about level of math and technical skills **(2.8)**

Familiarity with tools **(2.9)**

Solid level of self-confidence **(3.1)**

Familiarity with the aircraft maintenance occupation **(3.3)**

Time and stress management skills **(3.4)**

Physical health **(3.2)**

Personal contacts (important contacts in the field) **(2.7)**

Knowledge of job openings and fringe benefits **(3.0)**.

Table 4.7 shows the average response to individual items in the category Work Related Barriers.

Table 4.7 Individual Item Response of Work-Related Barriers by Race

Category Item	Caucasian	Black	Hispanic	Asian	Other
Concern about getting a job.	3.4	2.7	3.8	2.5	2.6
Concern about keeping a job.	3.5	2.5	3.9	2.1	3.4
Concern about moving up on the job.	2.9	3.3	3.4	2.6	2.5
Travel requirements.	2.4	2.3	3.0	2.3	2.1
Concern about effort required to succeed in a nontraditional career.	2.3	2.3	3.1	2.3	2.4
Concern that most new labor force entrants will be nontraditional.	2.3	2.1	3.1	1.7	2.3
Concern about working outside or in a hangar or in inclement weather.	2.4	2.7	2.9	1.9	2.0
Dislike for late shift work.	3.3	3.0	2.7	3.0	3.3

Table 4.7 Individual Item Response of Work-Related Barriers by Race

The Asian respondents identified the items less frequently than any other race including Caucasian. There was general agreement among the races as to a dislike for late shift work schedules and its potential as a possible barrier. Again, the noticeable information is the high level of frequency by the Hispanic respondents to many of the items. Those items were:

Concern about getting a job **(3.8)**

Concern about keeping a job **(3.9)**

Concern about moving up on the job **(3.4)**

Travel Requirements **(3.0)**

Concern about more effort required to succeed in a nontraditional career **(3.1)**

Concern that most new labor force entrants will be nontraditional **(3.1)**

The results of the ANOVA indicated that there were significant differences among the sexes on Work Related Barriers only. Table 4.8 gives the average responses by sex to the individual items in the category Work Related Barriers.

Table 4.8 Individual Item response of Work Related Barriers by Sex

	Female	Male
Concern about getting a job.	2.6	3.3
Concern about keeping a job.	2.6	3.3
Concern about moving up on the job.	2.6	2.9
Travel requirements.	2.6	2.9
Concern about more effort required to succeed in a nontraditional career.	2.5	2.3
Concern that most new labor force entrants will be nontraditional.	1.7	2.3
Concern about working outside or in a hangar or in inclement weather.	2.1	2.5
Dislike of late shift work schedule.	2.7	3.3

Table 4.8 Individual Item Response of Work Related Barriers by Sex

Males and females in this study did not agree on the significance of Work-Related Barriers for females and minorities. In fact, males identified every Work-Related Barrier item as more likely to be a barrier than did females with the exception of one item: Concern about more effort required to succeed in a nontraditional career.

It is important to note that males were not responding to items they found to be barriers for themselves. Rather, they were identifying items they thought to be barriers for females. In other words, males find these items to be barriers for females, but females say they are not barriers. The only item agreed upon as a barrier was concern about more effort required to succeed in a nontraditional career.

There were some items that crossed several barrier categories which women consistently identified as possible barriers that were not identified by men. These items are also consistently identified by females in other nontraditional careers as barriers. Those items are listed below:

Expense of child care **(2.85)**

Communicating with peers of the opposite sex **(2.55)**

Being the only one like me on the work team **(2.80)**

Sex and/or race discrimination **(2.90)**

Need to prove self **(3.0)**

Biased language, jokes, pictures **(2.35)**

Concern about being accepted by management **(2.50)**

Stress/time management **(3.05)**

Personal contacts in the field **(3.15)**

Knowledge of job openings and fringe benefits **(3.30).**

With the exception of the figures reported in these tables, aviation maintenance personnel do not differ significantly in how they perceive barriers to the training and employment of women and minorities as aviation maintenance technicians. However, the barrier categories and items that were reported in the tables provide information that can be helpful in removing these barriers.

The aviation maintenance industry in its determination to more evenly balance the work force by race and gender has endeavored to seek out possible barriers to training and employment for women and minorities. This study has shown that while women and minorities perceive some barriers, there exists no long list of barriers. Certainly, barriers alone are not enough to be the total cause of the disparity in the numbers of women and minorities in the AMT work place.

Hispanic and Black races perceived the greatest number of barriers to employment and training. Hispanics perceived barriers in all categories, and Blacks perceived Work-Related Barriers most significant for their race. There is also general agreement by Caucasians that these barriers may exist for these specified populations. Asians perceive few barriers as compared to the other races; however, Economic Barriers were most often identified as possible barriers for this population.

Females identified Life Experience/Education Barriers most often as the most problematic category of barriers. Men identified Work-Related Barriers most often as barriers for females in aviation. It is important to note that contrary to stereotypical perceptions, women do not perceive Physical Barriers as frequently as any of the other barrier categories.

The results of the ANOVA indicated there were significant differences among the races on Social Barriers, Life Experience/Education Barriers, and Work-Related Barriers. Blacks and Hispanics identified the most Social Barriers. Hispanics identified the most items in the Work-Related category. The results of the ANOVA indicated significant differences by sex on Work-Related Barriers only. In general, males perceive nearly all Work-Related Barrier items as possible barriers for females.

Of course, the aviation industry cannot be held responsible for all the barriers perceived to be significant for women and minorities. Our society as a whole must bear some of the burden for the Social Barriers perceived by women and minorities. Our families and educational systems must assume responsibility for the entrenchment of many of the Life Experience/Education Barriers.

The aviation industry is to be applauded for the steps it has already taken to encourage social and educational change to eliminate many of these barriers. It is also to be encouraged and supported in its continuing efforts to look into the possibility of reducing the remaining Work-Related Barriers.

Some specific recommendations for reducing barriers for women and minorities include:

1. Conduct workshops or training seminars for all employees in team building, communication skills, time and stress management, and sexual harassment issues - particularly language, jokes, pictures, and discrimination.
2. Provide a more accessible or directed method for informing employees about in-house job openings and fringe benefits.
3. Conduct workshops or training seminars in job-seeking and job-keeping skill development.

4. Alert employees that there may be differences in perceptions about barriers and encourage open discussion of solutions to possible barriers.

5. Provide all supervisory personnel with the findings of this study and provide the avenue for them to participate fully in workshops and training seminars on the above topics.

The aviation industry is recognized for its determination to eliminate any remaining barriers to increase the representation of women and minorities in aviation careers.

4.5 CHANGES IN REPRESENTATION

While parity of representation has not been established in most career fields, significant gains in the representation of women and minorities in many underrepresented aviation careers have been realized (Eiff et al., 1986). Most underrepresented minority populations have made dramatic gains in numbers from those of a decade ago. While no historical data exist on the levels of representation of minority populations, it is generally agreed that few members of these populations were included in the aviation maintenance work force as recently as two decades ago. By contrast, the FAA has compiled data on the representation of women in the maintenance field for several decades.

Although no official data exist, either historic or current, on the representation of minorities in the aviation work place, it is generally agreed that their numbers were very low two decades ago, but the level of representation for all minority populations has grown appreciably during the intervening years. While it is difficult to determine the exact representation of these populations in the current work place, the current study gives evidence that significant changes have occurred and that representation levels are dramatically improved. As nearly as can be determined, the current work force of aviation maintenance professionals in airline careers is comprised of approximately 11% Hispanic, 12% Asian, and 20% Black workers.

The representation of women, on the other hand, remains quite low. Current estimates place their representation at approximately 2% of airline maintenance professionals. As mentioned before, historic data are available for women mechanics. Although current research indicates that women have made dramatic strides toward equal representation in aviation career fields such as air traffic control and as flight crew professionals, the number of women in aviation maintenance technical fields has demonstrated little propensity for change and remains very low.

A decade of proactive effort by the aviation industry, governmental agencies, and special interest groups has resulted in increasing representation of women in many male-monopolized aviation careers. Aviation maintenance, however, remains the slowest career field in aviation to realize any trend toward greater representation. The most current available FAA statistics suggest that the representation of women among the ranks of certified mechanics remains very low. Current estimates place the number of active female aircraft mechanics at 3,901. While this is a dramatic increase over the number of active female mechanics of a decade ago, this number represents only just over 1% of the number of active mechanics (airlines and general aviation, combined) in the work force.

While the actual number of women in aviation maintenance careers remains quite low, there is reason for optimism about the future of women in this male-dominated field. A complex model for predicting the number of maintenance professionals needed in the years ahead was formulated for the demographic aspects of this study. As a result of this model, the anticipated levels for women could be predicted for the next several years. The model's prediction for the representation of women in aviation maintenance careers in Figure 4.12 is represented by the line extending to the year 2003. Statistical data from FAA records for the three most current years strongly suggest a marked deviation from the predicted levels of representation.

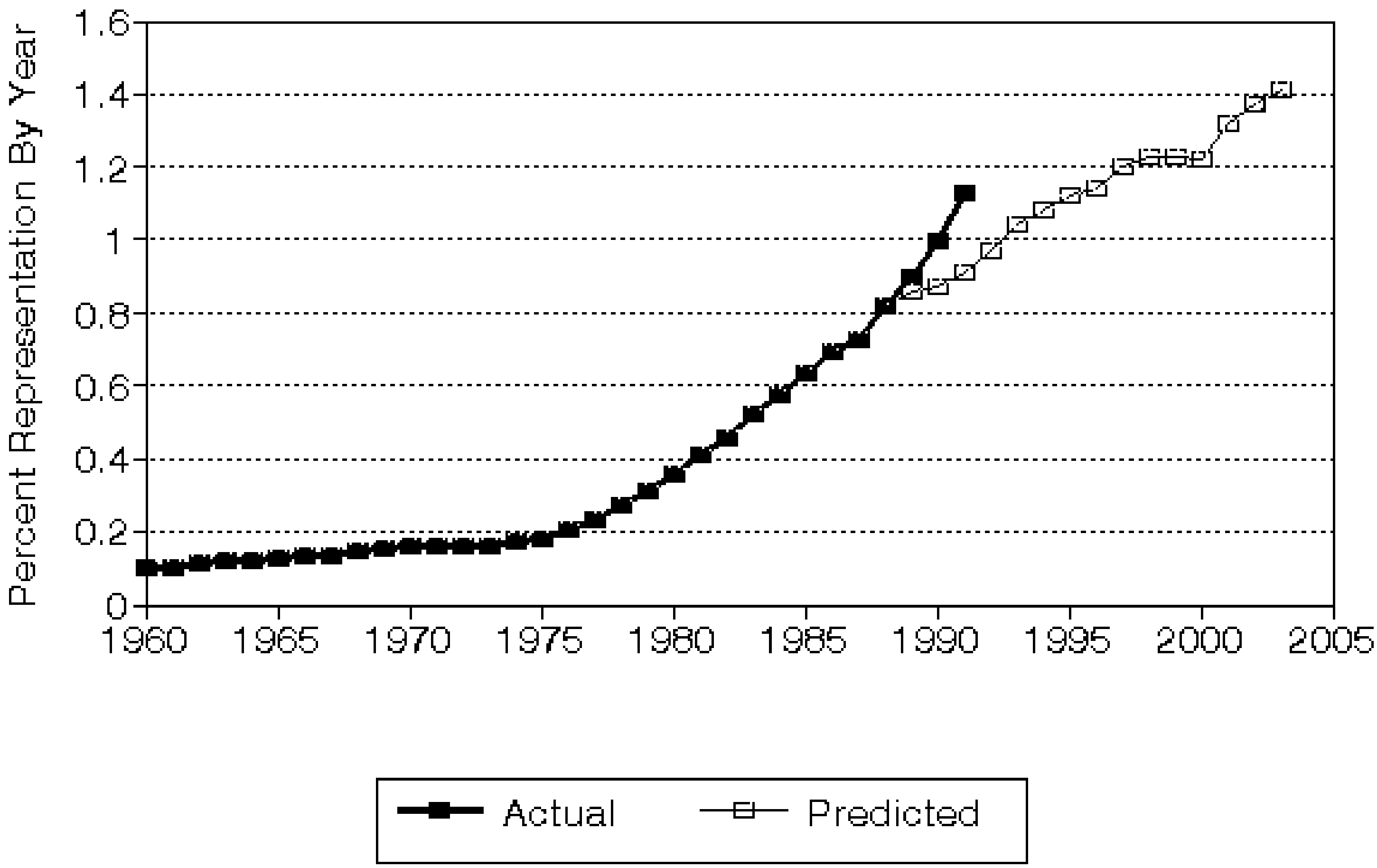

Figure 4.12 Percent Representation of Active Female Aircraft Mechanics

When viewed from a "rate-of-change" in representation prospective (Figure 4.13), the change in the level of representation of women in maintenance careers seems on the verge of dramatic growth. As suggested by the demographic model and as realized in actual data, the change in the representation of women in maintenance careers was relatively constant for the years between 1960 and 1975. From 1975 to 1988, an increase in the rate of change in this representation was noted. Instead of the predicted steady growth, this period demonstrated a yearly increase in the rate of change in representation of women mechanics in the work force. In the period from 1988 to that of the most current available data, there has been a very sharp increase in the rate at which women are selecting aviation careers. Thus, the data for the representation of women in aviation maintenance careers suggest that we may be on the verge of dramatic increase in the number of women in aviation maintenance career fields.

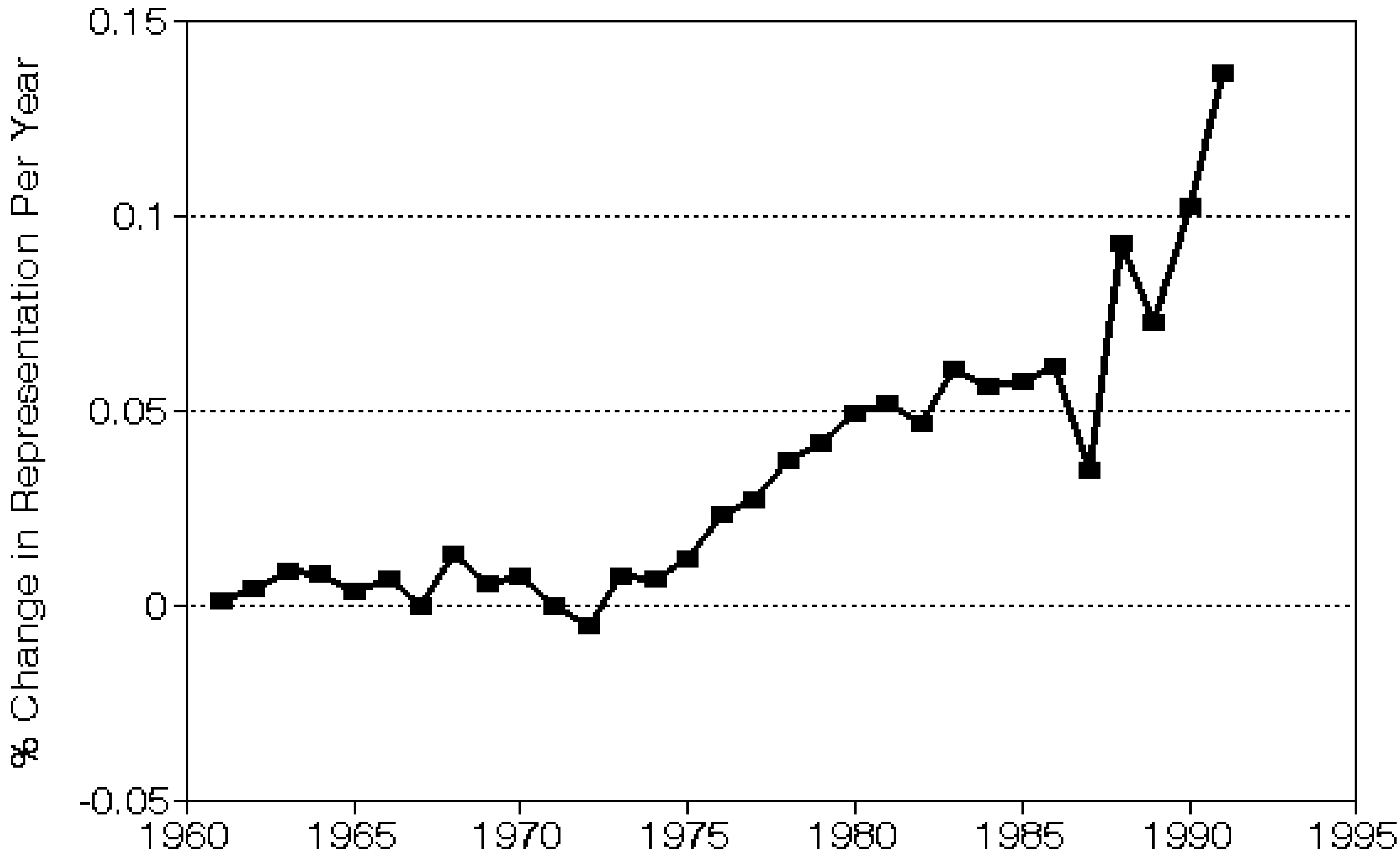

Figure 4.13 Change in Percent Representation of Active Female Aircraft Mechanics

4.6 SUMMARY

The aviation maintenance professional will continue to be a valuable asset to air safety well into the 21st century. Modern aircraft promise to bring greater reliability and maintainability to the aviation industry; yet, the complexity of these craft will bring new challenges to AMTs. The aviation industry must take a proactive approach if it expects to employ a competent work force which will meet equal opportunity standards while simultaneously maintaining the productivity of aviation maintenance technicians. Through the efforts of many individuals, learning institutions, and corporations, diversity in the AMT work force has begun to emerge. Current legislation helps to promote these efforts; however, much is yet to be done if true equity for both gender and race is to be accomplished. Improving diversity in the AMT work force and the relations between genders and the various races currently employed as AMTs will build a strong foundation for improved maintenance and future air safety.

The data collected in this study suggests that over the past several decades minorities have made dramatic progress in aspiring to AMT careers. Females, however, are still extremely under represented in the aviation maintenance industry. According to one major US air carrier, females currently make up approximately two percent of their AMT work force and minorities constitute approximately 26 percent. The lack of female role models, inadequate physical facilities at AMT schools, subliminal bias by teachers counselors and supervisors, and a general lack of career awareness comprise major barriers to females entering an AMT career.

This study points out that today's youth are for the most part unaware of the exciting well paid careers which exist in the aviation maintenance industry. With the liability and security problems of today's aviation environment it is very unlikely that young people will have a chance to explore a career in civil aviation. The changing military environment will assuredly supply less publicity and training aimed toward aviation. These factors leave a void which must be filled and enhanced if we hope to have a plentiful, diverse supply of competent AMTs in the future. Industry, AMT schools, and governmental agencies must join together to promote aviation in a gender and race fair manner.

Currently many programs exist which are helping to improve the diversity of the aviation maintenance industry. These programs must be amplified and used in conjunction with gender- and race-fair role models to help reach under represented populations. Table 4.9 shows several strategies which can be used to help eliminate the barriers which limit the employment of nontraditional populations in AMT careers. The data collected in this study suggests that women must be a primary focus group if significant change is to occur. There are two simple strategies which continue to emerge as primary methods to achieve equity: (1) promotion of aviation maintenance as an exciting and rewarding career, and (2) improving the image of the aviation maintenance professional. These strategies focused at the youth of America and enhanced for minorities and females will ensure a plentiful supply and diverse work force needed to meet the future challenges of the aviation maintenance industry.

Table 4.9 Strategies to Help Eliminate Barriers

IDENTIFIED BARRIERS		STRATEGY TO ELIMINATE BARRIERS
Recruitment (career selection)	•Lack of information concerning AMT careers •Lack of adequate role models	•Increase gender/race fair outreach programs •Better promotion of AMT careers by major air carriers •Increase awareness of AMT careers to elementary and high school students
Educational	•Recruitment •Retention •Learning environment	•Increase the number of female and minority AMT instructors •Promote gender/race fair educational practices for faculty and staff •Improve AMT school facilities to be more gender fair •Improve texts and other educational materials to be more gender/race fair •Increase and improve female and minority recruitment
Work place	•Economic •Emotional •Environmental	•Improve grant/loan programs to help disadvantaged individuals with cost of education and tool purchases •Increase and improve worker and administration awareness programs to promote gender/race fair interactions •Improve facilities to be more gender fair

Table 4.9 Strategies to Help Eliminate Barriers

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CHAPTER FOUR
APPENDIX
Projections of Future Need of Aviation Maintenance Technicians (AMTs) in Civilian Aviation

Introduction

This section of the report re-examines the results of the 1991 FAA Blue Ribbon Panel (BRP) report on Aviation Maintenance Technician (AMT) Shortages prepared as a working paper (WP). The 1991 paper produced projections of pilot and AMT work force needs in Civilian Aviation for the 1991-2003 time period were produced. This section of the report addresses only the projections of AMT future work force needs. A re-examination of civilian commercial pilot work force projections is beyond the scope of this project.

The re-examination of future AMT work force needs was called for in response to questions from aviation officials, union leaders, and others about the large shortages in AMTs projected in the 1991 working paper. The 1991working paper states "numerous sources predict that there will be a need for 100,000- 120,000 AMTs by the year 2000. This number is based on the current number of technicians combined with new positions related to new aircraft and increased attention to continuing airworthiness of older aircraft." The 1991 report projects the shortage of AMTs to be between 65,000 and 85,000 new AMTs by the year 2000. Many felt that the shortfalls were too large; others, that the projected shortfalls were too conservative.

The shortages projected were accompanied by supporting information and arguments that seemed to provide a rationale for the expected large shortfalls. In the report, the projected decline of the population in the 16-24 and 25-34 age groups by the year 2000, a declining pool of potential AMTs coming from the military, a low retention rate of AMTs in the aviation industry (only 45% of AMT school graduates remaining in aviation after 2 years), and other reasons are offered to explain why the supply of AMTs is not expected to keep up with demand. All of these reasons and rationales focus on the supply of AMT work force into the aviation industry. However, the BRP report does not offer specific yearly projections of AMT work force supply to accompany their detailed yearly projections of AMT work force demand. As a result, the precise yearly projected shortages remain unclear.

This study examines the working paper's projection of AMT work force need. The projections are recalculated using much of the original study's methodology but with some variation where the assumptions of the original projections have been questioned. This study also offers yearly projections of work force supply using data that was not used in the BRP study. This study projects supply by using FAA data on estimated active AMTs reported in the *FAA Statistical Yearbooks*. The yearly projections of AMT work force supply and demand can be compared to produce projected yearly shortages or surpluses.

Projection of AMT Demand

The projection of AMT demand by civilian aviation in this study follows the general assumptions and definitions used in the BRP study, with several exceptions. These exceptions are pointed out in the following discourse on how the working paper's projection methodology compares with this study's methodology. Using the definition of AMTs from page 6 of the working paper, an AMT in this study is defined as "any person who works to maintain an aircraft, aerospace vehicle, or component thereof in an airworthy condition." Thus, an AMT performs daily maintenance work to keep the civilian airfleet flying efficiently and safely. AMTs perform tasks from line maintenance to airframe modification.

WP Projections of AMT Demand

In the WP report, the projection of AMT demand revolves on several fundamental assumptions and pieces of information. Future AMT demand was argued to be closely tied to changes in the civilian airfleet, i.e. as the number of aircraft of various types increases or decreases, demand for AMTs would be affected. Projections of the number of aircraft in three areas of civilian aviation (large jet-commercial, commuter and general aviation) were taken from the FAA Aviation Forecasts report (Feb. 1992) which covered the years 1992-2003. The methodology for these projections is reported in the 1992 FAA report. The WP study combined estimates of the number of aircraft with assumptions concerning how many AMTs are necessary to service each class of aircraft project of how many AMTs are needed to service the airfleet in any one year. The large jet-commercial class of aircraft (which is composed of commercial 2, 3, and 4 engine narrow body and wide body turbojets) was assumed to require an average of 14 AMTs per aircraft for maintenance. The commuter class (which includes 2 and 4 engine turboprop; 2, 3, and 4 engine piston; and rotary wing turbine aircraft) was assumed to require an average of 4.2 AMTs per aircraft for maintenance. General aviation aircraft (which includes 1 engine, 2 engine, and other piston; 2 engine and other turboprops; piston and turbine rotary wing; 2 engine and other turbojet; and all other aircraft) was assumed to require an average of .15 AMTs per aircraft for maintenance. Multiplying the number of aircraft projected by the number of AMTs needed for maintenance per aircraft produces yearly projections of the number of AMTs needed to maintain the entire fleet.

A fourth category of AMTs was also included in the WP study's projection of AMT need. In the WP projection table, the category "Other" was included. The "Other" category included AMTs employed outside of aviation maintenance, but within aviation. The other category included AMTs employed in manufacturing, at repair stations, and as federal technicians. In 1988, the base year, it was deduced that about 43,000 AMTs were employed in the "Other" category. The WP report assumes a 2% yearly growth in "Other" AMT employment.

Of course, the AMT workforce is subject to attrition due to a variety of causes, including retirement, death, transfers, and leaving aviation employment. In the WP report, a 7 percent attrition rate was assumed for large jet, 20 percent for commuter, and 10 percent for general aviation AMTs. As jobs become available in large jet and commuter aviation, a number of transfers between the classes of aviation were anticipated. It was assumed that 60% of commuter attrition and 20% of general aviation and "Other" attrition were transfers to large jet aviation. It also assumed that 10% of general aviation and "Other" attrition were transfers to commuter aviation.

A rough estimate of the number of net vacant positions in each class of civilian aviation is calculated by subtracting the number of transfers into the type of aviation from the vacancies created due to attrition. For example, in the WP report, there were 2538 large jets in 1980 which yielded 35,532 jobs (2538 X 14). Attrition, which was 7% for the year, yielded 2487 vacant positions (35532 X .07). There were 1912 transfers into large jet maintenance from other aviation employment. Thus, after taking transfers into account, there were 575 (2487 - 1912) net vacant positions in large jet maintenance in 1980.

The WP report's procedure yielded projections of total AMT jobs in aviation maintenance for each year, as well as estimates of the total of net vacant positions in each year. The reader is directed to the WP report for a detailed summary of the findings.

Projection of AMT Demand in This Study

As stated earlier, the projection of AMT demand in this study follows the WP study's methodology, with some exceptions. One change is that this study does not use FAA projections of the number of aircraft reported in the February 1992 *FAA Aviation Forecasts* document. This study employs a different projection methodology than that used in the *FAA Aviation Forecast*. This was done to provide an independent confirmation of the projections of aircraft numbers. This is important since projected AMT demand relies directly on the aircraft projections.

The projection of the number of each type and class of aircraft uses FAA data on yearly estimates of each type of aircraft. In the *FAA Statistical Yearbooks*, estimates of the number of 2, 3, and 4 engine turbojets; 1, 2, 3, and 4 engine piston; 2 and 4 engine turboprops, and piston and turbine rotary wing aircraft are available for each year back to 1958. Using the 1958-1989 time series of data for each aircraft type, projections were made through the year 2003 using the Box-Jenkins time series analysis technique. This procedure examined a variety of long-term time series models to identify which particular time series model best fits the 1958-1989 data. It then used the model that best fits the data to produce the projections through 2003. Of course, a different time series model may fit each time series of data. For example, as will be seen in the analyses, some aircraft types show systematic increases and some show decreases across time. For other aircraft types, the change is cyclical, e.g., increase, decrease, then increase.

The results of the time series analyses of FAA aircraft estimates are reported in Tables 4A-1, 4A-2, and 4A- 3. Table 4A-1 gives estimates and projections for large jets. Estimates and projections for commuter aircraft are given in Table 4A-2. Table 4A-3 gives estimates and projections of general aviation aircraft. These tables all give estimates for 1980 to 2003. The numbers of aircraft for the years 1980-1989 are estimates derived from the best fitting Box-Jenkins time series model while the numbers of aircraft for the years 1990-2003 are projections based on the best-fitting models. Again, it is important to emphasize that these numbers were generated by time series models which analyzed FAA data on aircraft numbers of each aircraft type from 1958-1989 to establish long-term trends in the increase or decrease of each aircraft type. These estimates and projections of aircraft numbers serve as the basis for projecting AMT demand.

	4-engine	3-engine	2-engine	Total Large Jet
80	437	1358	751	2538
81	397	1386	847	2630
82	364	1414	939	2717
83	346	1434	1061	2841
84	338	1451	1204	2993
85	337	1481	1362	3180
86	360	1485	1538	3383
87	376	1484	1715	3575
88	389	1490	1864	3743
89	412	1500	2005	3917
90	427	1495	2110	4032
91	437	1505	2295	4237
92	452	1510	2342	4304
93	462	1515	2359	4336
94	467	1521	2511	4499
95	471	1529	2597	4597
96	472	1537	2772	4781
97	475	1552	2933	4960
98	481	1562	3149	5192
99	484	1574	3311	5366
00	48.	1582	3429	5494
01	489	1597	3579	5665
02	492	1609	3716	5817
03	496	1622	3812	5930

Table 4A-1

	Piston			Turbo-Prop		Rotary Wing	Total
	4-eng	3-eng	2-eng	4-eng	2-eng	Turbine	Commerical
1980	58	0	419	93	521	3	1094
1981	62	0	513	99	641	4	1319
1982	60	0	491	104	71.	5	1373
1983	53	0	497	107	788	7	1423
1984	44	2	436	106	880	7	1475
1985	42	4	410	103	966	6	1531
1986	39	4	374	102	1068	8	1595
1987	36	3	359	99	1174	9	1680
1988	38	3	341	97	1271	7	1757
1989	35	3	328	98	1315	8	1787
1990	36	5	303	96	1367	8	1815
1991	36	4	298	94	1439	7	1878
1992	34	4	289	96	1493	7	1923
1993	30	5	281	97	1544	8	1965
1994	29	5	273	98	1619	8	2032
1995	27	4	267	99	1689	9	2095
1996	23	4	261	101	1741	9	2139
1997	21	3	259	102	1773	9	2167
1998	20	3	254	103	1797	11	2188
1999	17	3	251	105	1827	11	2214
2000	17	3	247	107	1867	12	2253
2001	15	2	243	109	1897	12	2278
2002	13	2	231	108	0929	11	2294
2003	11	2	227	107	1964	11	2322

Table 4A-2

Year	Piston			Turbo-Prop		Rotary Wing			TurboJet		Total General Aviation
	1 engine	2 engine	Other	2 engine	Other	Piston	Turbine	Other	2 engine	Other	
1980	166310	24481	183	4016	111	2881	3182	4805	2618	331	208918
1981	167029	34873	167	4464	129	2825	3484	5184	2855	365	211375
1982	167735	24954	174	4894	145	2788	3268	5485	3179	439	213061
1983	166925	24813	161	5749	154	2804	3834	5749	3452	457	213498
1984	167701	24486	168	5400	164	2739	3894	6141	3697	496	214886
1985	169073	24171	163	5404	177	2817	3848	6451	3816	500	216420
1986	168776	23729	154	5354	189	2826	3813	6638	3890	450	215819
1987	167991	23101	121	5232	194	2758	3771	6763	3894	415	214240
1988	168514	22778	114	5183	200	2683	3853	6900	3881	373	214479
1989	167959	22201	105	5062	200	2675	3868	6894	3914	367	213245
1990	168142	21340	101	5049	198	2657	3899	6928	3926	361	212601
1991	168146	21229	100	5051	199	2671	3902	6992	3961	359	212610
1992	167563	21119	101	5047	193	2673	3911	7003	3970	358	211938
1993	167762	21097	99	5092	191	2677	3921	7009	3972	354	212174
1994	167928	21073	97	5089	189	2682	3943	7031	3968	352	212352
1995	168820	21069	98	5083	187	2677	3957	7052	3974	350	213267
1996	169527	21053	95	5081	183	2673	2964	7077	3978	348	213979
1997	170328	21047	97	5073	184	2669	3982	7091	3991	346	214808
1998	171572	21039	98	5069	181	2652	4001	7099	4001	344	216056
1999	172503	21021	99	5081	173	2637	4027	8123	4122	341	218127
2000	173609	21038	101	5079	177	2621	4052	8177	4157	329	219340
2001	174834	21042	100	5083	179	2611	4073	8197	4269	320	220708
2002	176221	21057	94	5129	193	2579	4138	8371	4412	311	222505
2003	177816	21059	79	5147	195	2538	4297	8419	4502	304	224366

[1]Projections and estimates are based on FAA estimates reported in the FAA Statistical Yearbooks

Table 4A-3

Two things are worth noting about the estimates and projections in Tables 4A-1, 4A-2, and 4A-3. First, when one considers the projections for each of the three classes of aircraft, the projections of this study do not substantially differ from the *FAA Forecasts*. This can be seen by comparing the numbers in Tables 4A-1, 4A-2, and 4A-3 with Tables 15, 20, and 21 in Chapter X of the *FAA Aviation Forecasts* (1992-2003) document. Second, there are substantial differences in the two sets of forecasts for some particular types of aircraft. For example, the projections of this study forecast more 3 engine turbojets and fewer 2 engine turbojets than does the FAA study. These particular differences in estimates and projections may be important in other contexts. However, since only the projections and estimates for three broad classes of aircraft are used to project AMT demand, the differences in the projections for particular types of aircraft are relatively unimportant in the overall context of this study.

A second major departure from the WP study's methodology is that assumptions concerning the number of AMTs necessary to maintain each class of aircraft are re-assessed in light of comments and criticism from a variety of sources in civilian aviation. Most thought that the assumptions of 14 AMTs per large jet, 4.2 AMTs per commuter aircraft, and .15 AMTs per general aviation aircraft were unrealistically high. The sources' estimates ranged from a high-end which reflected the WP assumptions to a low-end which was about half the level the WP assumed.

In response to these questions, varying assumptions concerning the number of AMTs needed per class of aircraft were employed to estimate and project AMT demand in civilian aviation. One set of projections was made using the assumptions of the WP report, i.e. 14 AMTs per large jet, 4.2 per commuter, and .15 per general aviation aircraft. Two additional sets of projections were generated. The first assumed 10.5 per large jet, 3.15 per commuter and .1125 per general aviation. The second assumed 7 per large jet, 2.1 per commuter, and .075 per general aviation aircraft. These three sets of projections and estimates are presented in Tables 4A-4, 4A-5, and 4A-6. Each table presents projections based on a different set of assumptions concerning the number of AMTs needed per aircraft for maintenance.

The projections in Tables 4A-4, 4A-5, and 4A-6 employ the WP study's assumptions concerning attrition and transfer rates, as well as the size and growth of the "Other" category. The "Other" category -- AMTs employed outside of aviation maintenance -- includes AMTs employed in manufacturing, at repair stations, and as federal technicians. The WP's assumptions in these areas are recognized to be somewhat arbitrary; but, in the absence of better or contradictory information, there are no compelling reasons to change them. The specific assumptions are the following. The attrition rate for all causes among large jet workers is 7%, 20% for commuter AMTs, and 10% for general aviation/"Other" workers. The transfer rates are that 60% of commuter attrition plus 20% general aviation/"Other" attrition are assumed to be caused by AMTs transferring to large jet maintenance. Transfers into commuter maintenance account for 10% of general aviation/"Other" attrition. Finally, it was estimated that 43,000 AMTs were employed in the "Other" category in 1988 (base year) and that this number grew by 2% each year. The 2% growth assumption is pegged to an assumed 2% annual economic growth.

Results of Demand Analysis

Tables 4A-4, 4A-5, and 4A-6 give the results of the analyses of AMT demand in civilian aviation through the year 2003. To aid the reader in understanding the information and calculations presented in the tables, it is useful to work through an example. In Table 4A-4, consider the row of information and calculations for 1993. In column 1 is reported the projected number of large jets for 1993 (4336). Assuming 14.2 technicians are needed to service each large jet -- yields column 2 -- the number of technicians needed to service large jets (4336 X 14 = 60704). In the third column is the estimated attrition for large jet technicians (60704 X .07 = 4249.28), i.e. the number of jobs that will become available due to attrition. In the fourth column is the estimated number of AMTs transferring to large jet maintenance from other aviation maintenance jobs. It is calculated as 60% of commuter attrition plus 20% of general/"other" aviation (.60 X 1651 plus .20 X 7930 = 2577). The Net Vacant column is the difference between available jobs and transfers (4249 - 2577 = 1672). The same general procedure is followed for commuter and general aviation/"Other" calculations. Since it is assumed that general aviation/"other" jobs represent entry level positions (BRP assumption), no estimate of transfer into general aviation/"other" is made. Rather, the attrition number represents available jobs in general aviation/"other" which are ultimately filled by newly certified AMTs.

The final four columns of Table 4A-4 present some summary measures. Again, for 1993, the Total Technicians column represents the number of jobs available in the three classes of civilian aviation [60704 (large jet) + 8253 (commuter) + 31826 (general aviation) + 47473 (other) = 148256]. The next column is the number of jobs added during the year (148256 - 146667 = 1589). The Net Vacant column is a summation of the net vacant jobs in the three aviation classes (1672 + 858 + 7930 = 10460). The final column sums attrition across the aviation classes.

Table 4A-4 gives projections using assumptions identical to the WP report. The results are quite similar to those reported to the DOT's Blue Ribbon Panel. The differences are due to the different projections of the number of aircraft used in each study. The two columns of interest in Table 4A-4 are the Total Technician and the Added from Last Year columns. The Total Technician column is a projection of AMT demand in aviation. The Added column is a projection of job increase in aviation. The Vacant Position column is not of particular interest since this report uses a direct measure of AMT supply. In a later section, projections of AMT demand (from Tables 4A-4, 4A-5, and 4A-6) are compared to projections of AMT supply. It is on the basis of a table similar to Table 4A-4 that the WP report projected a future shortage in AMTs.

Tables 4A-5 and 4A-6 give projections computed similarly to those in Table 4A-4. However, Tables 4A-5 and 4A-6 are based on somewhat different assumptions than Table 4A-4. In Table 4A-5, the average number of AMTs needed to service each class of aircraft were assumed to be 10.5 per large jets, 3.15 per commuter, and .1125 per general aviation/"Other" aircraft. In Table 4A-6, the assumed AMTs per aircraft were 7 per large jets, 2.1 per commuter, and .075 per general aviation/"Other". As can be seen by comparing the Total Technician and Added Jobs columns across the three tables, it is obvious that the differing assumptions produce significantly reduced projections of AMT demand.

Projection of AMT Supply

The FAA publishes estimates of the number of active AMTs in its *Statistical Yearbooks*. Estimates of active AMTs are available from 1958. Separate estimates are available for females. The FAA estimates include all those who are employed in the various components of aviation, plus those who hold certification but who are no longer active in aviation. It is assumed that the FAA estimates adjust yearly for newly certified AMTs, as well as for retirements and deaths. This time series of data can be subjected to the same time series analysis used earlier to project active AMTs to the year 2003.

Table 4A-7 gives the results of such a time series analysis. Column 1 reports the FAA *Statistical Yearbook* estimates of AMTs for the 1958-1988 period. Column 2 estimates and projects figures for active AMTs generated by a Box-Jenkins time series model for the 1958-2003 period. In column 3 are the yearly increases in AMTs. Column 3 clearly shows that the supply of AMTs tends to follow a 10 year cyclical pattern. Roughly every ten years there is a significant increase in AMT production. More will be said about this pattern in the discussion of Table 4A-8. Column 4 contains FAA estimates of active female AMTs. In column 5 are estimated and projected numbers of female AMTs which were generated by a time series model. The female AMT model is clearly not as cyclical in nature as the total AMT model.

	Estimated Active AMTs[1]	Projected Active AMTs[2]	Added From Last Year	Estimated Active Female AMTs[1]	Projected Active Female AMTs[2]	Added From Last Year
1958	107072	107932	-	118	115	-
1959	113520	112323	4391	119	116	1
1960	115688	115425	3102	110	120	4
1961	118689	119000	3575	117	125	5
1962	122160	122323	3323	137	134	9
1963	124945	126255	3932	141	148	14
1964	130131	130677	4422	166	164	16
1965	135351	135559	4882	182	176	18
1966	140799	142213	6654	197	194	18
1967	146572	150330	8117	196	204	10
1968	158211	160189	9680	229	238	34
1969	170716	170688	10499	269	263	25
1970	184647	181713	11025	302	294	31
1971	193295	188739	7026	322	305	9
1972	201700	194368	5629	349	314	9
1973	193337	198526	4158	284	326	12
1974	198863	202327	3801	318	346	20
1975	205436	206141	3814	360	377	31
1976	212303	213222	7081	422	440	63
1977	220768	220972	7750	505	516	76
1978	228743	229916	8944	600	622	106
1979	237611	239996	10080	695	748	126
1980	250157	251330	11340	890	907	159
1981	262705	263249	11919	1051	1085	178
1982	277436	278278	15029	1298	1276	191
1983	288335	280121	1843	1493	1455	179
1984	298028	284428	4307	1649	1636	181
1985	274100	288376	3948	1775	1824	188
1986	284241	293193	4817	1964	2038	214
1987	297178	297279	4086	2237	2218	180
1988	312419	310419	13140	2565	2545	327
1989	-	323677	13258	-	2769	224
1990	-	334666	10989	-	2927	158
1991	-	344535	9869	-	3139	212
1992	-	353504	8968	-	3427	288
1993	-	357202	3698	-	3728	311
1994	-	362098	4896	-	3922	194
1995	-	365756	3658	-	4107	185
1996	-	368454	2698	-	4203	96
1997	-	373106	4652	-	4469	266
1998	-	381002	7896	-	4672	203
1999	-	389925	8923	-	4783	111
2000	-	399950	10025	-	4872	89
2001	-	411208	11258	-	5427	555
2002	-	421055	9847	-	5773	346
2003	-	425353	4298	-	5983	210

Table 4A-7

Since the concern in this study is only with AMT demand in civilian aviation, the projected numbers of AMTs in Table 4A-7 will have to be adjusted to account for the fact that the majority of certified AMTs are not employed in civilian aviation. The WP report provides some information on which to base an assumption concerning the percentage of active AMTs employed in aviation. On page 7 of the WP report, it is stated that less than 4,500 of 10,000 graduating AMTs can be found in U.S. aviation 2 years later. In an August 11, 1992, memo to the Blue Ribbon Panel from Phaneuf Associates Incorporated, it was estimated that 43 percent of entry level AMTs went directly to jobs in non-aviation industries. Thus, any assumption concerning the percent of AMTs employed in aviation is somewhat subjective. As a result, two different assumptions are used in this report to estimate AMTs active in aviation. These assumptions are generally consistent with those reported to the BRP. The two assumptions are that 40 and 45 percent of AMTs remain active in aviation. Again, these assumptions are only loosely empirically based. Better information on retention in aviation jobs would adjust these assumptions. If anything, the percentage retention in aviation jobs is probably lower than

40 percent. These numbers reflect what many in the aviation industry point to as a significant problem, i.e. AMTs leave aviation maintenance jobs seeking more conventional hours, better working conditions, and better pay. Also, given the increasing volatility of the commercial aviation industry, job security of aviation employees has suffered.

Table 4A-8 gives the projected number of active aviation maintenance technicians (AMTs) for the 1980- 2003 period. In column 1 are the estimated and projected numbers of active AMTs generated by a Box- Jenkins time series model. In column 2 are the numbers of AMTs being added each year. As was commented on earlier, there is clearly a cyclical pattern in the production and certification of new AMTs. Roughly every ten years, there is a two or three year period marked by significantly higher AMT production. It also should be pointed out that this cyclical pattern occurs in the FAA data on active AMTs (see Table 4A-7). Why this cyclical pattern occurs is open to conjecture. There are any number of possible explanations. The pattern could represent variations in the production of AMTs by the schools. It could represent varying availability of potential AMTs coming from the military. It could also represent some cyclical pattern of retirements within the industry. What is most likely is that aviation maintenance schools tend to react to the volatility of the aviation industry, i.e. as aircraft orders increase with short-term expansion in aviation, schools react to perceived increased demand, and so on.

Columns 3 and 4 in Table 4A-8 report the estimated active AMTs in aviation assuming that 45% of active AMTs are employed in aviation (Column 3) and that 40% of active AMTs are employed in aviation (Column 4). The estimates and projections in Columns 3 and 4 will be used as rough indicators of AMT supply in the next analysis which attempts to answer the question, "Will there be AMT shortages in the future?"

Projected Demand and Supply of AMTs

To determine if there will be a future shortage of AMTs, the projections of AMT demand from Tables 4A- 4, 4A-5, and 4A-6 are combined with projections of AMT supply from Table 4A-8 and Table 4A-9. Projections of AMT shortages can be calculated by comparing the supply and demand projections. Only the situation where 40% of active AMTs are employed in aviation (Column 2) and where it is assumed that 14, 4.2 and .15 AMTs are needed to maintain each aircraft of each class of aircraft (Column 3) are there predicted to be substantial AMT shortages. However, for circumstances where greater than 40% of active AMTs remain employed in aviation and where fewer AMTs are needed to maintain each class of aircraft, shortages are not projected. In general, the supply of AMTs will meet the aviation industry's demand for them.

Another factor that has to be considered in projecting future shortages is the large pool of AMTs who are certified but who are not employed in aviation and who conceivably could return to aviation employment at some point. The aviation industry could draw upon this relatively large pool of available AMTs if circumstances warrant it. However, it is to the aviation industry's advantage not to draw upon this supply of AMTs. It is much more cost-effective to continue to fill positions with entry-level AMTs rather, than to pay higher wages to more senior people. The comparatively low wages, nighttime work schedules, and the uncertain job security in the aviation industry create retention problems within the industry, especially for more experienced and senior workers.

There may be short-term shortages of entry level AMTs in the aviation industry, given the cyclical nature of increase in the number of AMTs certified each year (see Table 4A-7 and Table 4A-8). Short-term shortages in the industry may indeed be the short-term stimuli that AMT schools react to, at least until it becomes difficult for newly trained AMTs to find jobs. The schools would then react by reducing the scope of their programs. Individuals then may also become less interested in AMT training due to a perceived or real lack of jobs in the industry. Given the nature of the aviation industry, it seems to be quite difficult to create any long-term balance between the training of new AMTs and the availability of jobs. Assuming that the aviation industry is tied to the overall economy, in the long-term (more than a few years), the number of AMTs needed will continue to show cyclical changes as the economy goes through its typical upturns and downturns.

Another trend that may substantially reduce demand for AMTs in the U.S. aviation industry is the movement of aviation maintenance facilities to foreign countries. As more of these facilities become realities, the growth in the number of jobs available to AMTs trained in the United States will slow.

The overall conclusion of these analyses is that AMTs are available to meet today's demand and that future shortages seem unlikely. There may be short-term shortages of entry-level AMTs as the aviation industry fluctuates with the economy. However, the massive shortages the WP suggested seem unlikely.

Description of Time Series Models

The Box-Jenkins procedure (described in Box and Jenkins, *Time Series Analysis: Forecasting and Control*, Holden-Day, 1976) is used to fit and project time series data by means of a general class of statistical models. An observation at a given point in time is modelled as a function of its past values and/or current and past values of random shock, both at seasonal and nonseasonal time logs. The Box-Jenkins technique will model a single variable with observations equally spaced in time with no missing values. Many times it is necessary before modelling the time series to transform the data (usually by taking the log or power transformation of the series) or by differencing the series on a seasonal or nonseasonal basis.

The modelling of time series data is usually done in three steps. First, a tentative model is identified for the time series. Second, the parameters of the model are estimated and diagnostics statistics and plots are examined to determine the adequacy of the model. Third, if the model is deemed adequate, projections based on the model can be made. If one model is determined to be inadequate, then other models are examined till one is found with an acceptable fit. Once the best-fitting model is formed, forecasts can be made. Fitting and forecasting a given time series of data usually requires multiple computer runs.

Thus, the specific best-fitting model for each series of data projected in this study differs from each other model in terms of its parameters. The clearest example of these differences can be seen by comparing the projection of AMT supply (clearly cyclical) with the projection e.g,. of the number of large jet aircraft. The best-fitting model for each time series of data was used to make the projection for that time series, but the best-fitting model was different for each time series.

Finally, the Box-Jenkins model allows for the calculation of three separate forecasts for each time series. The two additional sets of projections are based on the upper and lower confidence interval limits about the estimated model parameters. These additional projections were generated, but are not reported in this report. The use of the alternate projections would not alter the major conclusions of this analysis.