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Analyzing Vehicle Operator Deviations

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16. Abstract

Runway incursions (RIs) are one of the top safety issues for the Federal Aviation Administration (FAA). Considerable effort has gone into understanding how pilot deviations and air traffic control (ATC) operational errors contribute to RIs. In contrast, little is known about human factors issues related to vehicle operator deviations (VODs). VODs occur when a vehicle enters the airport movement area without ATC approval. We developed a VOD prediction model to help understand the human factors causes associated with different types of VODs. We then examined the validity of the model, using logistic regression and directed graphical modeling. Although the results of our analyses provided partial support for our prediction model, much of the data that we needed was missing due to incomplete reporting of the human factors associated with a given VOD. To aid in the development of a more comprehensive VOD reporting process, we adapted a human factors taxonomy used in air traffic control (JANUS-ATC) to ground operations (JANUS-GRO). JANUS-GRO was then used to demonstrate how VOD reporting could be improved.

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INTRODUCTION

Runway surface safety is a high priority issue for the Federal Aviation Administration (FAA) and the aviation community. Over the years, considerable effort has been invested in identifying and addressing runway incursions attributable to controller and pilot errors. However, runway incursions do not solely occur between aircraft. They also involve aircraft and vehicles or pedestrians on the movement area. Not all ground vehicle operators or pedestrians pay attention to the special procedures necessary for safe operation on an airfield. The failure of vehicle operators to acquire air traffic control (ATC) approval prior to accessing airport movement areas poses a serious threat to aviation safety. In this report, we present the results of an analytical study that examined the types of vehicle operator deviations (VODs) that occur and recommend a process for improving the manner in which VOD investigations are conducted. An adaptation of an ATC human error taxonomy called JANUS-ATC (Pounds & Isaac, 2003) is applied to ground operations. The adapted taxonomy is called JANUS-GRO (Scarborough, Pounds, & Bailey, 2005).

A VOD occurs when a vehicle operator crosses a taxiway or a runway (which are designated as the airport movement area) without approval/clearance from the air traffic control tower. If the VOD creates a collision hazard or results in a loss of separation with an aircraft taking off, intending to take off, landing, or intending to land, then it is classified as a Category A, B, or C runway incursion based on the International Civil Aviation Organization's (ICAO) safety risk metrics (FAA, 2007a). If there is no disruption of arriving or departing aircraft by the VOD, then it is classified as Category D runway incursion. More formal definitions of these terms were extracted from FAA (2007a) and appear in Appendix A.

The FAA Office of Runway Safety has implemented a number of initiatives directed at improving runway safety through increased education, training, awareness, and improved airport runway markings and lighting, along with new runway surveillance systems. Runway surface surveillance systems, such as the Airport Movement Area Safety System (AMASS) and the new Airport Surface Detection Equipment Model X (ASDE-X and ASDE-3X), use ground surveillance radar to provide tower controllers with information on the position and identification of aircraft and vehicles (FAA, 2007b).

Another FAA initiative designed to improve runway safety was the development of JANUS-GRO. The goals of JANUS-GRO were to provide a common human factors framework for identifying human factors trends through better VOD reporting, designing VOD mitigation strategies, and evaluating the success of VOD reduction efforts. As Figure 1 shows, JANUS-GRO consists of two broad error categories: (a) factors directly related to vehicle operator performance, and (b) factors that contribute indirectly to vehicle operator performance. Direct performance factors consist of the task being performed, the mental processes (i.e., perception and vigilance, memory, and planning and decision making) involved, and the vehicle operator's compliance with the standard operating procedures that govern ground movement. Indirect performance factors consist of the contextual conditions (e.g., airport configuration, amount of ground traffic, weather, and ambient noise) associated with vehicle operators' performance and supervisory and organizational influences.

Managing VODs is a shared responsibility between Airport Authorities and the FAA. An Airport Authority is governed by the county or region (e.g., Dallas/Fort Worth is regional) in which the airport resides. The Airport Authority manages all aspects of the airport operations area, or airside as it will be referred to in this report, defined as all restricted ground areas of the airport, including taxiways, runways, safety areas, loading ramps, and parking areas within the perimeter fence. However, the FAA controls access to runways and taxiways. Movement and safety areas are governed by FAA procedures and detailed in Title 14 of the Code of Federal Regulations (CFR) Part 139. Specific information for vehicle operators is contained in 14 CFR 139.329, and information addressing safety areas is contained in 14 CFR 139.309 (FAA, 2007c).

Any time a vehicle operator wants to enter the airside he/she first must be authorized by the Airport Authority. Two types of authorization may be issued: (a) to be on both movement areas (runways, taxiways, and safety areas) and non-movement areas (ramps/aprons, perimeter roads, etc.), or (b) to be only on the non-movement areas. Vehicle operators accessing movement areas are required to communicate with ATC and receive clearance for their route prior to movement. If a vehicle operator enters or moves about the movement area without prior ATC approval, regardless of whether an aircraft is nearby, then that person has committed a VOD (FAA, 2007c, 2007d). The person seeing the VOD (i.e., ATC, pilot, or other airport employee) then reports the observation to the ATC manager, as specified in FAA Order 8020-11B Chg 1 (2003). After receiving the information, the ATC

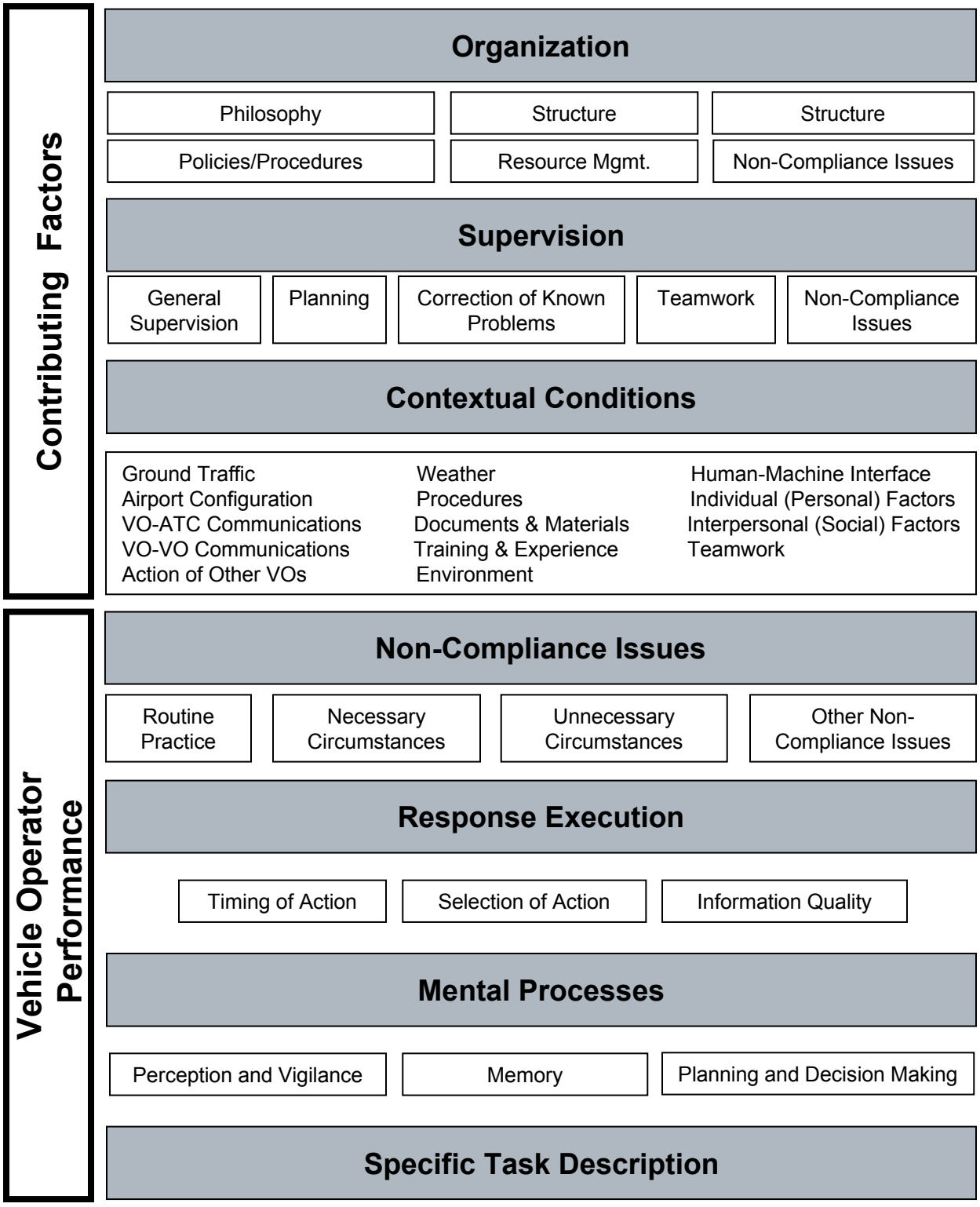

Figure 1. JANUS-GRO

manager files a preliminary report (FAA Form 8020-24), which records the basic VOD facts, such as the location of the incident on the surface, the vehicle(s) and aircraft involved in the incident, information about the drivers, pilots, pedestrians, surface equipment, environmental conditions at the time, and how the incident was detected (see Appendix B). The first ten items of the preliminary report must be completed and the information transmitted via facsimile or telephone within three hours of the incident to the regional Airports Division Manager and to the airport operator/certificate holder. The preliminary form must be completed in full and mailed to the appropriate offices by first-class mail within ten calendar days of the reported VOD.

Once the Airports Division Manager receives the preliminary report, he/she assigns an Airport Certification Inspector (ACSI) to the case. The ACSI issues a Letter of Investigation to the airport operator notifying him/her that an investigation of the VOD is being conducted. In response to the letter of investigation, the airport operator conducts an investigation of the VOD and sends a report of the outcome to the FAA. Based on the information which the ACSI receives, the ACSI reviews the report and ensures that the preliminary form is accurate in its representation of the incident and, if needed, interviews the vehicle operator before determining appropriate action. Appropriate action could take the form of either a close-out with no action, Letter of Correction, Warning Letter, or possibly Civil Penalty (FAA, 2004, 2006a, 2007e). The ACSI has 90 days to complete a final report, FAA Form 8020-25 (see Appendix C). Included in the final report are items that cover the type of deviation committed, the contextual conditions contributing to the deviation (e.g. weather) and the vehicle operator's cognitive state of mind (e.g., whether the vehicle operator believed he/she was cleared, was lost, or forgot to request clearance) at the time of committing the deviation, information about the level of airport authorization issued by airport operations, whether vehicle operator training was offered and completed, vehicle operator educational/skill deficiencies, and any ASCI recommendations (such as updating the training program) for improving the situation. After the ACSI integrates the results of the investigation, he/she distributes the completed report to the same organizations referenced in the preliminary report, and the case is closed based on the facts of the investigation. However, follow-up may be necessary to ensure that the airport operator has implemented the recommendations contained in the final report.

Research Hypotheses

Based on the information provided in Form 8020-25, we developed a directed model depicting the causal sequence of human factors associated with committing a VOD. By sequence, we mean a structured order of events based on the time in which they occurred (i.e., whether an event A happened before or after a given event B). As shown in Figure 2, the type of training one receives determines the level of airport access, which then creates the opportunity for certain types of VODs. This relationship is moderated by the contextual conditions

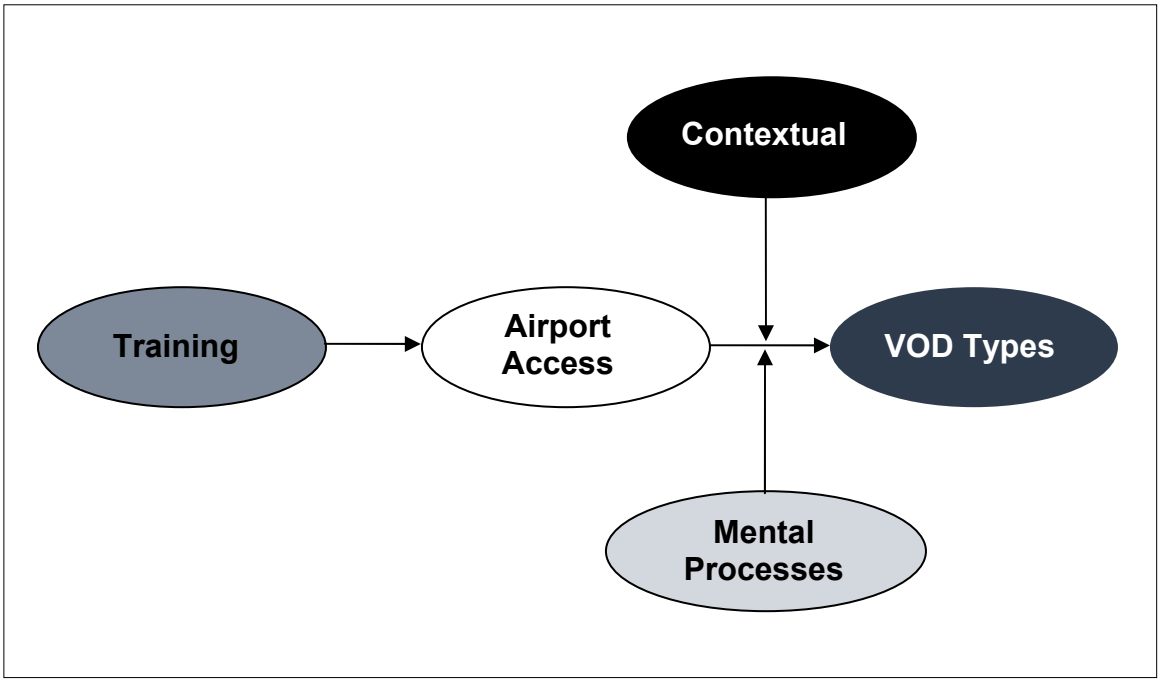

Figure 2. Hypothesized Causal Sequence of VODs

surrounding the movement area and the state of mind of the operator prior to committing the VOD. Historically, the occurrence of factors related to VODs has been reported in the form of frequencies and percentages. We wished to move beyond simply describing VODs to forming predictive models that could serve as exemplars for designing improved VOD mitigation strategies. Toward achieving that goal, we developed hypotheses about each of the topic areas shown in Figure 2.

H1: Training deficiencies are more likely to be associated with vehicle operators who are authorized to be on only the non-movement area.

Everyone who is granted access to the movement area receives some type of training. As a general rule, vehicle operators authorized to be on the movement area receive training in three areas:

1) Airport Operational Procedures, which includes the rules and regulations for operating vehicles on all or part of the airside.
2) Driver Familiarization, which includes runway and taxiway configurations; the demarcation of movement and non-movement areas; airfield lighting, signage, and markings; and communications with ATC.
3) Driver Training, in the form of simulation and/or test drives.

In contrast, vehicle operators that are only authorized to be on the non-movement area typically receive training just on operational procedures and do not receive training on driver familiarization or driver training.

Airports vary in the type and quality of training that they provide to vehicle operators who are granted access to the airside. Training delivery can vary from self-study (for movement areas), being briefed (for non-movement areas), receiving video instructions, and/or driving a simulated vehicle. Based on this information, we hypothesized that training deficiencies will be more evident for those who are unauthorized to be on the movement area because they typically receive less training than those who are authorized to be on the movement area.

H2: VOD types involving ATC communications are more likely associated with vehicle operators authorized to be on the movement area.

H3: VOD types not related to ATC communications will be equally associated with vehicle operators who are either authorized or unauthorized to be on the movement area.

As reported in the FAA Vehicle Pedestrian Deviation Investigation Forms (8020-24 and 8020-25), VODs fall into two categories:

1) those that involved ATC communications and
2) those that did not involve ATC communications.

There were two types of VODs involving ATC communications: (a) those in which the vehicle operator failed to follow the route assigned by ATC, and (b) those in which the vehicle operator failed to follow other ATC instructions (such as holding short of a runway or waiting until an aircraft clears the runway). There were three types of VODs not involving prior ATC communications: (a) those in which the vehicle operator failed to observe the signs, markings, and/or lighting associated with the movement area boundaries, (b) those in which the vehicle operator failed to follow the movement area procedures and (c) those that involved vehicle operators performing unexpected/unplanned actions.

Since only vehicle operators who have full access to the movement area are expected to have communications with ATC, we hypothesized that VOD types related to ATC communications would be more commonly associated with authorized vehicle operators. However, since both full and restricted authorized vehicle operators have access to the non-movement area (the area that does not require prior ATC coordination), we did not expect there to be a difference in VOD types unrelated to ATC communications.

H4: Mental processes related to ATC communications (i.e., forgetting to request a clearance and believing that a clearance was issued) are more likely associated with vehicle operators authorized to be on the movement area.

H5: Mental processes not necessarily related to ATC communications (i.e., inability to locate the route, being disoriented or lost, and being distracted) will be equally associated with vehicle operators who were either authorized or unauthorized to be on the movement area.

When investigators asked vehicle operators why they committed a given VOD type, the reasons were commonly associated with various mental processes that influenced their behavior. Examples of mental processes involving ATC communications include forgetting to request a clearance from ATC, and believing that a clearance was issued when it had not been issued. Examples of mental processes not involving ATC communication include inability to locate the route (this can also involve prior ATC communication), being disoriented or lost, and being distracted. Since authorized vehicle operators are required

to communicate with ATC, we hypothesized that the mental processes related to ATC communications (or the lack thereof) would more frequently involve authorized vehicle operators. However, since both authorized and unauthorized vehicle operators use the non-movement area, we expected that there would be no difference in the mental processes associated with the actions of vehicle operators unrelated to ATC communications.

H6: VOD types associated with failure to follow signals, signs, markings, and lighting are more likely related to maintenance and environmental contextual conditions compared to any other VOD type.

This hypothesis is based on the theory that maintenance and environmental contextual conditions are more likely to affect visual conditions than communications with ATC. Examples of maintenance contextual conditions include: signs, markings, and/or lighting that need repair. Examples of environmental contextual conditions include: adverse weather and construction.

All hypotheses will be tested from a logistic regression modeling perspective. This is because our data was based on the binary (yes/no) format of the VOD reporting form, which is ideally suited for logistic regression modeling. In addition to developing an overall prediction, logistic regression also produces the relative odds for a given risk factor being associated with the criterion of interest (i.e., a given VOD type).

The term "relative odds" is used here to emphasize that the calculation of the odds is based on the variables that appear in the regression equation. Thus, if important risk factors are not included in the model, then the resulting odds will not reflect the actual risks. This latter issue speaks to the need for a comprehensive investigation to determine the causes associated with VODs. At the conclusion of our study we provide guidelines for improving VOD reporting through the use of JANUS-GRO.

Finally, although Figure 2 was used to develop our hypotheses, the model itself had not been empirically validated. As a first attempt of validation, we used a data mining tool called WinMine (Chickering, 2002) to graphically display the structure of the VOD data, based on the probabilities that a given item from Form 8020-25 would be associated with another item. Using one-way directional arrows, WinMine displays the causal sequence embedded in the data. These causal sequences can then be compared to the causal sequences in our hypothesized model to determine if the model is supported by the data.

METHOD

Data

Archival data describing vehicle deviations occurring between January 2002 and May 2006 were extracted from the National Aviation Incident Monitoring System (NAIMS) database (n = 996). Of the 996 VODs, only 229 had sufficient data (i.e., no missing values for the variables of interest) to evaluate the utility of our directed/implicit model in Figure 2.

Materials

FAA Form 8020-25. Twenty-two items from FAA Form 8020-25 were used to populate each of the domains tested by the hypotheses described above. As shown in Table 1, six items described training/knowledge and experience, one item was used for airport access, five items represented contextual conditions, five represented mental processes, and five items described VOD types. Items on Form 8020-25 labeled as "Unknown," "Other," or "None of the Above," were not included in the analyses.

Statistical Analyses

Logistic Regression. Logistic regression modeling is ideally suited for finding associations between binary independent and dependent variables. The resulting beta coefficients are used to calculate the relative odds that a given independent variable is associated with a given dependent variable. Statistical significance ($p < .05$) is determined using the Wald statistic (Tabachnick & Fidell, 2007). In this report, we use the symbol W to indicate the value of the Wald test.

Directed Graphical Modeling. We used the WinMine Toolkit (Chickering, 2002) to develop a directed graphical model, based on the Form 8020-25 items shown in Figure 2. A directed graphical model uses Bayes' rule for probabilistic inference to identify the causal associations among variables. The causal sequence is displayed in a graphical form, using arrows to indicate the direction of causation (e.g., A→B→C). Although the mathematics behind graphical modeling are beyond the scope of this report, the interested reader is referred to Kevin Murphy's (2007) Web site (www.cs.ubc.ca/~murphyk/Bayes/bnsoft.html), which includes a discussion of graphical modeling and a comprehensive comparison of the different graphical modeling software packages, including WinMine.

Procedures

We converted data from the final Vehicle/Pedestrian Deviation Report (FAA Form 8020-25) from "yes/no" responses to a binary format: 0 = "absent" in the incident and 1 = "present" in the incident. Then, we tested the

Table 1. Form 8020-25 Items

Model Domains	Form 8020-25 Items (Block Number)
Training/Knowledge & Experience	Driver completed training program (5)
	English Language (7a)
	Airport Layout (7b)
	Signs, Markings, Signal, or Lighting (7c)
	ATC Movement Area Procedures (7d)
	ATC Terminology or Phraseology (7e)
Airport Access	Authorization (4b)
VO Mental Processes	Unable to locate route (9a)
	Was disoriented or lost (9b)
	Forgot to request clearance (9h)
	Believed he/she was cleared (9i)
	Was distracted (9j)
Contextual Conditions	
Maintenance	Unlocked or open gates (8a)
	Inadequate fence (8b)
	Signs, Markings, Signals or Lighting (8c)
Environmental	Conditions Outside Movement Area (8d)
	Movement Area Conditions (8e)
VOD Types	Did not observe markings/signals/ lighting (9c)
	Did not follow movement area procedures (9d)
	Did not follow route assigned by ATC (9e)
	Did not follow other ATC instructions (9f)
	Took inadvertent or unplanned actions (9g)

data for sufficient cell size and collinearity, and entered simultaneously into a logistic regression analysis following the procedures specified in Tabachnick and Fidell (2007). Next, we constructed separate Binary multivariate logistic models for each link depicted in the model shown in Figure 2. Then we examined casual relationships within a directed graphical model framework. Finally, we mapped Forms 8020-24 and 8020-25 items onto the JANUS-GRO taxonomy to identify the relative strengths and weaknesses of the current VOD reporting process.

RESULTS

Our results are presented in the following order: (a) hypotheses testing, (b) directed graphical modeling, and (c) improved VOD reporting.

Hypotheses Testing

Our first hypothesis was:

H1: Training deficiencies are more likely to be associated with vehicle operators who are only authorized to be on the non-movement area.

As shown in Table 2, this hypothesis was partially supported. Vehicle operators who completed the driver's training program were more likely to be authorized to be on the movement area (W = 26.96, p = .00). Although the associations for specific training deficiencies were not statistically significant, the trend was in the expected direction (as evident by the negative beta coefficients) for vehicle operators who were only authorized to be on the non-movement areas.

Our second and third hypotheses were related to the type of movement area authorization:

Table 2. Logistic Regression: Training and Knowledge/Experience Associated With Authorization

Training/Knowledge/Experience	B	S.E.	Wald	df	Sig.	Exp(B)
Training Completed	2.34	0.45	26.96	1.00	0.00	10.39
Airport Layout	-1.29	0.70	3.40	1.00	0.07	0.28
Signs, Markings, Signals, & Lighting	-1.24	0.74	2.79	1.00	0.09	0.29
ATC Movement Area Procedures	-0.88	0.50	3.12	1.00	0.08	0.41
ATC Terminology or Phraseology	1.37	0.75	3.34	1.00	0.07	3.94

Table 3. Logistic Regression: VOD Types Associated With Authorization

VOD Types	B	S.E.	Wald	df	Sig.	Exp(B)
Did not observe markings, signals, or lighting	-1.04	0.46	5.03	1.00	0.03	0.35
Did not follow movement area procedures	-0.37	0.33	1.30	1.00	0.26	0.69
Did not follow route assigned by ATC	0.97	0.60	2.56	1.00	0.11	2.63
Did follow other ATC instructions	2.70	0.77	12.32	1.00	0.00	14.93
Took inadvertent or unplanned actions	-0.54	0.33	2.71	1.00	0.10	0.58

H2: VOD types involving ATC communications are more likely associated with vehicle operators authorized to be on the movement area.

H3: VOD types not related to ATC communications will be equally associated with vehicle operators who are either authorized or unauthorized to be on the movement area.

As shown in Table 3, both hypotheses were partially supported. VODs related to following other ATC instructions were associated with vehicle operators who were authorized to be on the movement area ($W = 12.32$, $p = .00$). The other VOD type related to following the route assigned by ATC was in the predicted positive direction but was non-significant ($W = 2.56$, $p = .11$). Of the three VOD types not related to ATC communications, only one produced a statistically significant result: VODs related to the failure to observe signs, markings, signals and lighting were associated with vehicle operators who were unauthorized to be on the movement area (W = 5.03, $p = .03$). Although not significant, the failure to follow movement area procedures was in the predicted direction (negative beta coefficient) of unauthorized movement area vehicle operators. In contrast, the VODs related to unexpected/unplanned actions were also non-significant and were not in the predicted direction.

Our fourth and fifth hypotheses related to the mental processes:

H4: Mental processes related to ATC communications (i.e., forgetting to request clearance and believing that a clearance was issued) are more likely associated with vehicle operators authorized to be on the movement area.

H5: Mental processes not necessarily related to ATC communications (i.e. associated with the inability to locate the route, being disoriented or lost, and being distracted) will be equally associated with vehicle operators who were either authorized or unauthorized to be on the movement area.

Both hypotheses were partially supported by the results (Table 4). Of the mental processes related to ATC communications, only VODs in which the vehicle operator believed that he/she had been cleared by ATC were statistically associated with authorized vehicle operators ($W = 8.99$, $p = .00$). Of the three mental processes not necessarily related to ATC communications, only one—being unable to locate the route— was unrelated to either authorized or unauthorized vehicle operators.

Table 4. Logistic Regression: Mental Processes Associated With Authorization

States of Mind	B	S.E.	Wald	df	Sig.	Exp(B)
Forgot	0.27	0.49	0.32	1.00	0.57	1.31
Believe	1.01	0.34	8.99	1.00	0.00	2.75
Distract	1.43	0.65	4.89	1.00	0.03	4.17
Lost	-1.89	0.64	8.86	1.00	0.00	0.15
Locate	0.33	0.76	0.18	1.00	0.67	1.38

Table 5a. Logistic regression: VOD Types Associated With Conditions Outside Movement Area

Contextual Factors	B	S.E.	Wald	df	Sig.	Exp(B)
Did not observe markings, signals, or lighting	1.94	0.78	6.15	1.00	0.01	6.95
Did not follow movement area procedures	-0.33	0.74	0.20	1.00	0.66	0.72
Did not follow route assigned by ATC	1.72	0.81	4.47	1.00	0.03	5.57
Did not follow other ATC instructions	-0.59	1.16	0.26	1.00	0.61	0.55
Took inadvertent or unplanned actions	0.03	0.71	0.00	1.00	0.97	1.03

The remaining two mental processes each produced statistically significant associations, but in directions that differed from those hypothesized. VODs related to being lost were associated with unauthorized vehicle operators (W = 8.86, p = 00). In contrast, VODs related to being distracted were associated with authorized vehicle operators (W = 4.89, p = .03).

Our sixth and final hypothesis was:

H6: VOD types associated with not following signals, signs, markings, and lighting are more likely related to maintenance and environmental contextual conditions than to other factors.

This hypothesis was partially supported by the results shown in Tables 5a and 5b. The environmental contextual condition related to inclement weather and/or construction outside the movement area produced a statistically significant association with vehicle operators who did not observe signals, signs, markings, and/or lighting (W = 6.15, p = .01). The same environmental contextual condition also produced an unexpected association with vehicle operators who did not follow the route assigned by ATC (W = 4.47, p = .03). No maintenance contextual conditions produced statically significant results.

Directed Graphical Modeling

We used the WinMine tool kit to graphically display the causal associations among the Form 8020-25 items used in our analyses. As Figure 3 shows, there was a direct causal relationship between variables describing training, authorization, mental processes, and VODs involving the failure to follow other ATC instructions (e.g., holding short of a runway or waiting until an aircraft clears the runway before crossing). This VOD type occurs when authorized vehicle operators believed they were already cleared by ATC to proceed. However, it appears that, although these same vehicle operators had completed a drivers' training program, they displayed a lack of knowledge about the airport layout and failed to follow the signs, markings, signals, or lighting associated with the movement area. Although not related to a

Table 5b. Logistic Regression: VOD Types Associated With Conditions on Movement Area

Contextual Factors	B	S.E.	Wald	df	Sig.	Exp(B)
Did not observe markings, signals, or lighting	-1.05	0.80	1.71	1.00	0.19	0.35
Did not follow movement area procedures	-0.12	0.46	0.07	1.00	0.79	0.89
Did not follow route assigned by ATC	-0.14	0.80	0.03	1.00	0.86	0.87
Did not follow other ATC instructions	-0.62	0.78	0.64	1.00	0.42	0.54
Took inadvertent or unplanned actions	-0.31	0.48	0.41	1.00	0.52	0.73

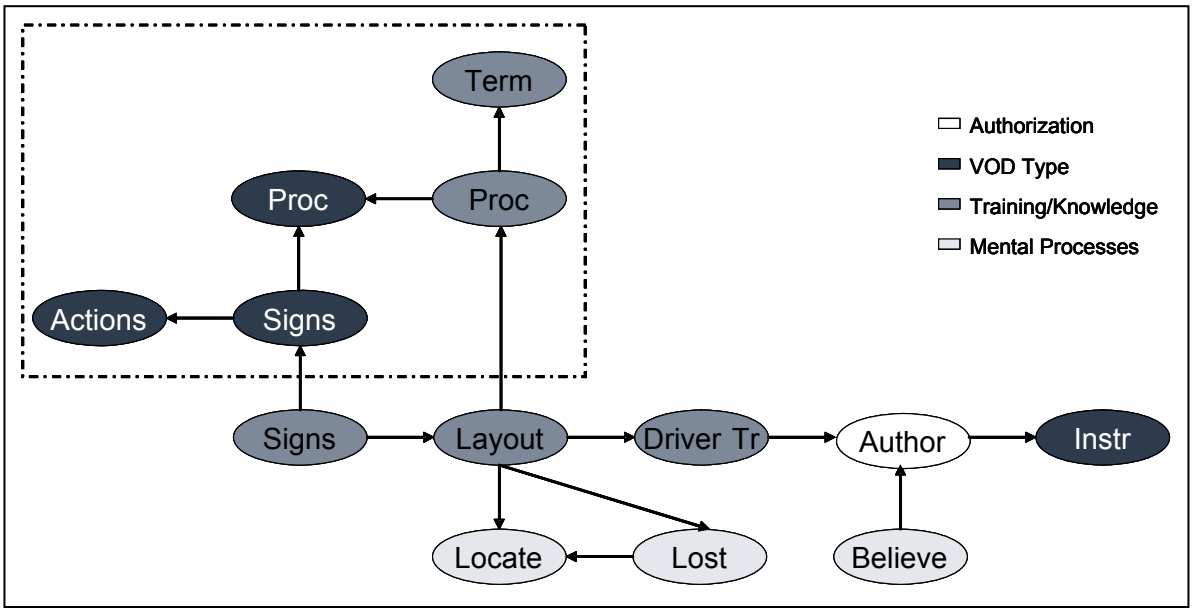

Figure 3. Data Driven Direct Graphical Model of Relevant Items From Form 8020-25

specific VOD type, Figure 3 also reveals that vehicle operators who lacked knowledge about the airport layout tended to get lost and were unable to locate the route assigned by ATC.

The relationships shown within the dotted box of Figure 3 were weak associations.[1] This means that the linkages were not as strong as those previously described and were more likely to change as additional data were collected. It appears, however, that the relationships are not associated with the level of vehicle operator authorization. This implies that both authorized and unauthorized vehicle operators were equally as likely to commit VODs related to unplanned actions; failure to observe signs, markings, signals, or lighting; or failure to follow movement area procedures.

Finally, none of the maintenance and environmental contextual conditions was represented in Figure 3 because the items representing these conditions had insufficient cell sizes to construct a probability distribution and thus were excluded from the final model.

Improved VOD Reporting

Earlier in the paper we mentioned that one of our objectives was to provide guidance for improving VOD reporting. After completing our hypothesis testing, we came to the conclusion that a majority of the VOD reporting process is focused on describing the context of VODs—without shedding much light on the underlying

[1] The weak associations tended to correspond to the non-significant findings reported in the logistic regression section.

Table 6. JANUS Mapping of VOD Information From Forms 8020-24 and 8020-25

	Form 8020-24		Form 8020-25		Total	
	No	Pct.	No.	Pct.	No.	Pct.
Organization	0	0.0	1	1.7	1	0.7
Management	0	0.0	0	0.0	0	0.0
Supervision	0	0.0	0	0.0	0	0.0
Contextual Conditions	28	35.5	21	36.2	49	35.8
Non-Compliance	0	0.0	5	8.6	5	3.7
Response Execution	0	0.0	0	0.0	0	0.0
Mental Processes	0	0.0	5	8.6	5	3.7
Specific Task Description	0	0.0	0	0.0	0	0.0
Descriptive Information	51	64.5	26	44.9	77	56.1
Total	79	100	58	100	137	100

human factors causes. To test this assumption, we mapped the items from Form 8020-25 onto the JANUS-GRO categories and examined the results.

Table 6 shows the mapping results of all the items (n=137) from Forms 8020-24 and 8020-25 onto JANUS-GRO categories. Of the 137 items, 56.1% provided descriptive information (unrelated to human factors causes) that documented the event, such as date, time, location, what happened, and to whom the report should be distributed. The next largest category was "contextual conditions," which represented 35.8% of the items. Non-compliance and mental processes each accounted for 3.7% of the items. From these results, we see that the current VOD reporting process has emphasized collecting information about the vehicle operator's actions in the context of the surrounding environment to the neglect of collecting information about why those actions occurred. The ramifications of these results will be used to recommend a method for improving the VOD investigation process.

DISCUSSION

We developed a VOD prediction model to help understand the human factors causes associated with different types of VODs. We then examined the validity of the model, using logistic regression and directed graphical modeling. From the logistic regression, we learned that the vehicle operators who were granted access to the movement areas were more likely to have completed a formal driver training program, compared to those who were only authorized to be on the non-movement area. We emphasize this point because when unauthorized vehicle operators wandered onto the movement area, they may have lacked sufficient training to navigate themselves back onto the non-movement area. Unfortunately, the current reporting process does not provide sufficient information about the quality or content of the training provided and, thus, we can only speculate.

Although logistic regression modeling was used to test our hypotheses, the results of the Bayesian network provided for a more comprehensive understanding of the relationships among the many items on the final VOD reporting form. The capability to identify causal sequences using WinMine allowed us to describe a chain of events associated with a given type of VOD (e.g., the failure to follow other ATC instructions). This information is useful not only for identifying VOD determinants but also for suggesting ways to reduce VODs. For example, we found that a lack of knowledge associated with the airport layout was instrumental in vehicle operators who completed driver training but became lost and/or were unable to locate the route they were instructed to follow. Knowing this, an airport operations manager could evaluate the airport's vehicle operator training program to determine whether improvements need to be made in how vehicle operators learn the airport layout and/or how they develop driving competencies for operating on and off the movement area.

However, perhaps the most important means of discovering why VODs occurred is to ask the vehicle operator why he/she wandered onto the movement area without

ATC approval. As we discovered when we briefed our research sponsors in the FAA's Airport Safety & Operations Division, vehicle operators are not always contacted to determine why they committed a VOD. Instead, the causal factors are sometimes inferred by reviewing and/or interpreting vehicle operators' behavior. For example, if a vehicle operator committed a VOD as a result of a failure to follow movement area procedures, it may have been inferred that the vehicle operator lacked the knowledge about movement area procedures. However, the VOD may instead have occurred because the vehicle operator was distracted due to thinking about the task that he/she was going to perform after arriving at the destination. Without conducting an interview with the vehicle operator, there is no way to know for certain why the vehicle operator did not follow movement area procedures.

Additional work needs to be done in the area of VOD reporting if we are going to reduce the number of VODs that occur each day on our nation's runways and taxiways. Our results illustrated that of all the information recorded on the current VOD reporting forms, less than 4% were associated with the vehicle operator's performance (i.e., task descriptions, non-compliance issues, and mental processes). Unless we collect additional information that allows us to understand why the VOD occurred, it is unlikely that we will be able to point to specific interventions that might reduce a given type of VOD, such as failing to follow the route assigned by ATC.

The need to improve human error reporting and management are some of the driving forces behind the current emphasis on developing safety management systems (SMS; FAA, 2006b). SMS is essentially an approach to controlling risk. SMS emerged from the conclusion that there will always be some degree of human error. Rather than attempting to completely eliminate human error through extensive inspection and remedial actions, SMS emphasizes reducing the severity and/or the likelihood of risk associated with system-wide safety hazards. These goals are accomplished by identifying the hazards, assessing the risk, analyzing the risk, and controlling the risk. The latter is accomplished through a feedback system that ascertains the effectiveness of mitigation strategies designed to reduce safety risks.

We suggest that representatives from airport operations and the FAA meet with the two-fold purpose of revising the current VOD reporting forms (8020-24 and 8020-25) and developing the necessary procedures to ensure that the relevant VOD human factors are collected during VOD investigations. We propose a revision that is based on the JANUS-GRO framework. As an example of how this might be accomplished, we developed flow charts to aid the data collection phase of the vehicle operator interviews. The instructions, reporting form, and flowcharts are included in Appendix D.

In our idealized situation, we assume that the designated airport operations investigator will be conducting the vehicle operator interviews. After presenting a general overview of the interview process, the investigator would use a combination of the six flow charts (Appendix D) to collect the relevant human factors information associated with the VOD. This includes information about (a) perception and vigilance, (b) memory, (c) planning and decision making, (d) response execution, (e) noncompliance, and (f) contextual factors. Each flow chart begins at an entry point and, through a series of branching questions, ends with the identification of a given human factors event. The emphasis on using flow charts is to ensure that the investigator does not prematurely arrive at a conclusion prior to collecting all the relevant facts. Once an endpoint is reached on a given flowchart, the information is then transferred to the data recording form (Appendix D).

In addition to guiding the interview process, the modified reporting form contained in Appendix D can also produce information that can be used to design initial and remedial training for both FAA and Airport Operations inspectors. Although the emphasis of our report has been on understanding the human factors associated with VODs, we would be remiss if we did not include in our discussion the importance of ensuring that VOD investigators are also grounded in basic human factors principles. At the time of this writing, there appears to be no standardized human factors training for FAA and Airport Operations inspectors. Consequently, considerable variation in the type and quality of data collected during vehicle operator interviews will occur. To reduce such variability in reporting, we suggest that an FAA/Airport Operations workgroup, including human factors experts, be convened to develop human factors training standards for FAA and Airport Operations inspectors.

CONCLUSION

The analysis of the human factors causes associated with VODs is dependent on the quality and quantity of the data collected. The results of our study suggest that it is possible to identify human factor causes associated with a specific VOD type. However, in its current state, the type of information collected during VOD investigations is insufficient and needs to be improved. We offer the JANUS-GRO framework as a first step towards improving the VOD investigation and reporting process.

REFERENCES

Chickering, D. (2002). *The WinMine toolkit*. Redmond, WA: Microsoft Research Technical Report No. MSR-TR-2002-103.

Federal Aviation Administration (2003). *Aircraft accident and Incident Notification, Investigation, and Reporting* (FAA Order 8020.11B CHG 1). Washington, DC: Author.

Federal Aviation Administration (2004). *Procedures for conducting investigations of vehicle/pedestrian deviations* (FAA Order 5200.10). Washington, DC: Author.

Federal Aviation Administration (2006a). *Airport Certification Program Handbook* (FAA Order 5280.5C). Washington, DC: Author.

Federal Aviation Administration. (2006b). *Introduction to safety management systems (SMS) for air operators* (FAA Advisory Circular 120-92). Washington, DC: Author.

Federal Aviation Administration Air Traffic Organization (2007a). *Runway safety report*. Washington, DC: Author.

Federal Aviation Administration (2007b). *Airport surface products*. Retrieved March 30, 2007 from www.faa.gov/and/and400/410/index.html

Federal Aviation Administration (2007c). *Title 14 Code of Federal Regulations, Part 139, Certification of Airports*.

Federal Aviation Administration (2007d). *Driving on the airport operations area: Airport vehicle operator safety study guide*. Retrieved March 30, 2007 from www.awp.faa.gov/ops/runwaysafety/education/operating%20airport%20environment.pdf.

Federal Aviation Administration (2007e). *FAA Compliance and Enforcement Program* (FAA Order 2150.3B). Washington, DC: Author.

Murphy, K. (2007). *Software packages for graphical models*. Retrieved March 30, 2007 from www.cs.ubc.ca/~murphyk/Bayes/bnsoft.html.

Pounds, J. & Isaac, A. (2003). *Validation of the JANUS technique: Causal factors of human error in operational errors*. Washington, DC: Federal Aviation Administration Office of Aerospace Medicine Technical Report No. DOT/FAA/AM-03/21.

Scarborough, A., Pounds, J., & Bailey, L. (2005). JANUS-GRO: A human factors taxonomy for ground operations. *Proceedings of the Second Safety Across High-Consequence Industries Conference, 2005-02-022.*

Tabachnick, B.G. & Fidell, L.S. (2007). *Using multivariate statistics* (pp.437-505). Boston: Pearson Education, Inc.

APPENDIX A

ICAO Runway Incursion Definition and Severity Classification*

As part of the Flight Plan goal for International Leadership, the FAA supported the efforts of ICAO to establish standard definitions for runway incursion and runway incursion severity (see Figure 24). This will eventually allow the collection of comparable data and enable the building of a comprehensive database of global information that may be used to enhance runway safety management.

Figure 24. Comparison between FAA and ICAO Runway Incursion Severity Definitions

FAA Runway Incursion Definition	ICAO Runway Incursion Definition
Any occurrence in the airport runway environment involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in a loss of required separation with an aircraft taking off, intending to take off, landing, or intending to land.	Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.

Currently, the FAA reviews all surface incidents (SIs), identifies a subset as runway incursions, and assigns a severity. Effective October 1, 2007, the FAA will categorize runway incursions using the ICAO definition of incursions and the ICAO severity categories. Figure 25 shows a comparison between FAA and ICAO runway incursion severity classifications.

Figure 25. FAA and ICAO Runway Incursion Severity Classification Comparison

FAA		ICAO	
Class	Description	Class	Description
A	Separation decreases and participants take extreme action to narrowly avoid a collision, or the event results in a collision.	Accident	Refer to ICAO Annex 13 definition of an accident.
		A	A serious incident in which a collision was narrowly avoided.
B	Separation decreases and there is a Significant potential for a collision.	B	An incident in which separation decreases and there is a significant potential for collision, which may result in a time critical corrective/evasive response to avoid a collision.
C	Separation decreases, but there is Ample time and distance to avoid A potential collision.	C	An incident characterized by ample time and/or distance to avoid a collision.
D	Little or no chance of a collision but meets the definition of a runway incursion		

(Continued)

FAA		ICAO	
Class	Description	Class	Description
Other SI	An event during which unauthorized or unapproved movement occurs within the movement area or an occurrence in the movement area associated with the operation of an aircraft that affects or could affect the safety of flight. (This subset includes only non-conflict events)	D	Incident that meets the definition of runway incursion such as incorrect presence of a single vehicle/pedestrian/aircraft on the protected area of a surface designated for the landing and take-off of aircraft but with no immediate safety consequences.
		Not Defined	(FAA non-conflict SI include more than just ICAO class "D" events)
ID	Insufficient Data: Inconclusive or conflicting evidence precludes severity assessment.	E	Insufficient information: inconclusive or conflicting evidence precludes severity assessment.

The FAA's expansion of the definition of a runway incursion to harmonize with the ICAO definition will lead to an increase in the total number of runway incursions and a change in the United States runway incursion severity distribution. For instance, runway incursions currently categorized as Category C or D under the FAA definition will become Category C incursions under the ICAO definitions.

*From FAA (2007a), p. 43 and 44.

APPENDIX B

PRELIMINARY VEHICLE/PEDESTRIAN DEVIATION REPORT
FORM 8020-24

PRELIMINARY
VEHICLE OR PEDESTRIAN DEVIATION REPORT

Incident Report Number

V

Air Traffic Control should complete this form after observing a vehicle or pedestrian deviation (V/PD) or receiving a report of one. Complete and distribute according to the instructions on page 3. Unless computer generated, complete the form by hand or typewriter.

1. Date, Time, and Location of Deviation:

   A. Date (Coordinated Universal Time-UTC)
   |__|__|__|__|__|__|
   M M D D Y Y
   B. UTC Time
   |__|__|__|__|
   C. Local Time
   |__|__|__|__|
   D. Airport ID at Surface Deviation Location
   |__|__|__|__|
   E. Nearest City or Town, and State
   _____

2. Type of Deviation *(mark one)*:

   A. ☐ Vehicle (excludes bicycles; includes aircraft being repositioned; c*omplete remainder of form, except item 14)*
   B. ☐ Pedestrian (includes bicycles; *complete items 5 to 11, and 14 to 2)*

3. If There Was Loss of Separation *(mark one)*:

   A. ☐ Yes, Closest Proximity Was
      1. Horizontal _____ Feet
      2. Vertical _____ Feet
   B. ☐ No

4. Vehicle Information *(report bicycles in item 14)*:

   A. Type *(mark one)*
      1. ☐ Tug
      2. ☐ Baggage or Cargo Truck
      3. ☐ Fuel Truck
      4. ☐ Aircraft Being Relocated by Non-pilot
      5. ☐ Snow Removal Equipment
      6. ☐ Mower
      7. ☐ Construction Equipment
      8. Motorcycle
      9. ☐ Car (includes sport-utility vehicles)
      10. ☐ Other Trucks (includes buses, vans, etc.)
      11. Other, Specify _____
   B. License/Tail No _____
   C. State of License _____
   D. Call Sign *(if applicable)* _____
   E. Make _____
   F. Model _____
   G. If Vehicle Was Escorted, Specify _____

5. Surface Detection Equipment:

   A. ☐ No Surface Detection Equipment at the Airport *(skip to item 6)*
   B. Equipment Was Operational
   (1) ☐ Yes (2) ☐ No (3) ☐ Unknown
   C. Equipment Was On
   (1) ☐ Yes (2) ☐ No (3) ☐ Unknown
   D. Movement Was Detected by Equipment ASDE/AMASS Only
   (1) ☐ Yes (2) ☐ No (3) ☐ Unknown
   E. There Was an Alert
   (1) ☐ Yes (2) ☐ No (3) ☐ Unknown
   F. There Was a Response to Alert
   (1) ☐ Yes (2) ☐ No (3) ☐ Unknown

6. Environmental Conditions *(mark appropriate boxes)*:

   A. ☐ Clear
   B. ☐ Cloudy Day
   C. ☐ Rain ( ) Light/Moderate ( ) Heavy
   D. ☐ Thunderstorm
   E. ☐ Snow ( ) Light/Moderate ( ) Heavy
   F. ☐ Freezing Rain
   G. ☐ Fog
   H. ☐ Snow on Pavement
   I. ☐ Slush
   J. ☐ Other, Specify _____
   K. ☐ Prevailing Visibility _____ (Statue Miles)
   ☐ Runway Visual Range _____ (Feet)
   ☐ Runway Visibility Value _____ (Statue Miles)
   L. ☐ Temperature _____ Fahrenheit
   M. ☐ Ceiling _____ Feet

7. Deviation Occurred on the Following Movement Area(s) *(mark appropriate boxes, describe pertinent non-movement areas in item 10)*:

   A. ☐ Runway, Specify _____
   B. ☐ Taxiway, Specify _____
   C. ☐ Intersection, Specify _____
   D. ☐ Other, Specify _____

8. A Clearance Was Issued or Amended to Preclude a Loss of Separation or Collision Hazard *(mark one)*:

   A. ☐ Yes, Specify _____
   B. ☐ No

9. Did Pilot, Driver, or Pedestrian Take or Request an Evasive Action to Avoid a Collision Hazard *(mark one)*:

   A. ☐ Yes, Specify _____
   B. ☐ No
   C. ☐ Unknown

10. Description of Deviation and Comments:

_____
_____
_____
_____
_____
_____

PRELIMINARY
VEHICLE OR PEDESTRIAN DEVIATION REPORT

Incident Report Number

V | | | | | | | | | | | | |

11. A Piloted Aircraft Was Operating on the Runway When the V/PD Occurred *(mark appropriate boxes)*:

A. ☐ Yes (complete items 11C to 11H)
B. ☐ No *(skip to item 12)*
C. Make _____
D. Model _____
E. Flight Number or Call sign *(if applicable)*
_____
F. Registration (N) Number
|___|___|___|___|___|___|
G. Pilot's Name _____
H. ☐ Pilot Accepted LAHSO Clearance

12. Vehicle Equipment and Communication with ATC *(mark one)*:

A. ☐ No Communication Equipment
B. ☐ 2-Way Radio Used
C. ☐ Telephone Used
D. ☐ Headlights Flashed
E. ☐ Flashing Lights Operating on Vehicle
F. ☐ Flag Flown
G. ☐ Equipment Not Operational, Specify _____
H. ☐ Vehicle's Equipment Unknown
I. ☐ Communication Difficulty With ATC, Specify _____
J. ☐ Unable to Start Vehicle
K. ☐ Other, Specify _____

13. Driver Information:

A. Name _____
B. Employed By
1. ☐ Airline
2. ☐ Airport Employee
3. ☐ Airport Tenant
4. ☐ Airport Contractor
5. ☐ FAA
6. ☐ Military Branch
7. ☐ Other Government
8. ☐ Airline Passenger
9. ☐ Airport Visitor
10. ☐ Taxi/Limo Service
11. ☐ General Aviation
12. ☐ Unknown
13. ☐ Other, Specify _____
C. Employer Name and Address *(if applicable)*
_____
_____
_____
_____
_____

14. Pedestrian Information (includes bicycles):

A. Name _____
B. Employed By
1. ☐ Airline
2. ☐ Airport Employee
3. ☐ Airport Tenant
4. ☐ Airport Contractor
5. ☐ FAA
6. ☐ Military Branch
7. ☐ Other Government
8. ☐ Airline Passenger
9. ☐ Airport Visitor
10. ☐ Taxi/Limo Service
11. ☐ General Aviation
12. ☐ Unknown
13. ☐ Other, Specify _____
C. Employer Name and Address *(if applicable)*
_____
_____
_____
_____
_____

15. Deviation Area Was Visible From the Tower *(mark one)*:

A. ☐ Yes
B. ☐ No
C. ☐ Partially, Specify _____

16. Deviation First Detected By *(mark one)*:

A. Tower Personnel Observation of
1. ☐ Movement Area
2. ☐ Airport Surface Detection Equipment (ASDE)
B. ☐ ASDE With Airport Movement Area Safety System (AMASS)
C. ☐ Airport Security
D. ☐ Public, Including Pilot
E. ☐ Other, Specify _____

17. Movement Area Had *(mark appropriate boxes)*:

A. ☐ Recent Runway or Taxiway Configuration Changes
B. ☐ Construction Activity
C. ☐ Portion Closed by Notice to Airmen, Specify Closed Area _____
D. ☐ Other, Specify _____
E. ☐ None of the Above

18. Attachment(s):

A. ☐ Airport Diagram (REQUIRED)
B. ☐ Other, Specify_____

19. Airport Management Notified of Deviation:

A. Airport Manager's Name _____
B. Local Date
|___|___|___|___|___|___|
M M D D Y Y
C. Local Time
|___|___|___|___|

20. Name of Individual Completing Form:

A. Name (type or print)
_____
B. Telephone Number
( ) - _____ - _____

PRELIMINARY
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Incident Report Number

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21. Facility Manager Approving Form:

A. Signature _____
B. Name (type or print)
_____ _____
C. Local Date
|__|__|__|__|__|__|
M M D D Y Y

22. Report Distributed to:

A. |_A_|__|__| FAA Region
B. Division Offices
☐ Airports
☐ Air Traffic
☐ Flight Standards (only if 11A is checked)
C. Others
☐ Airport Manager
☐ AAS-300
☐ AAT-20
☐ ATX-400
☐ ARI-1
☐ _____

INSTRUCTIONS

I. General

The incident report number and Items 1 to 10 of FAA Form 8020-24 must be completed and information transmitted or arrangements made to transmit it in numerical order within 3 hours of the detection of a V/PD. Transmit by: (1) telephone, facsimile, or in accordance with regional agreement to the Airports Division Office with jurisdiction over the area in which the V/PD occurred, and (2) by facsimile or National Airspace Data Interchange Network (NADIN) message using immediate (DD) precedence to FAA headquarters and others. If the V/PD is significant (e.g., involving air carriers, air taxis, or prominent persons), the above information should be communicated immediately by telephone to FAA headquarters. The form must be completed and mailed by first class mail within 10 calendar days of the V/PD. The definition of a V/PD and instructions on distribution of FAA Form 8020-24 are in FAA Order 8020.11, "Aircraft Accident and Incident Notification, Investigation, and Reporting." A V/PD that leads to an accident should also be reported as a V/PD using this form. If more than one vehicle or pedestrian was involved, file a single report based on the first vehicle or pedestrian involved in the deviation. Describe the other participants in Item 10.

If the categories given are inadequate, complete "Other, Specify." Sign and date the form (Item 21) before distribution.

II. Incident Report Number

Each facility completing FAA Form 8020-24 is responsible for assigning a unique 12-character number to each reported V/PD. The first character is V, for V/PD.

The second and third characters are the abbreviation of the FAA region in which the deviation occurred:

AL - Alaskan
CE - Central
EA - Eastern
GL - Great Lakes
WP - Western-Pacific
NE - New England
NM - Northwest Mountain
SO - Southern
SW - Southwest

The fourth character identifies the type of facility completing the form:

C - ARTCC
F - AFSS or FSS
Z - FSDO or Other
R - TRACON
T - ATCT

For combined TRACON or ATCT operations, use the character for the TRACON or ATCT reporting the V/PD.

The fifth through seventh characters are the facility location identifier (e.g., ZNY). See the latest edition of FAA Order 7350.6.

The eighth and ninth characters are the calendar year in which the V/PD occurred; e.g., 04 for 2004.

The last three characters are the sequential V/PD number for the year by reporting facility; e.g., V/PD's would be numbered 001 to 999 in 2004 at a given facility.

III. Abbreviations

The following abbreviations are used:

AFSS - Automated Flight Service Station
ARTCC - Air Route Traffic Control Center
ATCT - Airport Traffic Control Tower
FSDO - Flight Standards District Office
FSS - Flight Service Station
TRACON - Terminal Radar Approach Control

APPENDIX C

INVESTIGATION OF VEHICLE/PEDESTRIAN DEVIATION REPORT
FORM 8020-25

INVESTIGATION OF VEHICLE OR PEDESTRIAN DEVIATION REPORT

Incident Report Number

The Airports Division Office will complete this form after receiving FAA Form 8020-24 vehicle or pedestrian deviation (V/PD) report from air traffic control. Complete and distribute according to the instructions on page 2.

1. Date, Time, and Location of Deviation
   - A. Local Date |__|__|__|__|__|__| (M M D D Y Y)
   - B. Local Time_____
   - C. Airport ID at Surface Incident Location
     |__|__|__|__|

2. Type of Deviation (*Select one):*
   - A. ☐ Vehicle (excludes bicycles; includes aircraft being repositioned)
   - B. ☐ Pedestrian (includes bicycles)

3. Airport Certificated Under Part 139 of FAA Regulations
   - A. ☐ Yes, *Specify* A1. ☐ Full or A2. ☐ Limited
   - B. ☐ No

4. Deviator Was (*Mark one):*
   - A. ☐ Not Authorized to be on the Airfield (*Skip to Item 8)*
   - B. ☐ Authorized to be on the Airfield, but not on the Movement Area
   - C. ☐ Authorized to be on the Movement Area
   - D. ☐ Unknown (*Skip to Line 10)*

5. Airport Offers Driver Training Program (*Mark one):*
   - A. ☐ Yes
   - B. ☐ No

   Driver Completed Training Program
   - A. ☐ Yes, When_____
   - B. ☐ No
   - C. ☐ Unknown

6. Airport Training or Procedures Contributed to V/PD (*Mark all that apply):*
   - A. ☐ Driver Training Program
   - B. ☐ Driver Familiarization
   - C. ☐ Airport Operational Procedures

7. The Driver or Pedestrian Had Inadequate Knowledge or Experience With (*Mark all that apply):*
   - A. ☐ English Language
   - B. ☐ Airport Layout
   - C. ☐ Signs, Markings, Signals, or Lighting (*Specify):* _____
   - D. ☐ ATC Movement Area Procedures
   - E. ☐ ATC Terminology or Phraseology
   - F. ☐ Unknown
   - G. ☐ Other (*Specify):*_____ _____
   - H. ☐ None of the Above, Driver or Pedestrian Knowledge or Experience Not a Factor

8. Facilities, Construction, or Conditions That Contributed to V/PD (*Mark all that apply*)
   - A. ☐ Unlocked or Open Gates
   - B. ☐ Inadequate Fence, *Specify:*_____
   - C. ☐ Signs, Markings, Signals, or Lighting (*Specify):* _____
   - D. ☐ Conditions Outside Movement Area, *Specify:* (e.g., weather, construction)_____ _____
   - E. ☐ Movement Area Conditions, *Specify:* (e.g., weather, construction)_____
   - F. ☐ Unknown
   - G. ☐ Other, *Specify:*_____
   - H. ☐ None of the Above, Facilities, Construction, or Conditions Not a Factor

9. Investigation Indicates Driver or Pedestrian (*Mark all that apply):*
   - A. ☐ Was Unable to Locate Route
   - B. ☐ Was Disoriented or Lost
   - C. ☐ Did Not Observe Markings, Signals, or Lighting
   - D. ☐ Did Not Follow Movement Area Procedures
   - E. ☐ Did Not Follow Route Assigned by ATC
   - F. ☐ Did Not Follow Other ATC Instructions, *Specify:* _____
   - G. ☐ Took Inadvertent or Unplanned Actions
   - H. ☐ Forgot to Request Clearance
   - I. ☐ Believed He/She Was Cleared
   - J. ☐ Was Distracted, *Specify:*_____
   - K. ☐ Details Not Known to the Inspector
   - L. ☐ Other, *Specify:*_____
   - M. ☐ None of the Above

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10. Corrections and Additions to FAA Form 8020-24 (*Specify item number and new information*):

_____

_____

_____

_____

11. Description of V/PD and Comments With Recommendations, *if any*:

_____

_____

_____

_____

12. Attachment(s):

A. ☐ FAA Form 8020-24 (REQUIRED)

B. ☐ Other(s), *Specify*:_____

_____

13. Action(s) Taken or Planed (*Mark all that apply*):

A. ☐ No Part 139 Violations
B. ☐ Letter of Investigation, *Specify Date*:_____
C. ☐ Enforcement Action by Airport Operator
D. ☐ Procedural Changes
E. ☐ Capital Development
F. ☐ Other, *Specify*:_____
G. ☐ None

14. Investigating Airports Division Office:
Routing Symbol |___|___|___|___| - |___|___|___|___|

15. Inspector Completing Form:

A. Name _____

B. Signature _____

C. Date |___|___|___|___|___|___|
M M D D Y Y

D. Phone No. |___|___|___| - |___|___|___| - |___|___|___|___|

16. Report Distributed To:

A. FAA Region: |___|___|___|___|
Including Regional Division Offices:
Airports, Air Traffic, and Flight Standards
(*Only if 7A on Form 8020-24 is checked*).

Including:
Airport Manager, ATP-20, AAS-300,
ATX-400, and AAT-210.

B. Other(s), *Specify*:_____

INSTRUCTIONS

Within 90 calendar days of the receipt of FAA Form 8020-24, Preliminary Vehicle or Pedestrian Deviation Report, indicating the occurrence of a V/PD at an airport certificated under 14 CFR 139, FAA Form 8020-25 will be completed. FAA Form 8020-25 must be assigned the same incident report number as the corresponding FAA Form 8020-24. Instructions on distribution of FAA Form 8020-25 are in FAA Order 8020.11, Aircraft Accident and Incident Notification, Investigation, and Reporting.

The inspector completing FAA Form 8020-25 will attempt to ensure that all information reported on FAA Form 8020-24 is complete. If any information on FAA Form 8020-24 is incomplete or inaccurate, the inspector will provide additions or corrections to that information, if it becomes known, in Item 10.

Complete all items. If the categories given are inadequate, complete "Other, Specify." Sign and date the form (Item 15) before distribution.

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APPENDIX D

Proposed VOD Investigation Reporting Form Instructions

Use the accompanying flow charts (D4-D14) and Data Reporting Form (D15-D18) to document the results of the interview with the vehicle operator (VO) who committed the vehicle operator deviation (VOD). Before conducting the interview, first identify the VOD type that was reported for the VO and record that information on Block 1 of the Data Reporting Form. Next, begin the interview by asking about the task the VO was attempting to accomplish before committing the VO. The task description should be recorded on Block 2 of the Data Reporting Form. Next, obtain a general description from the VO about the events that transpired which lead him/her to commit the VOD. While the VO is describing what happened, use the Entry Level Flow Chart (D3) to identify the relevant mental processes that were involved in the VOD. For each mental process identified, use the corresponding flow charts to conduct a more detailed analysis. The mental processing flow charts include: a) perception and vigilance (D4-D6), (b) memory (D7-D8), and (c) planning and decision making (D9-D11). Once an endpoint is reached on a flow chart, record that information on Blocks 3-5 of the Data Reporting Form. Complete all identified mental processes before proceeding to the response execution flow chart (D12-D13). Once an end point is reached on the flow chart, record that information on Block 6 of the Data Reporting Form and continue to the Non-Compliance flow chart (D14). Once an endpoint is reached, record that information on Block 7 of the Data Reporting Form (D16). Finally, complete the interview process by identifying the various contextual conditions associated with the VOD and record that information on Blocks 8-20 on the Data Reporting Form (D16-D18).

Block 1. VOD Type. The investigator conducting the interview identifies the type of VOD that is being investigated. If a vehicle operator (VO) committed more than one type of VOD, then a separate reporting form must be completed for each type.

VOD PERFORMANCE (Blocks 2-7)

Block 2. Task Description (purpose for being on the movement area). The investigator conducting the interview describes the task that the VO was attempting to accomplish (e.g., mow grass, remove snow, walk to hanger, etc).

Block 3. Perception and Vigilance. The investigator conducting the interview completes this section if he/she makes a determination, based on an interview with the VO, that the VOD was the result of the VO failing to see or hear something or incorrectly seeing or hearing something. The investigator can use the Perception and Vigilance flowcharts to question the VO and identify the perception and vigilance processes.

Block 4. Memory. The investigator conducting the interview completes this section if he/she makes a determination, based on an interview with the VO, that the VOD was the result of the VO forgetting something or having an incorrect memory. The investigator can use the Memory flowcharts to question the VO and identify the memory processes.

Block 5. Planning and Decision Making. The investigator conducting the interview completes this section if he/she makes a determination, based on an interview with the VO, that the VOD was the result of the VO failing to plan or making a mistake in a plan or decision. The investigator can use the Planning and Decision-Making flowcharts to question the VO and identify the planning and decision-making processes.

Block 6. Response Execution. The investigator conducting the interview completes this section if he/she makes a determination, based on an interview with the VO, that the VOD was the result of the VO thinking one thing but doing or saying something other than what was intended. For example, the VO was attempting to backup but went forward or the VO transposed letters when reporting his/her location. The investigator can use the Response Execution flowcharts to question the VO and identify the response execution processes.

Block 7. Non-Compliance. The investigator conducting the interview uses the Non-Compliance flowchart, to identify the type of non-compliance associated with the VOD.

CONTEXTUAL CONDITIONS (Blocks 8 – 20)

Block 8. Ground Traffic. The investigator conducting the interview completes this section if he/she makes a determination that the dynamic characteristics of the traffic flow or mix complexity contributed to the VOD. This category includes only traffic on the airport surface.

Block 9. Environment. The investigator conducting the interview completes this section if he/she makes a determination that ambient factors such as noise, air quality, distractions, etc. contributed to the VOD.

Block 10. Airport Configuration. The investigator conducting the interview completes this section if he/she makes a determination that the physical changes to the movement area contributed to the VOD.

Block 11. Actions of Other Vehicle Operators. The investigator conducting the interview completes this section if he/she makes a determination that actions of other vehicle operators contributed to the VOD.

Block 12. Vehicle Operator (VO) – Air Traffic (ATC) Communication. The investigator conducting the interview completes this section if he/she makes a determination that communication, whether miscommunication, improper communication, or no communication with ATC, contributed to the VOD.

Block 13. Vehicle Operator (VO) – Vehicle Operator (VO) Communication. The investigator conducting the interview completes this section if he/she makes a determination, based on an interview with the VO, that communication, whether miscommunication, improper communication, or no communication with another VO such as a team leader, contributed to the VOD.

Block 14. Weather. The investigator conducting the interview completes this section if he/she makes a determination that weather conditions contributed to the VOD.

Block 15. Documents and Materials. The investigator conducting the interview completes this section if he/she makes a determination that incomplete or out-of-date documents and materials contributed to the VOD.

Block 16. Human-Machine Interface (HMI)/Equipment. The investigator conducting the interview completes this section if he/she makes a determination that equipment malfunctions and/or the inability of the vehicle operator to properly use the equipment contributed to the VOD.

Block 17. Procedures. The investigator conducting the interview completes this section if he/she makes a determination that the official procedures used for operating on the airport movement area contained latent errors which contributed to the VOD.

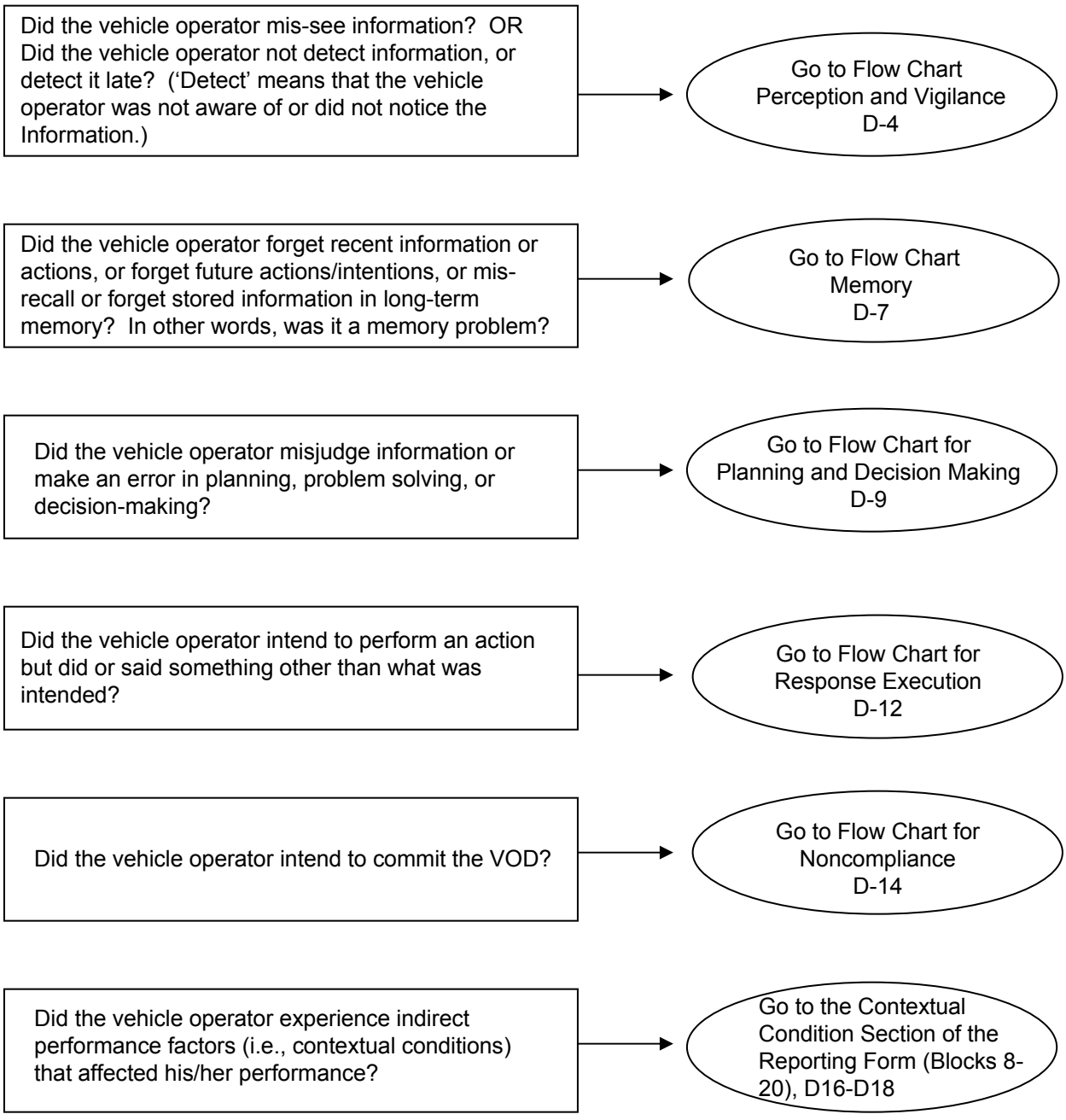
Block 18. Teamwork. The investigator conducting the interview completes this section if he/she makes a determination that lack of coordination or interpersonal problems within the work team contributed to the VOD.

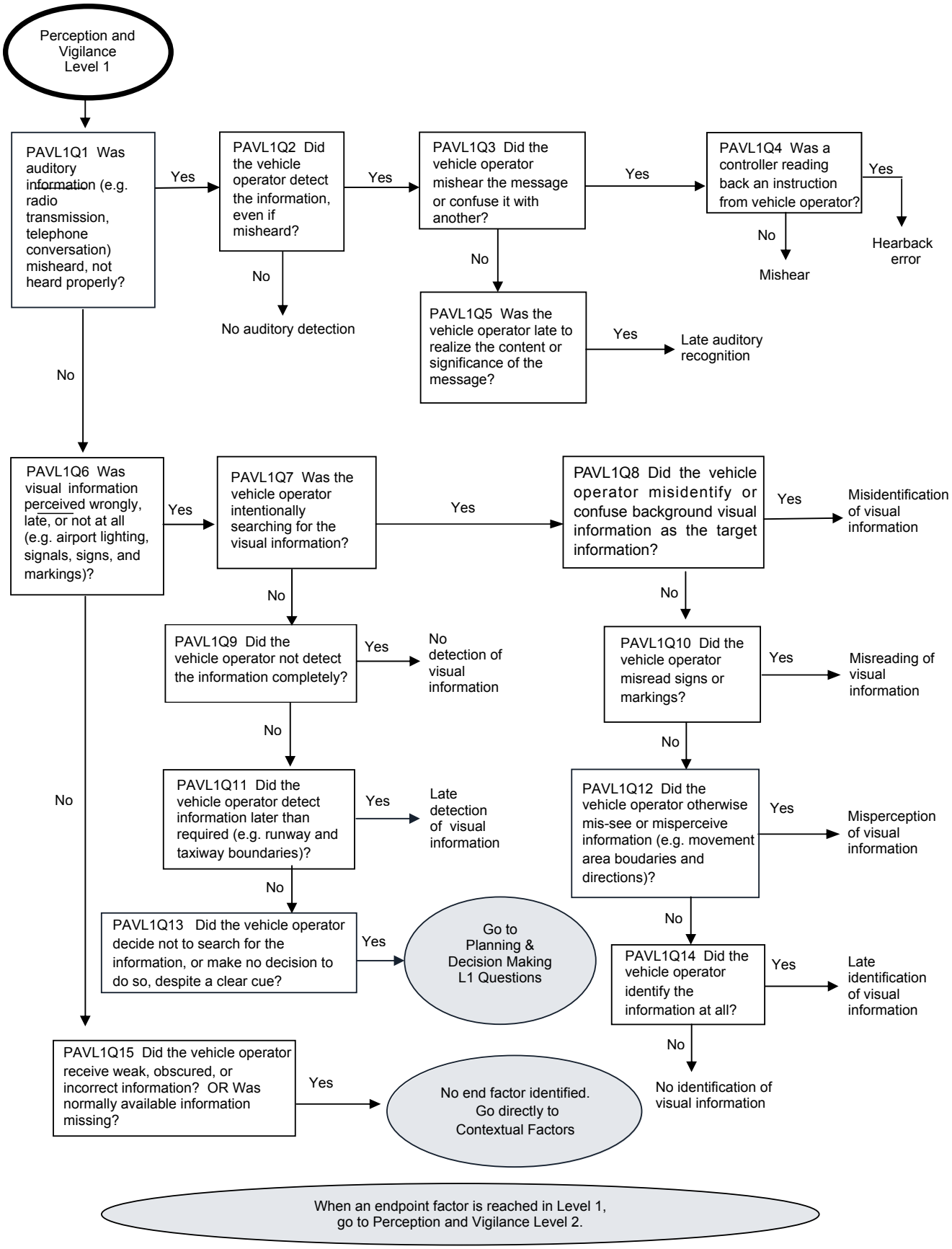
Block 19. Individual (Personal) Factors. The investigator conducting the interview completes this section if he/she makes a determination that physical and/or mental vulnerabilities of the vehicle operator contributed to the VOD.

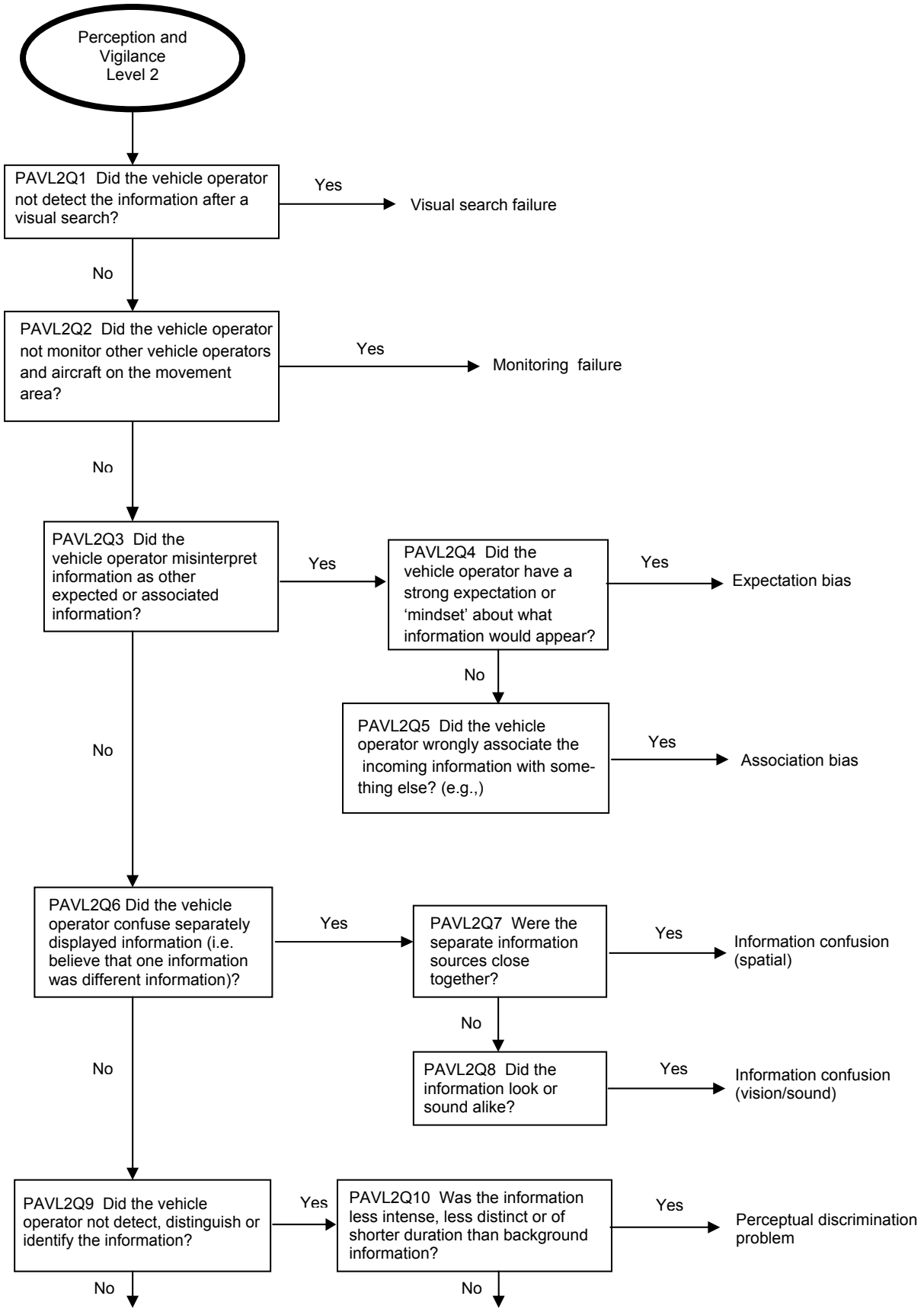
Block 20. Training. The investigator conducting the interview completes this section if he/she makes a determination that inadequate training/experience of a certain type(s) contributed to the VOD.

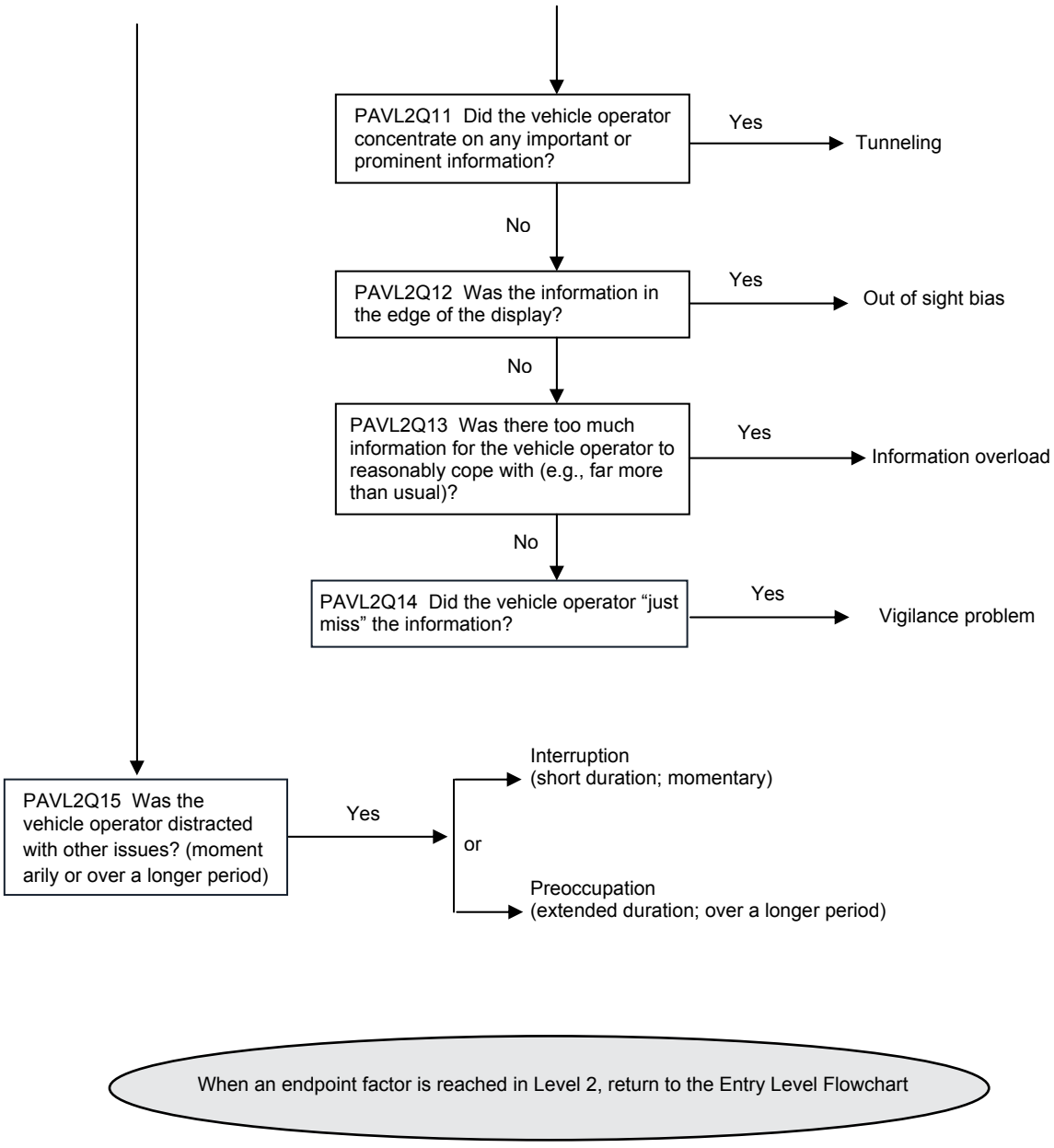
JANUS-GRO ENTRY LEVEL FLOWCHART

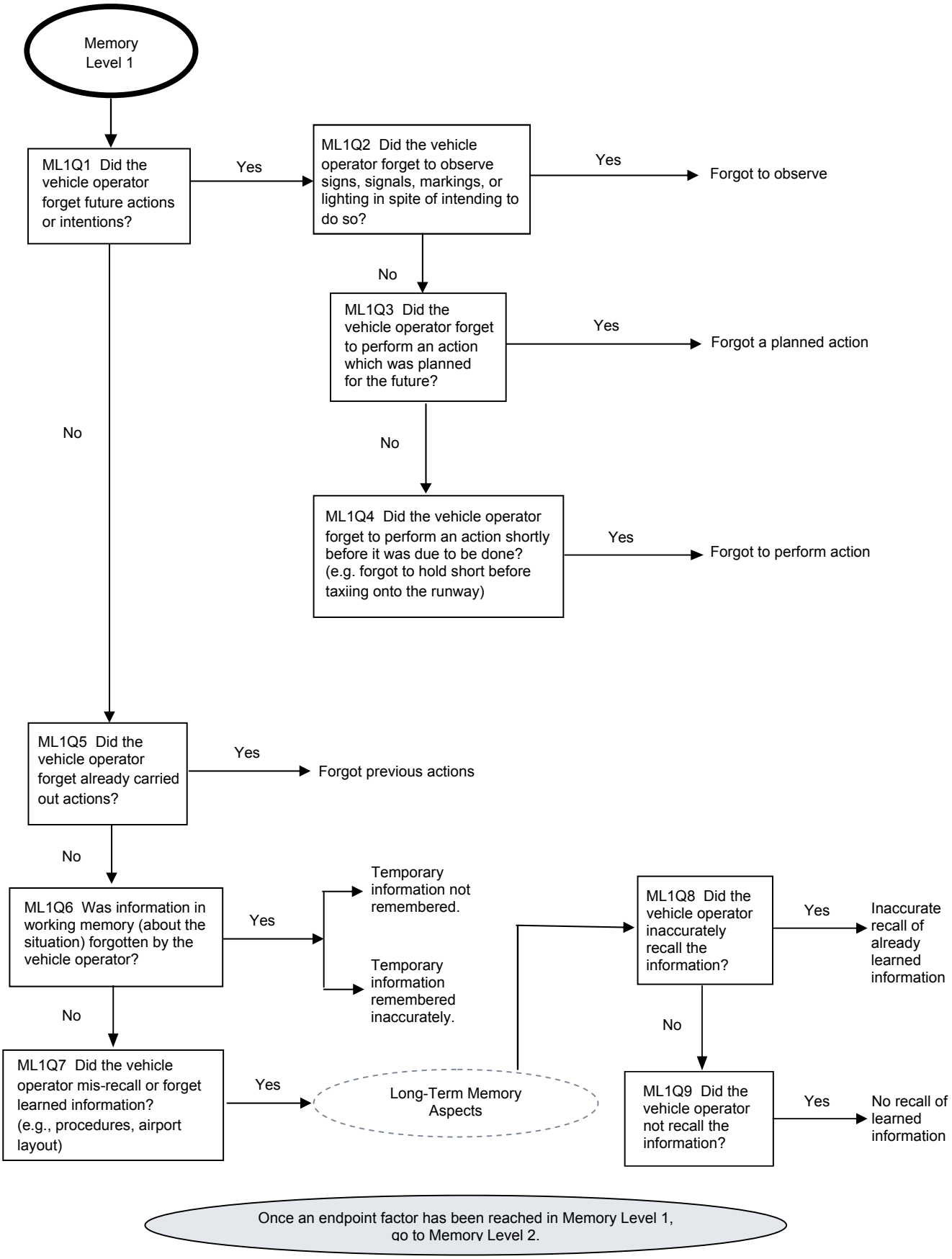
Select the best explanation for the VOD type being analyzed

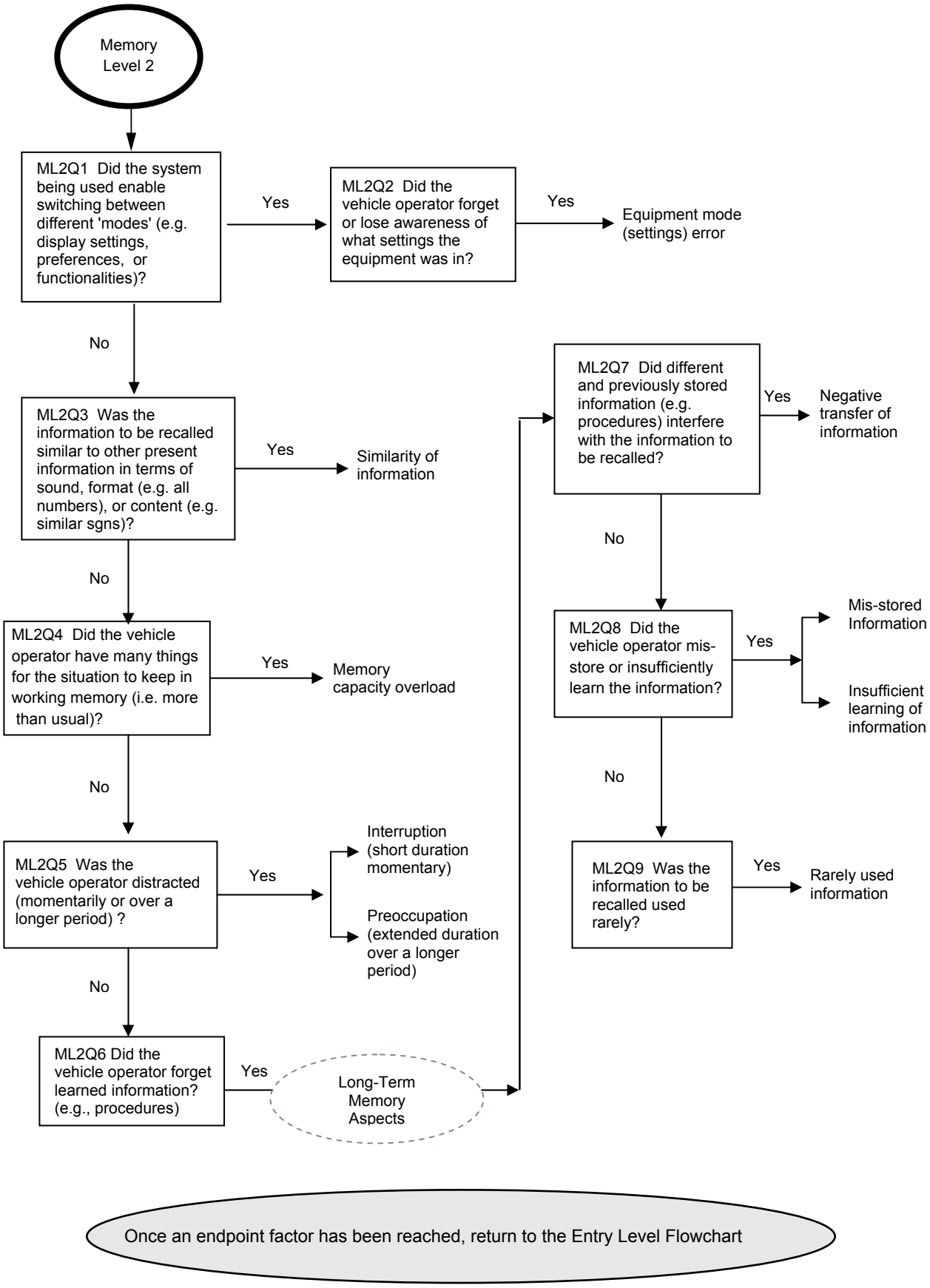


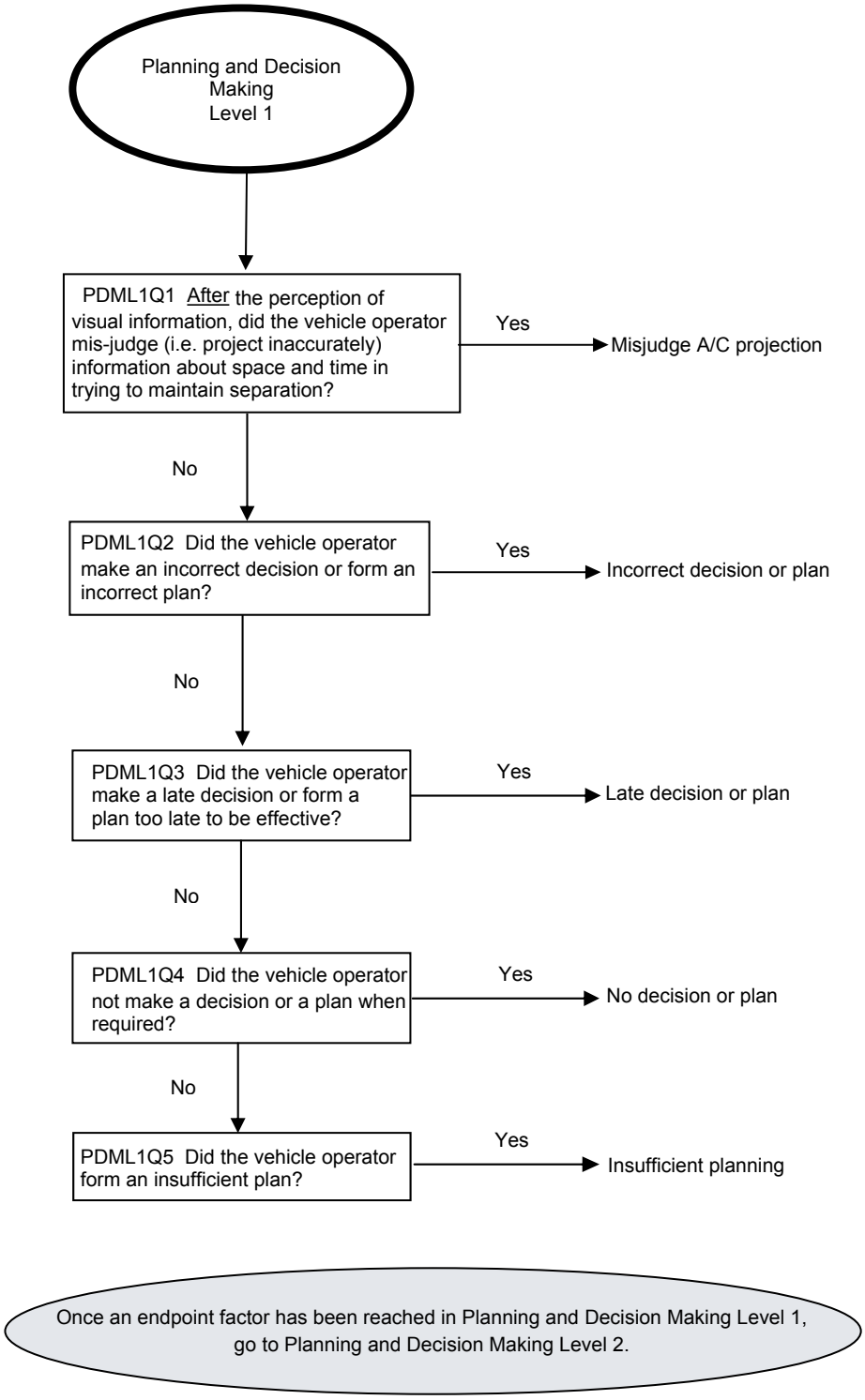

Perception and Vigilance Level 1
PAVL1Q1 Was auditory information (e.g. radio transmission, telephone conversation) misheard, not heard properly?
Yes
PAVL1Q2 Did the vehicle operator detect the information, even if misheard?
Yes
PAVL1Q3 Did the vehicle operator mishear the message or confuse it with another?
Yes
PAVL1Q4 Was a controller reading back an instruction from vehicle operator?
Yes
Hearback error
No
Mishear
No
PAVL1Q5 Was the vehicle operator late to realize the content or significance of the message?
Yes
Late auditory recognition
No auditory detection
No
PAVL1Q6 Was visual information perceived wrongly, late, or not at all (e.g. airport lighting, signals, signs, and markings)?
Yes
PAVL1Q7 Was the vehicle operator intentionally searching for the visual information?
Yes
PAVL1Q8 Did the vehicle operator misidentify or confuse background visual information as the target information?
Yes
Misidentification of visual information
No
PAVL1Q9 Did the vehicle operator not detect the information completely?
Yes
No detection of visual information
No
PAVL1Q10 Did the vehicle operator misread signs or markings?
Yes
Misreading of visual information
No
PAVL1Q11 Did the vehicle operator detect information later than required (e.g. runway and taxiway boundaries)?
Yes
Late detection of visual information
No
PAVL1Q12 Did the vehicle operator otherwise mis-see or misperceive information (e.g. movement area boudaries and directions)?
Yes
Misperception of visual information
No
PAVL1Q13 Did the vehicle operator decide not to search for the information, or make no decision to do so, despite a clear cue?
Yes
Go to Planning & Decision Making L1 Questions
No
PAVL1Q14 Did the vehicle operator identify the information at all?
Yes
Late identification of visual information
No
No identification of visual information
No
PAVL1Q15 Did the vehicle operator receive weak, obscured, or incorrect information? OR Was normally available information missing?
Yes
No end factor identified. Go directly to Contextual Factors
When an endpoint factor is reached in Level 1, go to Perception and Vigilance Level 2.

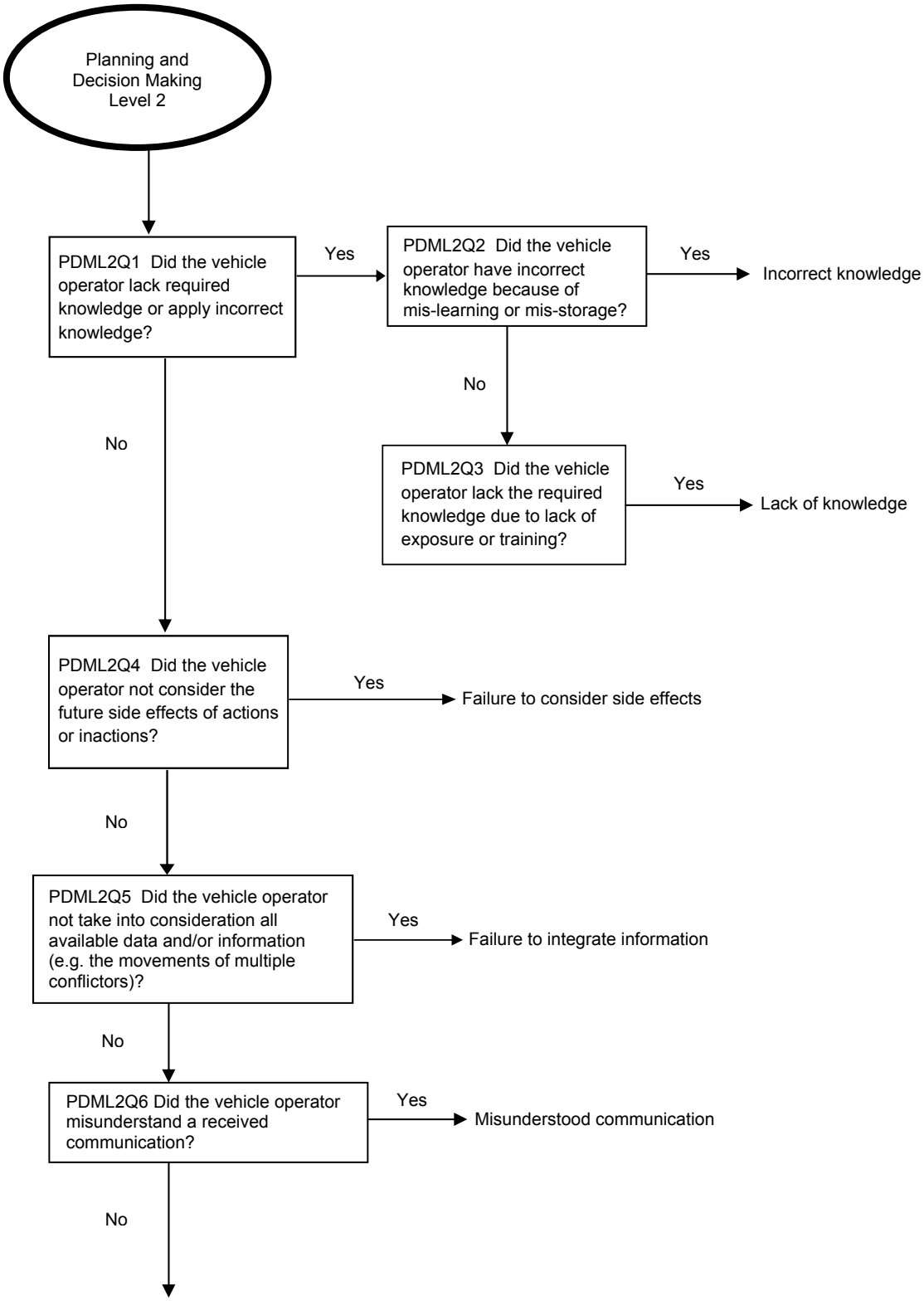

Perception and Vigilance Level 2
PAVL2Q1 Did the vehicle operator not detect the information after a visual search?
Yes
Visual search failure
No
PAVL2Q2 Did the vehicle operator not monitor other vehicle operators and aircraft on the movement area?
Yes
Monitoring failure
No
PAVL2Q3 Did the vehicle operator misinterpret information as other expected or associated information?
Yes
PAVL2Q4 Did the vehicle operator have a strong expectation or 'mindset' about what information would appear?
Yes
Expectation bias
No
PAVL2Q5 Did the vehicle operator wrongly associate the incoming information with some-thing else? (e.g.,)
Yes
Association bias
No
PAVL2Q6 Did the vehicle operator confuse separately displayed information (i.e. believe that one information was different information)?
Yes
PAVL2Q7 Were the separate information sources close together?
Yes
Information confusion (spatial)
No
PAVL2Q8 Did the information look or sound alike?
Yes
Information confusion (vision/sound)
No
PAVL2Q9 Did the vehicle operator not detect, distinguish or identify the information?
Yes
PAVL2Q10 Was the information less intense, less distinct or of shorter duration than background information?
Yes
Perceptual discrimination problem
No
No

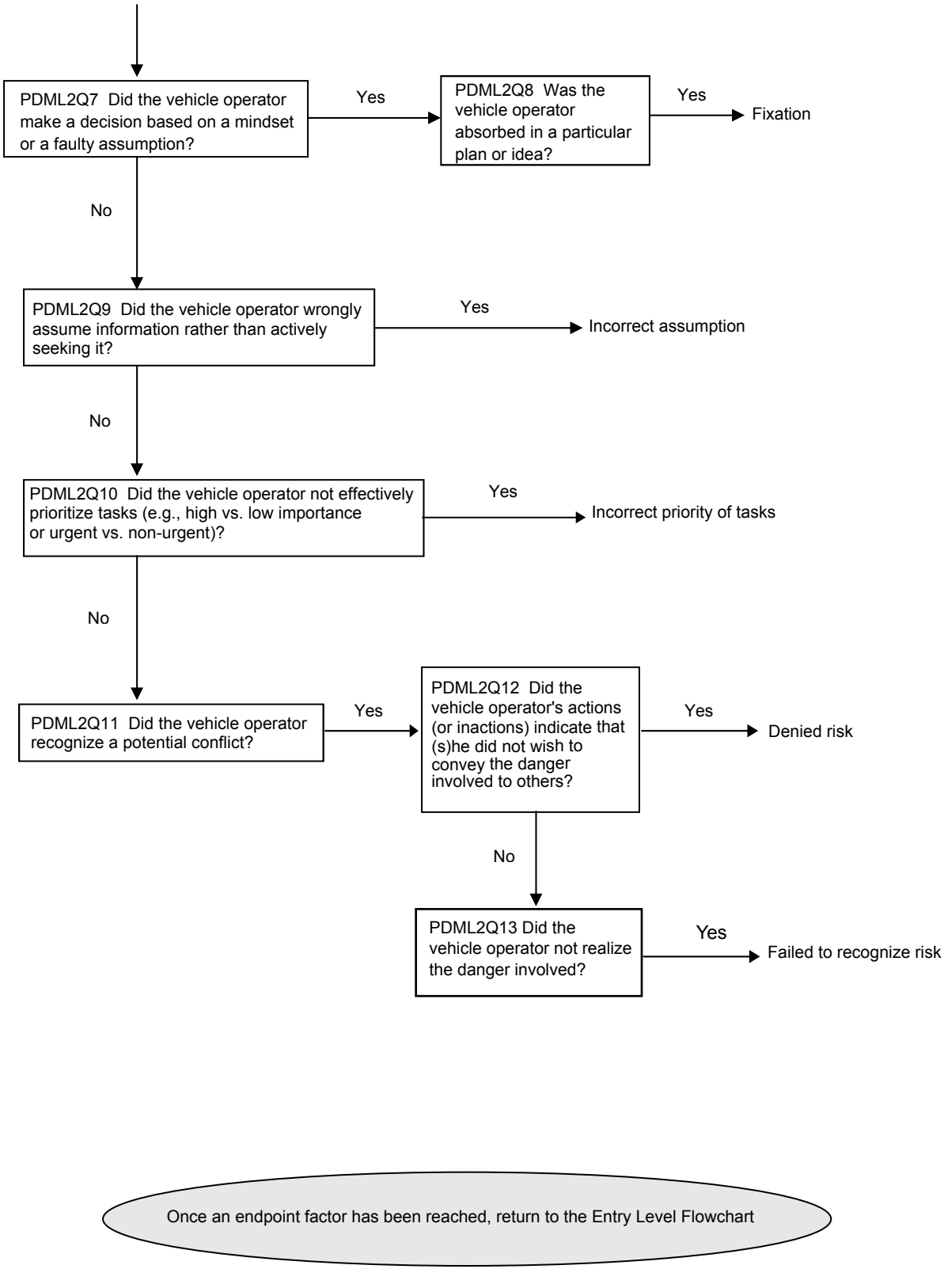

PAVL2Q11 Did the vehicle operator concentrate on any important or prominent information?
Yes
Tunneling
No
PAVL2Q12 Was the information in the edge of the display?
Yes
Out of sight bias
No
PAVL2Q13 Was there too much information for the vehicle operator to reasonably cope with (e.g., far more than usual)?
Yes
Information overload
No
PAVL2Q14 Did the vehicle operator "just miss" the information?
Yes
Vigilance problem
PAVL2Q15 Was the vehicle operator distracted with other issues? (moment arily or over a longer period)
Yes
Interruption
(short duration; momentary)
or
Preoccupation
(extended duration; over a longer period)
When an endpoint factor is reached in Level 2, return to the Entry Level Flowchart

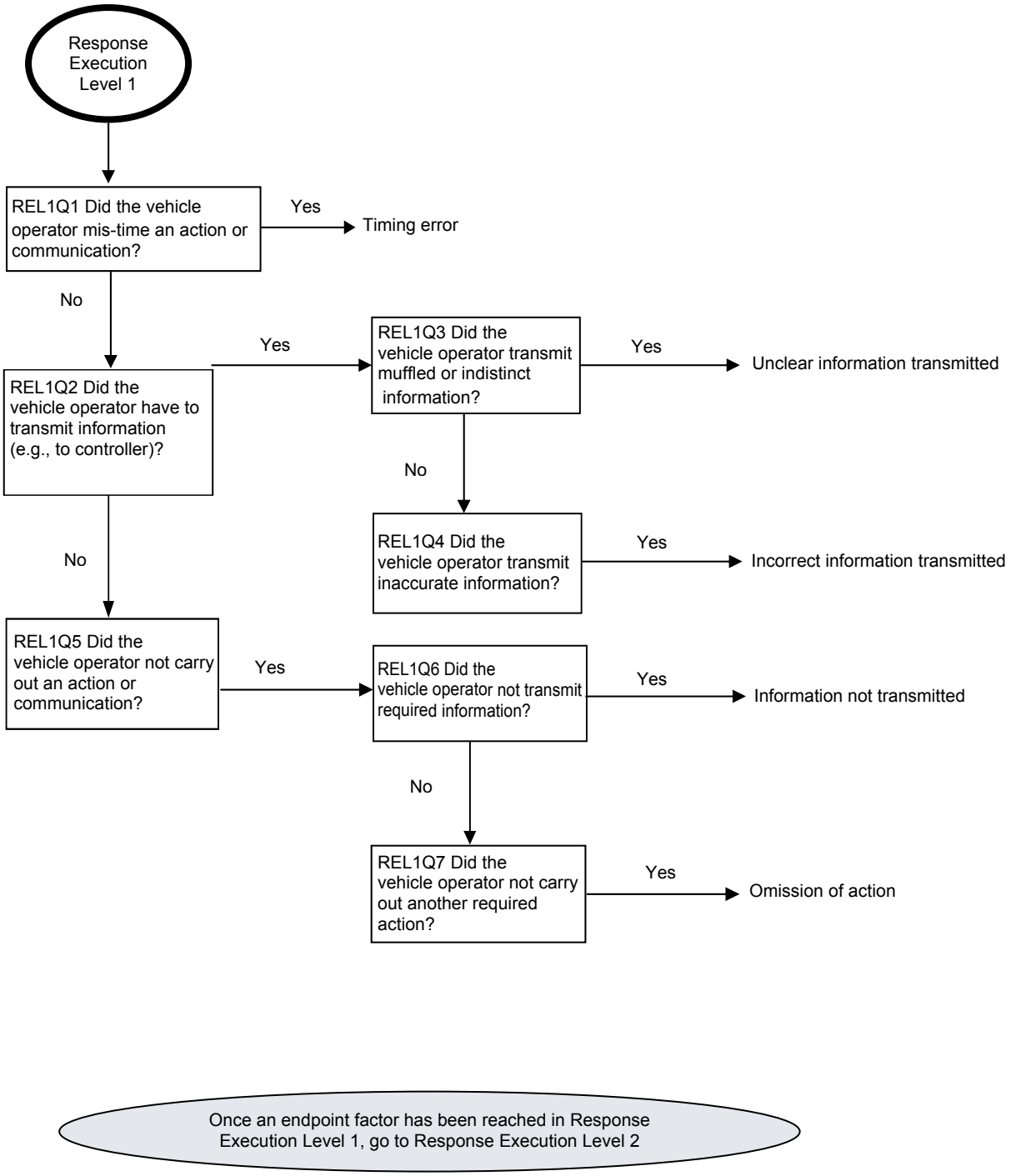

Memory Level 1
ML1Q1 Did the vehicle operator forget future actions or intentions?
Yes
ML1Q2 Did the vehicle operator forget to observe signs, signals, markings, or lighting in spite of intending to do so?
Yes
Forgot to observe
No
ML1Q3 Did the vehicle operator forget to perform an action which was planned for the future?
Yes
Forgot a planned action
No
ML1Q4 Did the vehicle operator forget to perform an action shortly before it was due to be done? (e.g. forgot to hold short before taxiing onto the runway)
Yes
Forgot to perform action
No
ML1Q5 Did the vehicle operator forget already carried out actions?
Yes
Forgot previous actions
No
ML1Q6 Was information in working memory (about the situation) forgotten by the vehicle operator?
Yes
Temporary information not remembered.
Temporary information remembered inaccurately.
No
ML1Q7 Did the vehicle operator mis-recall or forget learned information? (e.g., procedures, airport layout)
Yes
Long-Term Memory Aspects
ML1Q8 Did the vehicle operator inaccurately recall the information?
Yes
Inaccurate recall of already learned information
No
ML1Q9 Did the vehicle operator not recall the information?
Yes
No recall of learned information
Once an endpoint factor has been reached in Memory Level 1, go to Memory Level 2.

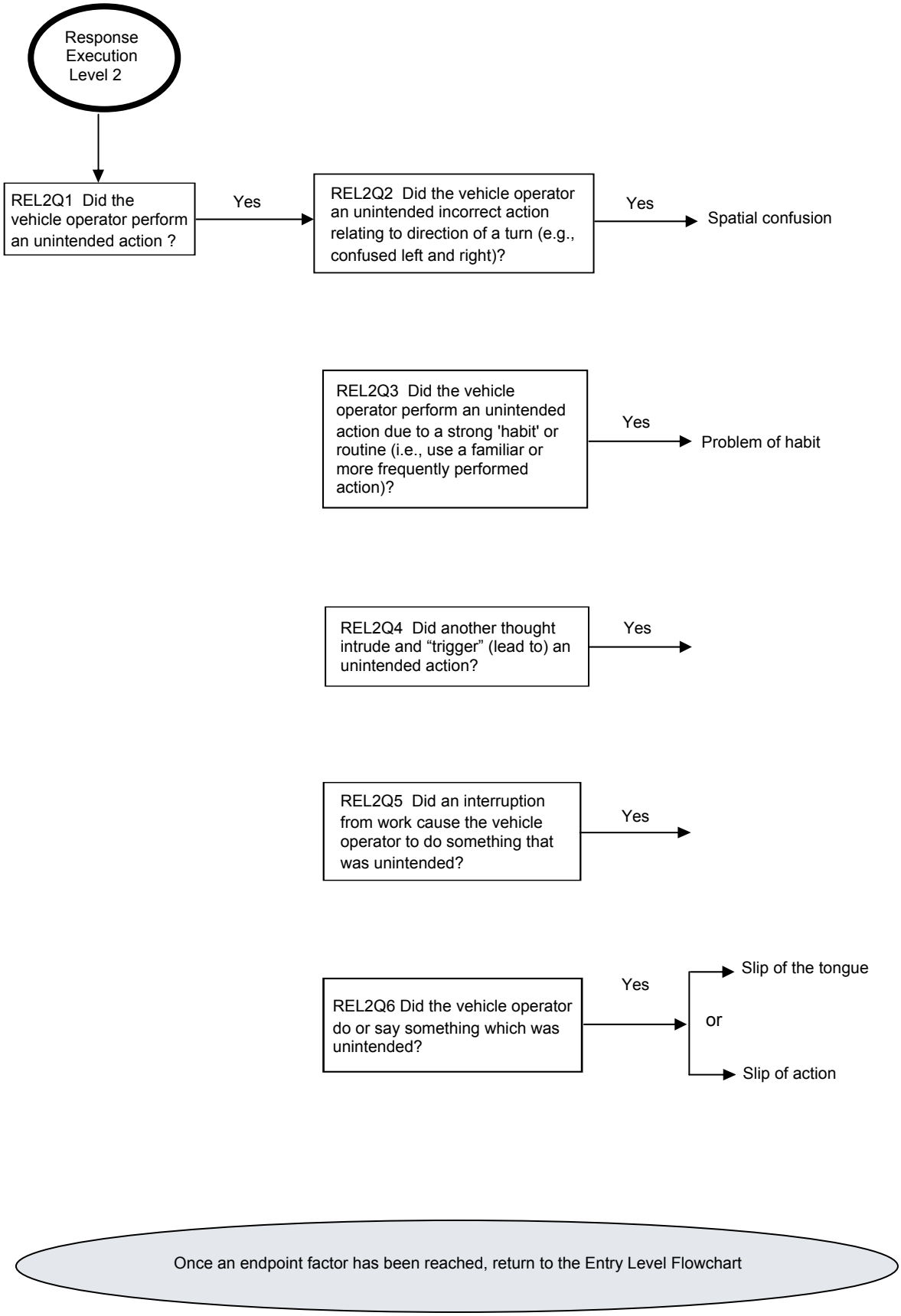

Memory Level 2
ML2Q1 Did the system being used enable switching between different 'modes' (e.g. display settings, preferences, or functionalities)?
Yes
ML2Q2 Did the vehicle operator forget or lose awareness of what settings the equipment was in?
Yes
Equipment mode (settings) error
No
ML2Q3 Was the information to be recalled similar to other present information in terms of sound, format (e.g. all numbers), or content (e.g. similar sgns)?
Yes
Similarity of information
No
ML2Q4 Did the vehicle operator have many things for the situation to keep in working memory (i.e. more than usual)?
Yes
Memory capacity overload
No
ML2Q5 Was the vehicle operator distracted (momentarily or over a longer period) ?
Yes
Interruption (short duration momentary)
Preoccupation (extended duration over a longer period)
No
ML2Q6 Did the vehicle operator forget learned information? (e.g., procedures)
Yes
Long-Term Memory Aspects
ML2Q7 Did different and previously stored information (e.g. procedures) interfere with the information to be recalled?
Yes
Negative transfer of information
No
ML2Q8 Did the vehicle operator mis-store or insufficiently learn the information?
Yes
Mis-stored Information
Insufficient learning of information
No
ML2Q9 Was the information to be recalled used rarely?
Yes
Rarely used information
Once an endpoint factor has been reached, return to the Entry Level Flowchart

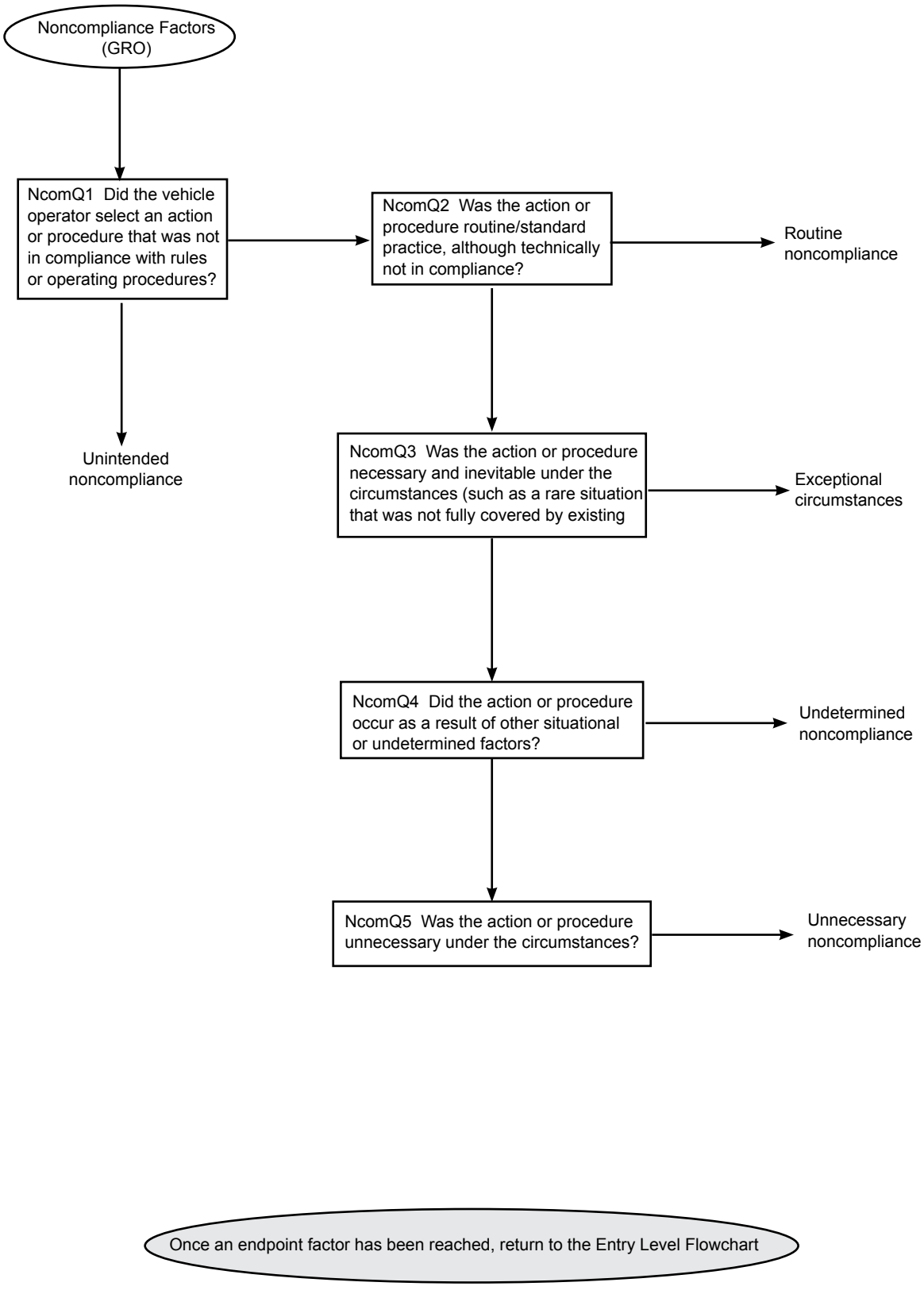

Planning and Decision Making Level 1
PDML1Q1 After the perception of visual information, did the vehicle operator mis-judge (i.e. project inaccurately) information about space and time in trying to maintain separation?
Yes
Misjudge A/C projection
No
PDML1Q2 Did the vehicle operator make an incorrect decision or form an incorrect plan?
Yes
Incorrect decision or plan
No
PDML1Q3 Did the vehicle operator make a late decision or form a plan too late to be effective?
Yes
Late decision or plan
No
PDML1Q4 Did the vehicle operator not make a decision or a plan when required?
Yes
No decision or plan
No
PDML1Q5 Did the vehicle operator form an insufficient plan?
Yes
Insufficient planning
Once an endpoint factor has been reached in Planning and Decision Making Level 1, go to Planning and Decision Making Level 2.


Planning and Decision Making Level 2
PDML2Q1 Did the vehicle operator lack required knowledge or apply incorrect knowledge?
Yes
PDML2Q2 Did the vehicle operator have incorrect knowledge because of mis-learning or mis-storage?
Yes
Incorrect knowledge
No
No
PDML2Q3 Did the vehicle operator lack the required knowledge due to lack of exposure or training?
Yes
Lack of knowledge
PDML2Q4 Did the vehicle operator not consider the future side effects of actions or inactions?
Yes
Failure to consider side effects
No
PDML2Q5 Did the vehicle operator not take into consideration all available data and/or information (e.g. the movements of multiple conflictors)?
Yes
Failure to integrate information
No
PDML2Q6 Did the vehicle operator misunderstand a received communication?
Yes
Misunderstood communication
No


PDML2Q7 Did the vehicle operator make a decision based on a mindset or a faulty assumption?
Yes
PDML2Q8 Was the vehicle operator absorbed in a particular plan or idea?
Yes
Fixation
No
PDML2Q9 Did the vehicle operator wrongly assume information rather than actively seeking it?
Yes
Incorrect assumption
No
PDML2Q10 Did the vehicle operator not effectively prioritize tasks (e.g., high vs. low importance or urgent vs. non-urgent)?
Yes
Incorrect priority of tasks
No
PDML2Q11 Did the vehicle operator recognize a potential conflict?
Yes
PDML2Q12 Did the vehicle operator's actions (or inactions) indicate that (s)he did not wish to convey the danger involved to others?
Yes
Denied risk
No
PDML2Q13 Did the vehicle operator not realize the danger involved?
Yes
Failed to recognize risk
Once an endpoint factor has been reached, return to the Entry Level Flowchart


Response Execution Level 1
REL1Q1 Did the vehicle operator mis-time an action or communication?
Yes
Timing error
No
REL1Q2 Did the vehicle operator have to transmit information (e.g., to controller)?
Yes
REL1Q3 Did the vehicle operator transmit muffled or indistinct information?
Yes
Unclear information transmitted
No
REL1Q4 Did the vehicle operator transmit inaccurate information?
Yes
Incorrect information transmitted
No
REL1Q5 Did the vehicle operator not carry out an action or communication?
Yes
REL1Q6 Did the vehicle operator not transmit required information?
Yes
Information not transmitted
No
REL1Q7 Did the vehicle operator not carry out another required action?
Yes
Omission of action
Once an endpoint factor has been reached in Response Execution Level 1, go to Response Execution Level 2


Response Execution Level 2
REL2Q1 Did the vehicle operator perform an unintended action ?
Yes
REL2Q2 Did the vehicle operator an unintended incorrect action relating to direction of a turn (e.g., confused left and right)?
Yes
Spatial confusion
REL2Q3 Did the vehicle operator perform an unintended action due to a strong 'habit' or routine (i.e., use a familiar or more frequently performed action)?
Yes
Problem of habit
REL2Q4 Did another thought intrude and “trigger” (lead to) an unintended action?
Yes
REL2Q5 Did an interruption from work cause the vehicle operator to do something that was unintended?
Yes
REL2Q6 Did the vehicle operator do or say something which was unintended?
Yes
Slip of the tongue
or
Slip of action
Once an endpoint factor has been reached, return to the Entry Level Flowchart


Noncompliance Factors (GRO)
NcomQ1 Did the vehicle operator select an action or procedure that was not in compliance with rules or operating procedures?
NcomQ2 Was the action or procedure routine/standard practice, although technically not in compliance?
Routine noncompliance
Unintended noncompliance
NcomQ3 Was the action or procedure necessary and inevitable under the circumstances (such as a rare situation that was not fully covered by existing
Exceptional circumstances
NcomQ4 Did the action or procedure occur as a result of other situational or undetermined factors?
Undetermined noncompliance
NcomQ5 Was the action or procedure unnecessary under the circumstances?
Unnecessary noncompliance
Once an endpoint factor has been reached, return to the Entry Level Flowchart

Vehicle Operator Investigation Data Reporting Form

1. VOD Type *(mark only one)*

- ☐ Did not comply with signs, markings, signals, or lighting
- ☐ Did not follow movement area procedures
- ☐ Did not follow route assigned by ATC
- ☐ Did not follow other ATC instructions
- ☐ Took inadvertent or unplanned actions

2. Task Description (purpose for being on the movement area)

_____

_____

Vehicle Operator Performance Factors

3. Perception & Vigilance

Level 1 (*mark only one*)

- ☐ No auditory detection
- ☐ Mishear
- ☐ Hearback error
- ☐ Late auditory recognition
- ☐ Misidentification of Visual information
- ☐ No detection of visual information
- ☐ Misreading of visual information
- ☐ Late detection of visual information
- ☐ Misperception of visual information
- ☐ Late identification of visual information
- ☐ No detection of visual information
- ☐ No level 1

Level 2 (*mark only one)*

- ☐ Visual search failure
- ☐ Monitoring failure
- ☐ Expectation bias
- ☐ Association bias
- ☐ Information confusion (spatial)
- ☐ Information confusion (vison/sound)
- ☐ Perception discrimination Problem
- ☐ Tunneling
- ☐ Out of sight bias
- ☐ Information overload
- ☐ Vigilance problem
- ☐ Interruption
- ☐ Preoccupation
- ☐ No level 2

4. Memory

Level 1 *(mark only one)*

- ☐ Forgot to observe
- ☐ Forgot a planned action
- ☐ Forgot to perform an action
- ☐ Forgot previous action
- ☐ Temporary information not remembered
- ☐ Temporary information remembered inaccurately
- ☐ Inaccurate recall of already learned information
- ☐ No recall of learned information
- ☐ No level 1

Level 2 *(mark only one)*

- ☐ Equipment mode (settings) error
- ☐ Similarity of information
- ☐ Memory capacity overload
- ☐ Interruption-2
- ☐ Preoccupation-2
- ☐ Negative transfer of information
- ☐ Mis-stored information
- ☐ Insufficient learning of information
- ☐ Rarely used information
- ☐ No level 2

5. Planning & Decision Making

Level 1 *(mark only one)*

- ☐ Misjudge A/C projection
- ☐ Incorrect decision or plan
- ☐ Late decision or plan
- ☐ No decision or plan
- ☐ Insufficient planning
- ☐ No level 1

5. Planning & Decision Making *(Continued)*
Level 2 (*mark only one*)
- ☐ Incorrect knowledge
- ☐ Lack of knowledge
- ☐ Failure to consider side effects
- ☐ Failure to integrate information
- ☐ Misunderstood communication
- ☐ Fixation
- ☐ Incorrect assumption
- ☐ Incorrect priority of tasks
- ☐ Denied risk
- ☐ Failed to recognize risk
- ☐ No level 2

6. Response Execution
Level 1 *(mark only one)*
- ☐ Timing error
- ☐ Unclear information transmitted
- ☐ Incorrect information transmitted
- ☐ Information not transmitted
- ☐ Omission of action
- ☐ No level 1

Level 2 (*mark only one*)
- ☐ Unclear speech
- ☐ Wrong voice tone
- ☐ Spatial confusion
- ☐ Problem of habit
- ☐ Intrusion of thought
- ☐ Interruption from environment
- ☐ Slip of tongue
- ☐ Action slip
- ☐ No level 2

7. Noncompliance *(mark only one)*
- ☐ Unintended
- ☐ Routine
- ☐ Exceptional
- ☐ Undetermined
- ☐ Unncessary
- ☐ No Known compliance

Contextual Conditions

8. Ground Traffic *(mark all that apply)***:**
- ☐ Ground traffic mix (kinds)
- ☐ Ground traffic density (amount)
- ☐ Ground traffic fluctuation (ebb and flow)
- ☐ Other, Specify: _____

9. Environment *(mark all that apply)***:**
- ☐ Odors
- ☐ Noise
- ☐ Vision obstruction (air quality smoke, smog)
- ☐ Inadequate signs, markings, signals or lighting
- ☐ Other, Specify:_____

10. Airport Configuration *(mark all that apply)***:**
- ☐ Recent runway configuration changes
- ☐ Recent taxiway configuration changes
- ☐ Construction activity on the movement area
- ☐ Portion of the movement area closed by Notice to Airmen
- ☐ Other, Specify:_____

11. Actions of Other Vehicle Operators *(mark all the apply)***:**
- ☐ Loss of separation with another vehicle
- ☐ Another vehicle operator responded to instructions from ATC not intended
- ☐ Other, Specify:_____

12. Vehicle Operator-Air Traffic Control Communications *(mark all that apply)***:**
- ☐ English language spoken was not comprehended by the VO
- ☐ Aviation phonetic alphabet was not used properly and/or not comprehended by the VO
- ☐ ATC terminology or phraseology was not used properly and/or not comprehended by the VO
- ☐ Procedures for contacting ATC were not properly used by the VO
- ☐ Light gun signals were not comprehended/ improperly used/operating
- ☐ Hearback/readback errors
- ☐ Incorrect radio frequency used
- ☐ Other, Specify:_____

13. Vehicle Operator–Vehicle Operator Communications *(mark all that apply)***:**
- ☐ English language spoken was not comprehended by the receiving VO
- ☐ Aviation phonetic alphabet was not used properly and/or not comprehended by the receiving VO
- ☐ Movement area terminology or phraseology was not used properly and/or not comprehended by the receiving VO
- ☐ Procedures for contacting another vehicle operator were not properly used by the VO
- ☐ Hearback/readback errors
- ☐ Incorrect radio frequency used
- ☐ Other, Specify:_____

14. Weather *(mark all that apply):*

- ☐ Clear, but bright sun
- ☐ Cloudy
- ☐ Fog
- ☐ Rainy: light___ moderate___ heavy___
- ☐ Thunderstorm
- ☐ Freezing rain
- ☐ Snow: light___ moderate___ heavy___
- ☐ Slush
- ☐ Icy
- ☐ Surface Winds
- ☐ Other, Specify:_____

15. Documents and Materials *(mark all that apply)***:**

- ☐ Airport procedurals manuals
- ☐ Advisory manuals/circulars
- ☐ Checklists
- ☐ FAA Order
- ☐ Operational material (e.g., charts, notices)
- ☐ System information Area (SIA) (e.g., NOTAMS, SIGMETS, etc.)
- ☐ Maps
- ☐ Training manuals
- ☐ Other documents or materials:_____

16 Human-Machine Interface/Equipment *(mark all that apply)***:**

- ☐ Vehicle operator unfamiliar with vehicle and/or vehicle equipment
- ☐ Vehicle controls or vehicle equipment layout was a problem for the vehicle operator
- ☐ Vehicle lights malfunctioned
- ☐ Unable to start/move vehicle due to vehicle malfunction
- ☐ Unable to steer vehicle due to vehicle malfunction
- ☐ Unable to stop vehicle due to vehicle malfunction
- ☐ Two-way radio malfunctioned
- ☐ Telephone malfunctioned
- ☐ Flashing lights malfunctioned
- ☐ Light gun malfunctioned
- ☐ Flags malfunctioned
- ☐ Other, Specify_____

17. Operating procedures *(mark all that apply)***:**

- ☐ Runway
- ☐ Taxiway
- ☐ Intersection
- ☐ Special Ramp
- ☐ Other, Specify:_____

18. Teamwork *(mark all that apply)***:**

- ☐ No briefing given for shift change
- ☐ Briefing was incomplete or insufficient
- ☐ ntimely return to work after break: too early___ too late___
- ☐ New or temporary team assignments
- ☐ nadequate staffing for team assignments
- ☐ Poor team relations (e.g., conflicts, personality differences)

19. Individual (Personal) Factors *(mark all that apply)***:**

- ☐ Stress symptoms
- ☐ Boredom
- ☐ Complacency
- ☐ Confidence in self or others
- ☐ Distracted by inside thoughts, i.e., home problems, vacation plans, etc.
- ☐ Domestic/lifestyle problems
- ☐ Fatigue (sleep deprivation)
- ☐ General health and fitness
- ☐ High anxiety/panic
- ☐ Impairment due to other influences (e.g., over-the-counter drug use, illness)
- ☐ Incapacitation, e.g., illness/collapse
- ☐ Motivation/morale
- ☐ Pain
- ☐ Trust in the automation (over/under/mistrust)
- ☐ Hunger
- ☐ Other, Specify:_____

20. Training Deficiencies *(mark all that apply)*:

- □ Airport Operating Procedures (Standard)
- □ Airport Familiarization
  - □ Knowledge about Airport Locations
    - □ Runway configuration safety areas
    - □ Taxiway configuration safety areas
    - □ Movement areas
    - □ Non-movement areas
    - □ Confusing areas
    - □ Touch down zone
    - □ Taxiway Lead-Off Lights
    - □ Threshold
    - □ Runway approach light system
    - □ Taxiway
      - □ Taxiway edge lights
        - □ Taxiway centerline lights
        - □ Runway guard lights
  - □ Knowledge about Airport Signage
    - □ Runway position holding sigh
    - □ Distance remaining sign
  - □ Knowledge about Airfield Markings
    - □ Runways
      - □ Centerline
      - □ Edge marks
      - □ Runway ID numbers
      - □ Threshold markings
      - □ Hold short lines
    - □ Knowledge about Airfield Markings (Continued)
      - □ Taxiways
        - □ Hold lines
        - □ ILS hold lines
        - □ Geographic position markings
        - □ Centerline
        - □ Edge markings
      - □ ILS Critical Area
      - □ Non-movement area boundary marking
    - □ Knowledge about Airport NAVAIDS and Visual approach aids
      - □ Location
      - □ Non-interference
    - □ Knowledge about Airport Communications
      - □ ATC-VO communications
        - □ Radio frequencies
        - □ Procedural words and phrases
      - □ Aviation phonetic alphabet
      - □ Aviation terminology
      - □ Procedures for contacting ATC Tower
      - □ Light gun signals
        - □ Sending and receiving
        - □ VO – VO Communications
  - □ Drivers Training
    - □ Written
    - □ Driving Test
- □ Other, Specify:_____