

## DATA-DRIVEN STAFFING RECOMMENDATIONS FOR AIR TRAFFIC CONTROL TOWERS

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The FAA is interested in an optimal strategy for placing air traffic controllers into high-level Terminal facilities. Our research question is whether new hire trainees (developmentals) should begin field training at lower-level facilities and transfer to higher-level facilities later, if successful at the lower-level facility, or begin training at a higher-level facility and transfer to a lower-level facility if unsuccessful? We compared the success rates of developmentals placed into medium- and high-level Terminal facilities after completing Academy training to the success rates of certified professional controllers (CPCs) allowed to transfer after completing field training at a lower-level facility. We found that the CPCs who began training at a lower-level facility succeeded in training at medium-level Combined Tower/TRACON facilities at a significantly higher rate than did developmentals at the same facility type and level. We recommended that the FAA staff higher-level facilities with CPC transfers rather than with new hires.

Should the Federal Aviation Administration (FAA) place newly hired air traffic controllers, with no prior experience in air traffic control (ATC), into a high, medium, or low-level ATC facility as their first facility? The FAA assigns a numerical level to a facility based on the volume, complexity, and sustainability of air traffic at that facility (FAA, 2016). Facility levels range between 4 and 12. In general, controlling air traffic is more challenging at higher than at lower-level facilities. It also takes most trainees longer to complete training and more trainees fail training at higher-level than at lower-level facilities (FAA, 2014a; FAA, 2016). However, because of the challenge and the pay (i.e., controllers are paid more at high-level than at low-level facilities), many controllers express a desire to be assigned to a high-level facility as early as possible. Our research objective was to determine if new hire trainees (called “developmentals”) should be allowed to proceed directly to a medium- or high-level facility for field qualification training after they complete training at the FAA ATC Academy or if they should have to demonstrate their proficiency by becoming a successful certified professional controller (CPC; i.e., successfully completing all ATC training) at a less complex facility prior to moving to a higher-level, more complex facility and completing the additional training there as a CPC-In-Training (CPC-IT). Which placement strategy will result in a greater rate of successful training completion and qualification as CPC at higher-level facilities?

### **Terminal Operations**

This question is especially important within the Terminal option of ATC, because unlike En Route centers, in which most are classified as high-level facilities (Levels 10–12), Terminal facility levels vary from low (Levels 4–6), to medium (Levels 7–9), to high (Levels 10–12) levels. Controllers at Terminal facilities work in airport towers, terminal radar approach control (TRACON) facilities or a combined tower and TRACON facility to “watch over” the aircraft traveling through the airspace of the airport or airports assigned (FAA, 2015). Terminal facilities vary in the extent to which air traffic is controlled using visual observation or radar and the number of airports for which the facility is responsible. There are 314 Terminal facilities within the National Airspace System (NAS) and the FAA manages the hiring and placement of new air traffic controllers at these facilities. A way to assess

placement strategies of air traffic controllers is to compare the success rates at medium- and high-level facilities of developmentals trained as new hires with the success rates of those who transfer to a higher-level ATC facility after attaining CPC status at a lower-level facility.

### **National Training Database**

Training outcomes for developmentals and CPC-ITs at FAA facilities are contained in the FAA's National Training Database (NTD; FAA, 2011). Researchers at the FAA's Civil Aerospace Medical Institute (CAMI) Aerospace Human Factors Research Division extract data from the NTD to develop a longitudinal ATC training database. Researchers regularly update and use the longitudinal ATC training database to respond to questions about air traffic controllers and to conduct human factors research to develop recommendations for improving controller placement and training practices.

Possible training outcomes that are stored in the NTD are as follows: *Completed, In Progress, Facility Fail, Transfer Lower, Transfer, and Separated – Other Reasons*. The outcomes of *Facility Fail* and *Transfer Lower* reflect unsuccessful completion of field qualification training. Developmentals coded as *Transfer Lower* failed field qualification training at their first facility but demonstrated the potential for being successful in training at a lower-level ATC facility, and thus were allowed to transfer to a less complex (lower-level) facility following FAA policies (FAA, 2013; Pierce, Byrne, & Manning, 2016). Records in the NTD allow analyses to be conducted based on training outcomes by option (Terminal or En Route) and by Terminal facility type and level. To determine which placement method produced the highest success rates in training at higher-level facilities, we compared the success rates in field training of new hires and CPC-ITs at medium- and high-level Terminal facilities. The type of Terminal facilities analyzed were Tower with Radar (Medium-level facilities = Levels 7–9 and High-level facilities = Levels 10–12) and Combined Tower with Radar and Terminal Radar Approach Control (Combined Tower/TRACON; Medium-level facilities = Levels 7–9 and High-level facilities = Levels 10–12). In general, Tower with Radar facilities rely more heavily on visual observation to control air traffic at one airport and Combined Tower/TRACON facilities rely on both visual observation and radar procedures to control air traffic at more than one airport (FAA, 2016). TRACON-only facilities were not included in the analysis because, in current practice, new hires no longer begin training at a TRACON-only facility as most of the facilities are high-level due to combinations of tower and TRACON facilities that occurred since 1995 and the relatively low number of low-volume TRACON facilities that remain. The placement of new hires at the remaining high-level TRACON facilities results in an exceptionally low success rate.

### **ATC Placement**

Trainees with no prior experience in ATC attend the FAA ATC Academy to receive initial training that is germane for all facilities in either the En Route or Terminal option before receiving a facility assignment at which they receive site-specific training. The process for assigning ATC Academy graduates to a field facility has varied over time, but currently, graduating classes are offered a list of facilities from which to choose based on the current needs of the Air Traffic Organization (ATO). The number of facilities to be included on the list (facilities from which graduates in a class may choose) is based on the number of students in the class who successfully completed the Initial Qualification training course. The majority of classes begin with 18 trainees and graduation rates typically vary between 50% and 75%. Academy graduates are allowed to make their selections based on class rank. The trainee earning the highest overall point total in the initial qualification training course chooses first from among the facilities offered. Facility selection proceeds through the class in overall point rank order such that those whose scores rank them lower in the class have fewer options from which to choose. The list is generated by the FAA's ATO Management Services, Technical Requirements and Forecasting Group, Air Traffic Services Team (AJG-P21) and is based on the needs of the FAA to fill controller vacancies at specific facilities.

Management Services may use the results of the current research as input in developing policy for making field assignments for Academy graduates. This data-driven approach is in line with FAA efforts to improve safety and identify hazards and risks based on continuous analysis of data (FAA, Destination 2025) and the FAA’s current strategic initiatives, Risk-Based Decision Making and Workforce of the Future.

## Method

### Database

From the longitudinal ATC training database, we extracted records for controllers who had trained at medium- and high-level Tower with Radar and Combined Tower/TRACON facilities as new hires from 2004 to 2015. Our sample included developmentals and CPC-ITs who had *Completed* training and were either *Successful* or *Unsuccessful* in training. Controllers with training outcomes of *Completed* were considered *Successful*. Controllers with training outcomes of *Facility Fail* or *Transfer Lower* were considered *Unsuccessful*.

We created two datasets. The first dataset included the training outcomes of developmentals at medium- (Levels 7–9) and high-level (Levels 10–12) Towers with Radar or Combined Tower/TRACONs as their first facility for training from 2004 to 2015. There were 1,997 records in the first dataset. Of those, 379 records were excluded because the developmental was still *In Progress* (n=176, 8.8%) and had not completed training or had *Transferred* (n=105, 5.3%) or left training for other reasons (*Other* (n=98, 4.9%)). To ensure independence of our groups, we excluded an additional 201 (12.4%) records because the new hires were also included in our second group of CPC-ITs. As shown in Table 1, there were 1,417 records remaining in the dataset. The number and percentage of developmentals categorized as either *Successful* or *Unsuccessful* in training are also shown.

Table 1.  
*Sample Characteristics for New Hires.*

		Tower with Radar (7–9)	Tower with Radar (10–12)	Combined Tower/TRACON (7–9)	Combined Tower/TRACON (10–12)	Totals
Successful	Number	306	147	622	71	1,146
	Percent	(88.2)	(79.5)	(77.9)	(81.6)	(80.9)
Unsuccessful	Number	41	38	176	16	271
	Percent	(11.8)	(20.5)	(22.1)	(18.4)	(19.1)
Totals		347	185	798	87	1,417

The second dataset extracted from the longitudinal ATC training database was for the CPC-ITs, the comparison group. The CPC-IT group (n = 797) included controllers who were new hires at their first facility, had made CPC at that facility, and then transferred and began training at a second facility from 2004 to 2015. We only included records for those controllers who had transferred to a medium- or high-level Tower with Radar or Tower/TRACON facility after reaching CPC-IT at a lower level facility (of any type) and had completed training (Successfully or Unsuccessfully) at the second facility. We excluded 171 records with training outcomes listed as *In Progress* (n=139, 17.4%), *Transferred* (n=23, 2.9%), or *Other* (n=9, 1.1%). There were 626 records remaining in the CPC-IT dataset (see Table 2).

Table 2.  
*Sample Characteristics for CPC-ITs at a 2<sup>nd</sup> Facility.*

		Tower with Radar (7-9)	Tower with Radar (10-12)	Combined Tower/TRACON (7-9)	Combined Tower/TRACON (10-12)	Totals
Successful	Number Percent	149 (93.7)	163 (86.2)	203 (89.4)	44 (86.3)	559 (89.3)
Unsuccessful	Number Percent	10 (6.3)	26 (13.8)	24 (10.6)	7 (13.7)	67 (10.7)
Totals		159	189	227	51	626

**Procedure**

To determine which group was more successful in training at medium- and high-level Tower with Radar and Combined Tower/TRACON facilities, the percentage of new hires who successfully completed training at medium- and high-level facilities was compared to the percentage of successful CPC-ITs at medium- and high level Terminal facilities of the same level.

**Results**

The percentage of successful new hires at a first facility and CPC-ITs at a second facility are shown by facility type and level grouping (Medium-Level 7-9 and High-Level 10-12) in Figure 1. Across all medium-level (7-9) and high-level (10-12) Tower with Radar and Combined Tower/TRACON facilities, 80.9% of the new hires were successful. The success rate for CPC-ITs at medium- and high-level Tower with Radar and Combined Tower/TRACON facilities was 89.3%.

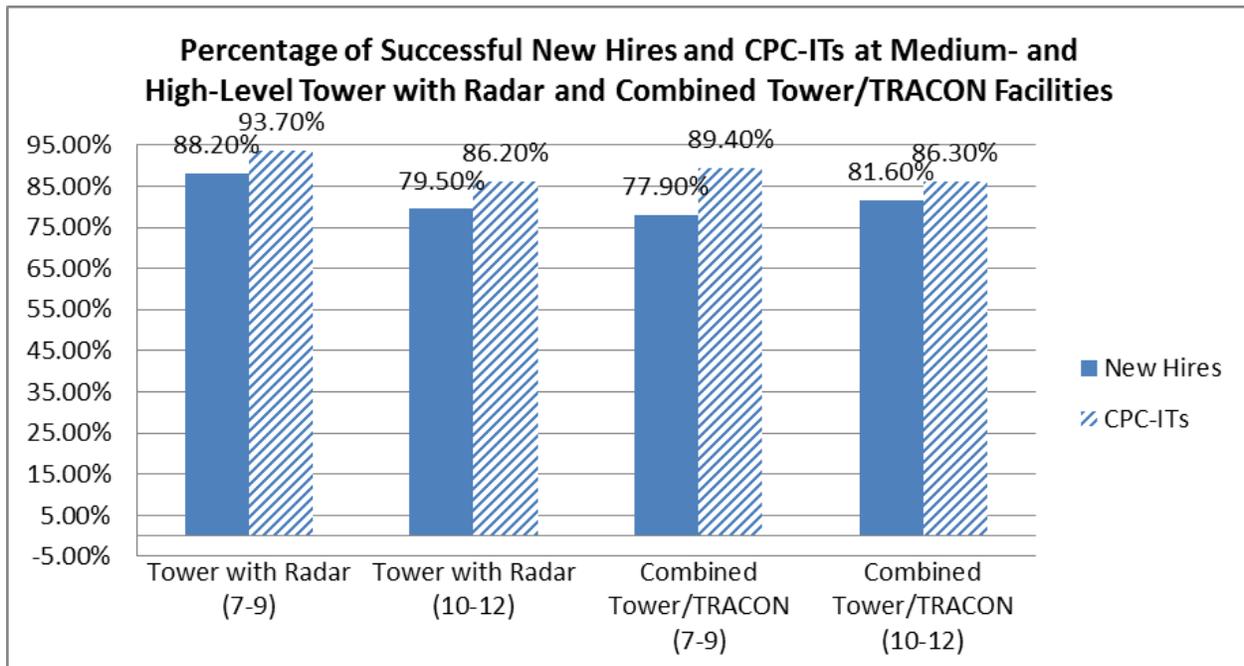


Figure 1.

We tested the significance of the difference using a Z-test to compare the proportion of successful developmentals and CPC-ITs at each facility type and level. We used the  $p < .05$  value to determine if the difference between the two groups was statistically significant. The Z-test statistic and the  $p$ -value for each comparison are shown in Table 3. We found that the CPC-ITs assigned to medium-level Combined Tower/TRACON facilities completed training successfully at a significantly higher proportion than did new hires assigned to the same type and level facility. The difference between CPC-ITs and new hires at medium-level Tower with Radar facilities was marginally significant, but comparisons at high-level facilities, Tower with Radar and Combined Tower/TRACON, were non-significant.

Table 3.  
*Z-Test of the Difference Between Group Proportions.*

	Tower with Radar (7–9)	Tower with Radar (10–12)	Combined Tower/TRACON (7–9)	Combined Tower/TRACON (10–12)
Z-score	-1.917	-1.742	-3.852	-0.710
$p$ -value	.055	.081	.001	.478

### Discussion

The FAA’s Management Services, Technical Requirements and Forecasting Group, Air Traffic Services Team (AJG-P21) is responsible for technical workforce planning, prioritization, and hiring plan development for the ATO, as well as onboarding and placement of newly hired controllers. The average cost to train one developmental is approximately \$139,207 per year, based on training costs reported from 2009 through 2013 (FAA, 2014b). On average, developmentals spend from 18 to 36 months in training, depending on facility type and level (FAA, 2014a; FAA, 2016). Thus, the FAA strives to place developmental controllers for field qualification training in ATC facilities in which they have the highest probability of success.

The results of the current effort clearly indicate that success rates at medium-level Combined Tower/TRACON facilities can be increased by staffing those facilities with CPC-ITs. The time for CPC-ITs to certify at a medium-level Combined Tower/TRACON facility is approximately 1 year (FAA, 2014a). Thus, the overall benefit to certification rates at medium-level Combined Tower/TRACON facilities of having new hires certify at a lower-level facility prior to transferring may be slightly diminished by higher training costs.

While the other comparisons were not statistically significant, the practical importance of the results is worth considering. More CPC-ITs were successful than new hires at the same type and level facility. While our results do not allow us to predict that there will continue to be a difference in success rates at these facilities, we have no reason to believe that the differences will not continue. It is likely that the small number of controllers, especially the CPC-ITs trained at the higher-level facilities, as well as the dichotomous outcome measure used in these analyses influenced our inability to find a significant difference. Future research will need to increase the sample size and consider other outcome measures to verify these findings. However, we believe that this information is useful in developing future practices and policies in ATC placement and training.

## Limitations

Although we constrained our groups to developmentals and CPC-ITs at two facility types (Tower with Radar and Combined Tower/TRACON) there are approximately 130 independent facilities in each group. It is possible that variability in training methods at the facilities and differences in training methods used over time could differentially affect eventual training outcomes. A second limitation is the number of developmentals and CPC-ITs *In Progress*, who were excluded from the assessment. Seventeen percent of the CPC-ITs in the group assessed were still *In Progress* and due to the time needed to complete training, the majority of the developmentals and CPC-ITs *In Progress* and excluded from the assessment were from the 2014-2015 timeframe, which may also have differentially affected the results. We recommend updating the assessment as the developmentals and CPC-ITs currently *In Progress* complete training. We further recommend evaluating the total cost to achieve training success in field facilities including a comparison of the cost of training developmentals at higher-level facilities as compared to the recommended path of requiring developmentals to be trained to initial CPC at lower-level facilities followed by training them as CPC-ITs to achieve CPC at higher-level facilities.

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