

Summary of Automation Training Research Questions Survey

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Introduction

Research funding is limited and it is important to prioritize funding allocation and research project definition to be consistent with the current challenges of the airlines. The purpose of this study is to gather information that can be used in determining such priorities for human factors research to address training for pilots who fly airplanes with flight decks that include automated systems. The process used was to gather information about the issues of importance to industry, create a list of research questions based on those issues, conduct a survey to understand the importance and urgency of those research questions, and prioritize the research questions based on responses to the survey. This document describes each of these steps.

Research Question Development

The first step in our process was to understand the issues being faced by the airline training directors, managers, and instructors. We met with the training committees of the Air Transport Association, Regional Airline Association, and Air Line Pilots Association to gather their input on these issues. The issues from all of these groups were integrated into a common list of issues. The list of common issues was then translated into a list of research questions that could address the issues, resulting in a list of 42 research questions.

Survey Development

The purpose of the survey was to develop a prioritized list of research questions based on input from the industry participants. For each research question, the survey requested responses on three items:

- In your opinion, how important is it to find an answer to this research question?
- Does your organization already have a satisfactory answer to this question?
- If not, how urgent is it to your organization to obtain the answer?

The research questions were organized into five categories for the survey: training program development (5 research questions), training methods (19 research questions), training evaluation (7 research questions), integration of programs (4 research questions), and policy and other issues (7 research questions). The full list of research questions is included in Appendix A. The survey was conducted online and the participants could go to the survey website and enter their responses at their convenience.

Participants

Survey participation requests were sent to all members of the ALPA Training Council, ATA Training Committee, and RAA Training Committee. We had 26 responses to our survey. The participant demographics are presented in the following table.

Your answers are anonymous, but we would like to know the roles and positions you serve in your organization to help us understand the results. Please choose all that apply of the following.

Answer Options	Response Percent	Response Count
Line Pilot	50.0%	13
Check Airman	7.7%	2
Instructor	3.8%	1
Training Manager	11.5%	3
Fleet Manager	3.8%	1
Director (with training oversight)	26.9%	7
Other	11.5%	3
Comments		5
<i>answered question</i>		26
<i>skipped question</i>		0

Results

Overall Rank

All of the survey responses were used to develop a set of prioritized research questions. To develop the ranking system, first, an average importance response score was calculated for each question. The calculation consisted of multiplying the responses to the five point "importance" scale (not important, neutral, somewhat important, very important, extremely important) by the number responding for each item by 1 through 5, respectively, and then dividing the sum by the number of responses. Below is an example with the average importance for this question highlighted in yellow.

In your opinion, how important is it to find the answer to this research question?		
Answer Options	Response Percent	Response Count
Not important	3.8%	1
Neutral	3.8%	1
Somewhat important	19.2%	5
Very important	57.7%	15
Extremely important	15.4%	4
<i>answered question</i>		26
<i>skipped question</i>		0

1	1
2	2
3	15
4	60
5	20
Avg	3.77

The approach was also applied to rank the responses to the question on urgency. Below is an example with the average urgency score highlighted in yellow. The urgency question may have been skipped if the respondent had already indicated, in the previous survey item, having a satisfactory answer to that research question.

If not, how urgent is it to your organization to obtain the answer?		
Answer Options	Response Percent	Response Count
Not urgent	20.0%	3
Neutral	33.3%	5
Somewhat urgent	26.7%	4
Very urgent	13.3%	2
Extremely urgent	6.7%	1
Comments		3
<i>answered question</i>		15
<i>skipped question</i>		11

1	3
2	10
3	12
4	8
5	5
Avg	2.53

To develop a final overall ranking of the research questions, the average importance and average urgency scores for each research question were added together and divided by two. Then this number was weighted by dividing by the number of respondents who indicated they “do not have satisfactory answer” for that research question; thus, giving a higher weight to those questions for which there were more organizations with no solutions. This process resulted in an Overall Rank for each of questions based on all three types of survey data (importance, whether already have a solution, and urgency).

The top 10 research questions ordered by Overall Rank are in the following list. The full list of 42 research questions and their ranks are presented in Appendix A.

Overall rank	Research Question
1	M9: What are the most important things to train for a pilot flying an automated airplane?
2	E2: What effective evaluation methods and best practices are there for ensuring that pilots who have trained using a distance education program are proficient?
3	M5: A number of technologies/approaches are available for presenting training materials (distance education, classroom table-top trainers, PC-based trainers, fixed-base simulators, motion-based simulators, training in the aircraft). What skills or knowledge is each approach best at training?
4	M6: What are the best practices to make the most effective use of distance training?
5	M15: What are effective methods and best practices for training new technology (such as RNAV, EFB, EVS, ADS-B, HUDs)?
6	M10: What are effective methods and best practices for continuing to train and evaluate basic airmanship skills in training programs for automated airplanes?
7	M17: What are effective methods and best practices for captain development training?
8	M2: What knowledge and skills can be trained using distance education programs?

9	I1: What are effective methods and best practices for integrating safety data (such as ASAP, FOQA, SMS) into training development and implementation?
10	M1: What are the best practices for developing and implementing distance education programs?

It is interesting to note that eight of these top 10 questions address training methods (those for which the ID numbers start with M), one addresses training evaluation, and one addresses integration of programs. Five of the 10 have some element of the question relating to training methods for and evaluation of distance education.

Urgency

An alternative way to consider the priority of the research questions is to look at those that are rated most urgent by the participants who did not think that their organizations have answers to the questions. The top ten research questions based on urgency ratings are shown in the following table along with the percentage of the respondents who answered that their organization does not have a solution to the question.

Urgency rank	Percentage of respondents who do not have solution	Research Question
1	66.7%	E4: How can we measure and give credit for what pilots have already learned and accomplished?
2	47.4%	M10: What are effective methods and best practices for continuing to train and evaluate basic airmanship skills in training programs for automated airplanes?
2	52.6%	M9: What are the most important things to train for a pilot flying an automated airplane?
4	63.2%	M15: What are effective methods and best practices for training new technology (such as RNAV, EFB, EVS, ADS-B, HUDs)?
5	75.0%	E2: What effective evaluation methods and best practices are there for ensuring that pilots who have trained using a distance education program are proficient?
6	47.1%	E5: What methods and metrics are effective for evaluating a pilot's underlying understanding of automated systems?
6	41.2%	E6: What evaluation methods and best practices are available for measuring the proficiency of using the automated systems?
6	46.7%	I1: What are effective methods and best practices for integrating safety data (such as ASAP, FOQA, SMS) into training development and implementation?

9	55.6%	M17: What are effective methods and best practices for captain development training?
10	68.4%	M5: A number of technologies/approaches are available for presenting training materials (distance education, classroom table-top trainers, PC-based trainers, fixed-base simulators, motion-based simulators, training in the aircraft). What skills or knowledge is each approach best at training?

Seven of the research questions in this table are also in the top ten by Overall Rank. The other questions all address training evaluation. Even though these questions have been ranked as most urgent, these results are based only on a subset of the participants and do not take the importance ratings into account as is done in the overall rank.

There are many other possibilities for understanding and using these results. All research questions and their associated responses for importance and urgency are presented in Appendix A.

Conclusions

Speaking with representatives of the airlines industry, we have found that there are many human factors research questions related to pilot training for the automated airplanes that are important to them. We have also identified the urgency of getting answers to those research questions for which organizations do not already have solutions. The ratings of importance and urgency were used together with a weighting of how many respondents did not already have solutions to develop an overall ranking of the research questions. This list of questions can be used as input for developing project definition and funding priorities for serving the needs of this section of the industry.

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Appendix A

All Research Questions Sorted by Overall Rank

Research Question	Avg Importance	Importance Rank	Number who have solution	Number who do not have solution	Other	Avg Urgency	Urgency Rank	Imp rank + Urgency rank / 2	Imp + Urg rank	Imp + Urg rank / do not have	Overall rank
M9: What are the most important things to train for a pilot flying an automated airplane?	4.53	1	9	10	0	3.70	2	1.5	1	0.150	1
E2: What effective evaluation methods and best practices are there for ensuring that pilots who have trained using a distance education program are proficient?	4.41	2	4	12	0	3.58	5	3.5	2	0.291	2
M5: A number of technologies/approaches are available for presenting training materials (distance education, classroom table-top trainers, PC-based trainers, fixed-base simulators, motion-based simulators, training in the aircraft). What skills or knowledge is each approach best at training?	4.32	3	6	13	0	3.43	10	6.5	5	0.500	3
M6: What are the best practices to make the most effective use of distance training?	4.32	3	5	13	1	3.40	11	7	7	0.538	4
M15: What are effective methods and best practices for training new technology (such as RNAV, EFB, EVS, ADS-B, HUDs)?	4.21	9	7	12	0	3.62	4	6.5	5	0.542	5

M10: What are effective methods and best practices for continuing to train and evaluate basic airmanship skills in training programs for automated airplanes?	4.21	9	10	9	0	3.70	2	5.5	3	0.611	6
M17: What are effective methods and best practices for captain development training?	4.26	5	8	10	1	3.45	9	7	7	0.700	7
M2: What knowledge and skills can be trained using distance education programs?	4.15	12	6	14	0	3.40	11	11.5	11	0.821	8
I1: What are effective methods and best practices for integrating safety data (such as ASAP, FOQA, SMS) into training development and implementation?	4.24	6	8	7	2	3.50	6	6	4	0.857	9
M1: What are the best practices for developing and implementing distance education programs?	4.14	13	4	16	1	3.25	17	15	14	0.938	10
D3: What knowledge and skills can be trained using distance education programs?	4.23	8	6	18	2	2.95	27	17.5	19	0.972	11
M7: What are the best practices to make the most effective use of: • Table-top trainers • PC-based trainers • Fixed-base simulators • Motion-based simulators • Training in the aircraft	4.16	11	5	13	1	3.21	20	15.5	16	1.192	12
E4: How can we measure and give credit for what pilots have already learned and accomplished?	3.88	24	5	10	0	3.90	1	12.5	12	1.250	13
E5: What methods and metrics are effective for evaluating a pilot's underlying understanding of automated systems?	4.12	14	9	8	0	3.50	6	10	9	1.250	13

E7: How can we train and measure performance to ensure that pilots, instructors, evaluators, and regulators have been trained to the same level of proficiency?	4.24	6	9	8	0	3.33	14	10	9	1.250	13
D2: What are the best practices for developing and implementing distance education programs?	4.08	18	6	18	2	2.90	29	23.5	23	1.306	16
E1: What should one look for when deciding which outside vendor's distance education program to purchase?	4.12	14	6	11	0	3.25	17	15.5	16	1.409	17
D5: How can an airline determine whether training is necessary when adding new technology (e.g. display technology) to their airplanes?	3.96	23	5	18	3	2.74	35	29	29	1.611	18
D4: What factors (e.g., fatigue, night scheduling, training scheduling) influence training effectiveness and overall pilot performance enough that they should be considered in policy development?	3.77	28	5	19	2	2.70	36	32	31	1.684	19
E6: What evaluation methods and best practices are available for measuring the proficiency of using the automated systems?	4.00	19	10	7	0	3.50	6	12.5	12	1.786	20
I3: What are the best practices for effectively integrating error management methods and approaches into training programs?	4.12	14	7	10	0	3.17	22	18	20	1.800	21
M18: What are effective methods and best practices for training for new self-separation requirements?	3.58	35	2	16	0	3.13	24	29.5	30	1.844	22

E3: What metrics could be developed to demonstrate that a training objective (e.g. maneuver or system usage) has been well-learned and is well understood?	4.00	19	8	8	1	3.40	11	15	14	1.875	23
M3: What are the best practices for effectively integrating pilots initially trained in the multi-crew pilot license (MPL) program into the workforce?	3.84	25	3	16	0	2.53	39	32	31	2.000	24
O5: What data and methods can be used to ensure consistent treatment of training program requests and requirements for all operators?	3.71	30	2	13	1	3.15	23	26.5	25	2.038	25
O4: What data and methods can be used to convince regulators that performance of a maneuver has not degraded and thus does not need to be assessed?	4.00	19	6	8	3	3.33	14	16.5	18	2.063	26
M8: What are the best practices for sequencing training program elements (e.g., classroom, procedures trainers, simulators, etc.) to most effectively train pilots?	4.00	19	9	9	1	3.18	21	20	21	2.222	27
M14: What are effective methods and best practices for mixed-fleet flying training programs?	3.47	37	6	12	1	3.23	19	28	26	2.333	28
M19: What are effective methods and best practices for training to work with ATC on requests not consistent with airplane capabilities?	3.42	38	6	13	0	2.93	28	33	36	2.538	29

O3: What can be done to develop and implement industry programs that will result in the sharing of best practice information throughout the industry?	3.82	26	5	11	1	2.87	31	28.5	27	2.591	30
M11: What are effective methods and best practices for re-qualification training?	3.79	27	11	8	0	3.30	16	21.5	22	2.688	31
M4: What factors (e.g., fatigue, night scheduling, training scheduling) influence training effectiveness and overall pilot performance enough that they should be considered in policy development?	3.68	31	6	12	1	2.77	34	32.5	35	2.708	32
I2: What are the best practices for merging training programs when airlines merge?	3.65	33	2	13	1	2.67	38	35.5	38	2.731	33
I4: What are the best practices for effectively integrating pilots initially trained in the multi-crew pilot license (MPL) program into the workforce?	3.19	40	2	14	0	2.33	42	41	42	2.929	34
O6: What are the best practices for coordinating across airlines and operators to share training for new capabilities and other training issues?	3.18	41	2	12	2	2.87	31	36	39	3.000	35
O7: What methods can be used to gather information about why a system was designed as it was (given that OEMs do not typically share this information)?	3.12	42	4	12	0	2.69	37	39.5	41	3.292	36
O1: What methods can be used to ensure that pilot records contain objective and factual data?	4.12	14	10	7	0	2.80	33	23.5	24	3.357	37

O2: How can human factors data on the operational elements (e.g. fatigue) that influence training effectiveness and overall pilot performance be brought to bear on pilot labor contract development?	3.56	35	4	11	0	2.36	41	38	40	3.455	38
M13: What are effective methods and best practices for upset recovery training?	3.63	34	10	9	0	2.89	30	32	31	3.556	39
D1: What are the best practices for developing an effective AQP program for the first time (first fleet)?	3.77	28	15	9	2	2.53	39	33.5	37	3.722	40
M16: What are effective methods and best practices for transition training when pilots move to less automated airplanes?	3.33	39	10	7	0	3.00	25	32	31	4.571	41
M12: What are effective methods and best practices for training stabilized visual approaches?	3.67	32	14	4	0	3.00	25	28.5	27	7.125	42