

## APPENDIX C

### Selected Findings for Minor and Critical Vessel Casualties Combined

In this study, *minor* vessel casualties were defined as those involving limited property damage with no risk to the loss of the vessel or personnel injury. *Critical* vessel casualties were defined as those involving significant damage to the vessel or property, or in which the safety of the crew was at risk. *Minor* vessel casualties were defined as those that exclusively involved a temporary loss of vessel steering or propulsion. Minor vessel casualties comprised 106 of the 589 total casualties investigated and reported in this study. Due to their relatively less severe nature, the minor vessel casualties were excluded from many of the analyses in the main body of this report. For the purpose of comparison, however, the 106 minor vessel casualties are included among the 267 critical vessel casualties in the results below.

#### Results of Criticality and Human Factors Screening

Figure C-1 summarizes the criticality and human factors screening results for the 486 vessel casualties investigated and reported during this study. Beginning with the criticality screening depicted in the figure, 219 vessel casualties were determined to be non-critical and 267 cases were determined to be critical. For the human factors screening applied to the 267 critical vessel casualties, 185 cases were determined not to have a direct human factors contribution and 82 cases were determined to have a direct human factors contribution.

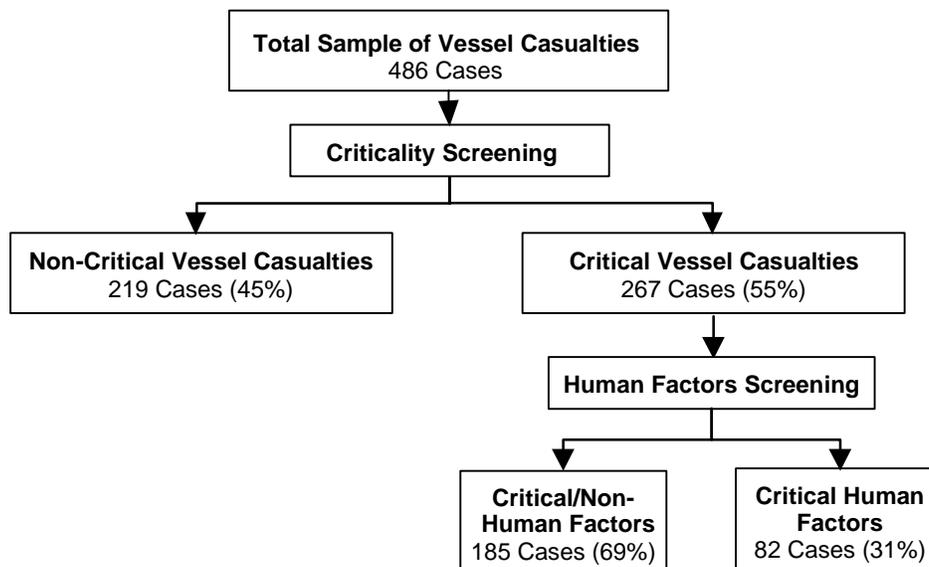
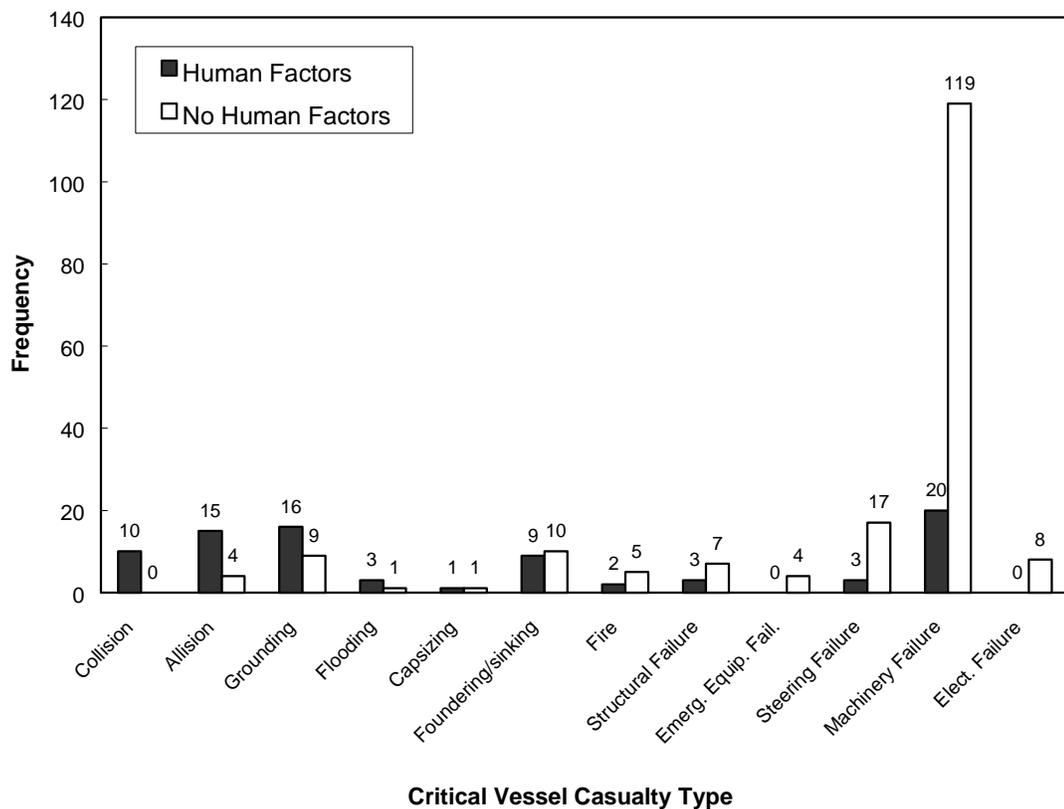


Figure C-1. Summary of vessel casualty criticality and human factors screening.

## Human Factors Contributions to Vessel Casualties

In considering the general contribution of human factors to vessel casualties, two topics were addressed. First, the specific types of vessel casualties with a human factors contribution were examined. Second, the vessel types involved in these casualties were considered. These analyses included all 267 critical vessel casualties.

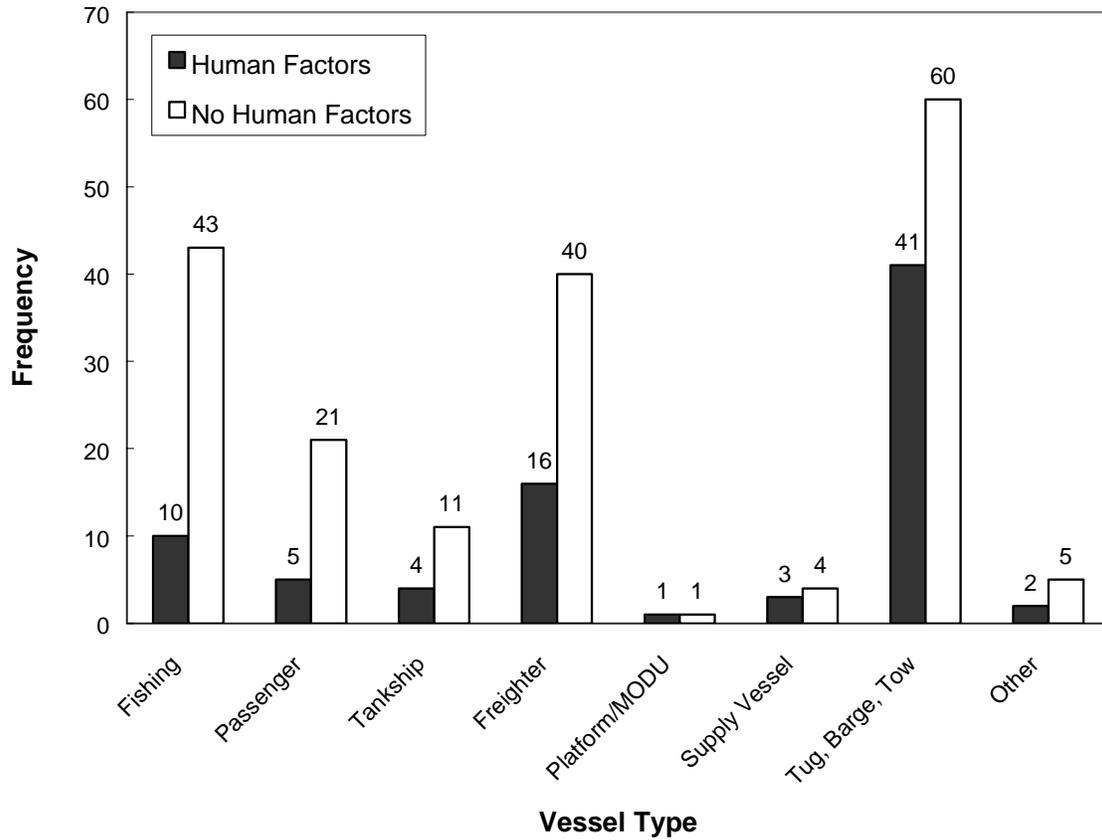
*Types of critical vessel casualties with human factors contribution.* Figure C-2 presents the frequency of vessel casualty types with and without a direct human factors contribution for the 267 critical vessel casualties identified in this study. Direct human factors contributions were most prevalent in collisions (92 percent), allisions (62 percent), groundings (56 percent), and foundering and sinking casualties (47 percent). In general, these are the types of casualties in which an individual's action, decision, or inaction can be tied directly to inadequate vessel navigation or handling. In contrast, human factors are found to have much lower rates of direct contributions in structural failures (30 percent), fires (25 percent), and all four types of equipment failures (12 percent).



**Figure C-2. Frequency of critical vessel casualty types with and without a direct human factors contribution (N=267).**

*Vessel types involved in critical vessel casualties with a human factors contribution.* Figure C-3 presents the frequency of vessel types involved in vessel casualties with and

without a direct human factors contribution for the 267 critical vessel casualties identified in this study. Here, the findings indicate relatively low rates of human factors contributions to vessel casualties aboard passenger vessels (19 percent) and fishing vessels (19 percent). Among those vessel types with an adequate number of vessel casualties to interpret trends in human factors contributions, there is a relatively higher rate of human factors contribution aboard the tugs, barges, and towboats (41 percent).



**Figure C-3. Frequency of vessel types in critical vessel casualties with and without a direct human factors contribution (N=267).**

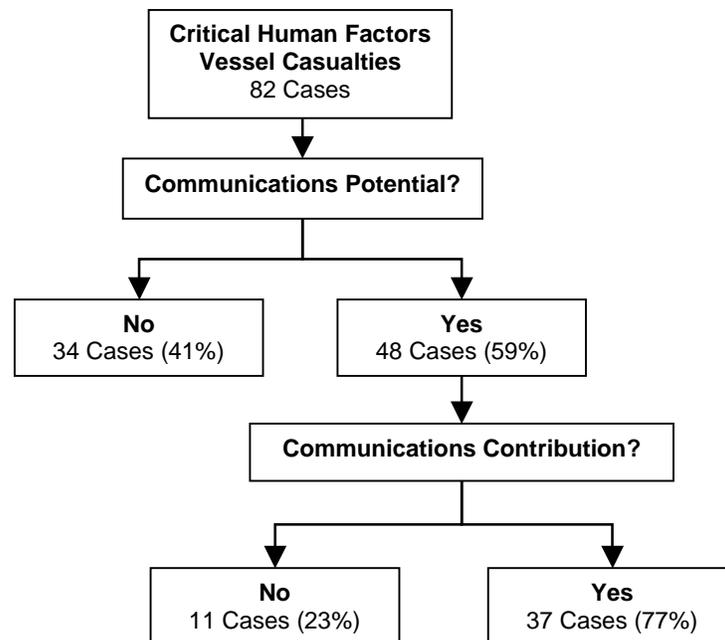
## **Characteristics of Vessel Casualties with a Communications Contribution**

The separate discussions of communications problems in vessel casualties address four topics:

- Communications problem areas across five communications sub-topics.
- Most frequently identified communications problems within selected communications sub-topic/problem area combinations.
- Frequency of contributing factors to communications problems.
- Most frequently identified contributing factors within selected communications problems.

### Prevalence of Communications Problems

Figure C-4 summarizes the results of the screening for potential communications contribution and the final determination regarding the contribution of communications to each vessel casualty. Of the 82 critical human factors vessel casualties, 48 cases were determined to have a potential for communications involvement. Of the 48 critical vessel casualties with a potential for a communications problem, 37 (77 percent) were determined to have one or more communications problems contributing to the casualty.



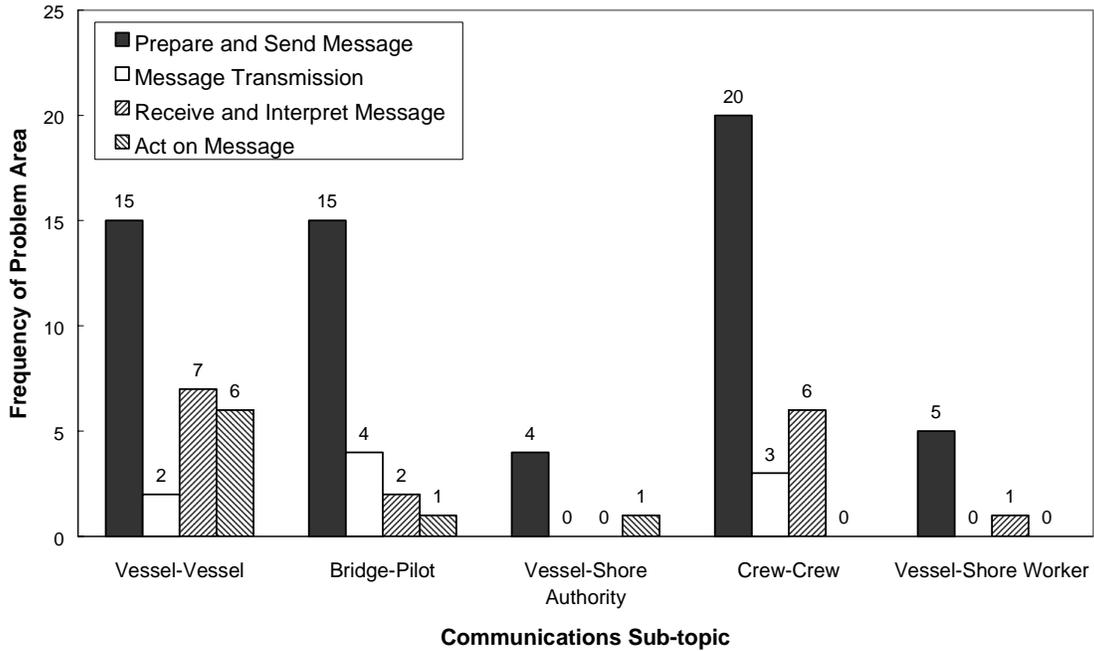
**Figure C-4. Summary of critical vessel casualty communications potential screening and communications investigation results.**

## Vessel Casualties and Communications Problems

The following discussion of vessel casualties and communications problems addresses problems and contributing factors identified among 37 critical vessel casualties, including three cases that involved both vessel and personnel injury casualties. Multiple communications problems were identified for most casualties. For example, 92 separate problems were identified among the 37 critical vessel casualties with communications problems. Because of this, the discussion focuses on the relative prevalence of different problems and contributing factors, rather than the percentage of cases in which different types of problems were cited.

*Communications problem areas in vessel casualties.* Among the 37 critical vessel casualties in which communications problems were identified as a contributor, IOs identified 92 separate instances of communications problems. Figure C-5 presents the distribution of these 92 problems across the five communications sub-topics (vessel-vessel, pilot-bridge, vessel-shore authority, crew-crew, and vessel-shore worker) and the four communications process areas (prepare and send message, message transmission, receive and interpret message, and act on message). This figure depicts several findings worthy of note. First, there is a definite clustering of problems within communications processes. The *Prepare and Send Message* process has the majority of problems associated with it, with 59 (64 percent) of the total set of 92 cited problems. The *Receive and Interpret Message* process has 16 problems associated with it, or 17 percent of the total set of cited problems.

The second noteworthy characteristic of Figure C-5 is that a subset of communications process and sub-topic combinations represents most of the cited problems. The seven most frequently cited problem areas in Figure C-5 represent 78 (85 percent) of all cited problem areas. These seven areas constitute potential opportunities for improving communications processes to reduce the risk of these vessel casualties.



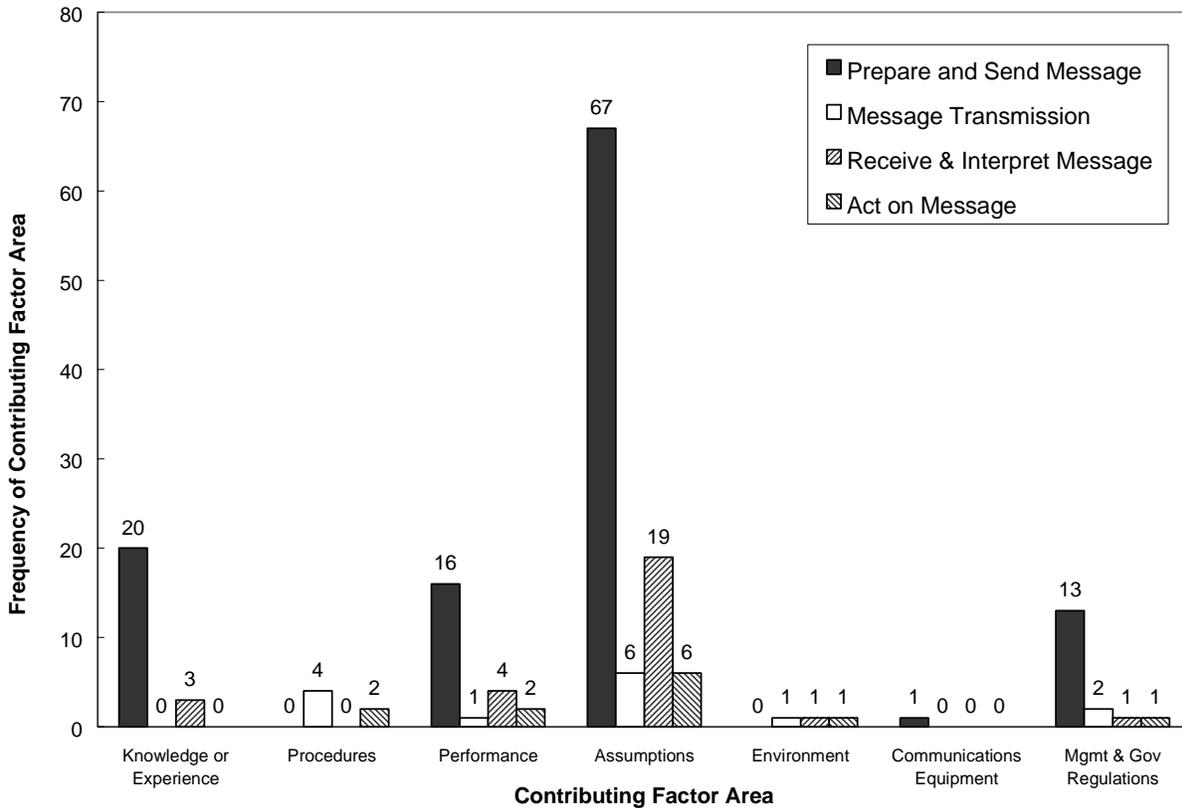
**Figure C-5. Critical vessel casualties – Communications problem areas across five communications sub-topics.**

*Most frequently identified communications problems in vessel casualties.* Table C-1 presents the frequency with which 78 specific communications problems were cited by IOs within the seven most prevalent problem areas in critical vessel casualties. In this table, the seven problem areas are listed in order of their frequency, as are the specific problems listed under each area. Note that an IO could cite multiple problems within a casualty. A number of specific findings are apparent in reviewing Table C-1. First, the *Did not communicate* problem was the most prevalent within *Prepare and Send Message* problems, especially among crewmembers on the same vessel. Second, a fairly broad range of specific problems in the *Prepare and Send Message* process were cited by IOs. Third, *Did not monitor communications* was the most prevalent problem associated with *Receive and Interpret Message* problems. Finally, a general disregard for previous communications was indicated as the problem (*Took no action* and *Action was not in accordance with agreement*) when *Act on Message* was cited as the general problem area.

**Table C-1. Critical vessel casualties – Most frequently identified communications problems within selected communications sub-topics.**

| <b>Communications Sub-topic – Communications Problem Area</b>          | <b>Frequency</b> |
|--|------------------|
| <b>Crew-Crew – Prepare and send message</b>                            |                  |
| Did not communicate  | 13               |
| Communicated ambiguous, incorrect, or incomplete information           | 3                |
| Did not request information  | 3                |
| Did not question other's actions or assert interpretation of situation | 1                |
| <b>Vessel-Vessel – Prepare and send message</b>                        |                  |
| Did not communicate  | 4                |
| Did not question other's actions or assert interpretation of situation | 4                |
| Did not request information  | 3                |
| Communicated ambiguous, incorrect, or incomplete information           | 2                |
| Did not send information in a timely manner                            | 2                |
| <b>Pilot-Bridge – Prepare and send message</b>                         |                  |
| Did not communicate  | 6                |
| Did not question other's actions or assert interpretation of situation | 3                |
| Communicated ambiguous, incorrect, or incomplete information           | 2                |
| Did not request information  | 2                |
| Did not send information in a timely manner                            | 2                |
| <b>Vessel-Vessel – Receive and interpret message</b>                   |                  |
| Did not monitor communications   | 5                |
| Did not listen to complete message                                     | 1                |
| Did not acknowledge information reception                              | 1                |
| <b>Vessel-Vessel – Act on message</b>                                  |                  |
| Took no action   | 4                |
| Action was not in accordance with agreement                            | 2                |
| <b>Crew-Crew – Receive and interpret message</b>                       |                  |
| Did not interpret the information correctly                            | 3                |
| Did not verify the validity or accuracy of the information             | 2                |
| Did not acknowledge information reception                              | 1                |
| <b>Pilot-Bridge – Message Transmission</b>                             |                  |
| Message not transmitted  | 4                |

*Frequency of contributing factor areas to communications problems in vessel casualties.* In determining how communications contributed to a casualty, IOs were asked to choose from a list of 34 individual contributing factors, which were divided into seven areas. Investigating Officers identified 171 individual factors that contributed to specific communications problems among the 37 critical vessel casualties in which communications problems were identified as a contributor. Figure C-6 presents the frequency with which IOs identified general contributing factor areas across the four communications processes for these critical vessel casualties. As seen in the figure, 98 of the total 171 contributing factors identified (57 percent) are associated with assumptions of those communicating. In addition, 135 of the total 171 identified factors (79 percent) are clustered within five of the 28 possible combinations of contributing factor areas and communications processes.



**Figure C-6. Critical vessel casualties – Frequency of contributing factor areas to communications problems.**

*Most frequently identified contributing factors to communications problems in vessel casualties.* Table C-2 provides a list of the specific contributing factors identified in each of the five most frequently cited areas in Figure C-6. Note that IOs identified a total of 135 specific contributing factors within these five problem areas. Review of this table provides a number of insights regarding the factors contributing to these communications problems. First, many of the problems associated with *Assumptions in Prepare and Send Message* stem from the contributing factor *Assumed there was no need to communicate* (31 instances). Second, a frequent problem associated with knowledge or experience in *Prepare and Send Message* is *Limited English skills or knowledge*. Third, there was a broad range of factors contributing to problems of assumptions in *Receive and Interpret Message*. Fourth, factors contributing to *Performance* problems in *Prepare and Send Message* involved both attitude (*Not willing to communicate*) and conflicting job requirements (*Distracted or interrupted by other tasks* and *individual not at workstation*). Finally, a lack of regulation and/or procedures was seen as a contributing factor in *Management and Policy* problems in *Prepare and Send Message*.

**Table C-2. Critical vessel casualties – Most frequently identified contributing factors within selected communications processes.**

| <b>Communications Process – Contributing Factor Area</b>     |           |
|--|-----------|
| Specific Contributing Factor                                 | Frequency |
| <b>Prepare and send message – Assumptions</b>                |           |
| Assumed that there was no need to communicate                | 31        |
| Incorrect interpretation of the situation                    | 11        |
| Assumed incorrectly that other party knew the information    | 10        |
| Assumed that individual in charge recognized the problem     | 9         |
| Other  | 3         |
| Assumed lack of response as implicit (silent) confirmation   | 3         |
| <b>Prepare and send message – Knowledge or experience</b>    |           |
| Other  | 6         |
| Limited English skills or knowledge                          | 5         |
| Lack of common language                                      | 3         |
| Inadequate knowledge of correct communications protocol      | 2         |
| Inadequate knowledge of regulatory requirements              | 2         |
| Improper use of standard marine technical vocabulary         | 1         |
| Inadequate knowledge of company procedures or policies       | 1         |
| <b>Receive and interpret message – Assumptions</b>           |           |
| Assumed that there was no need to communicate                | 4         |
| Assumed that individual in charge recognized the problem     | 4         |
| Assumed incorrectly that other party knew the information    | 3         |
| Incorrect interpretation of the situation                    | 3         |
| Other  | 3         |
| Assumed lack of response as implicit (silent) confirmation   | 2         |
| <b>Prepare and send message – Performance</b>                |           |
| Not willing to communicate                                   | 6         |
| Distracted or interrupted by other tasks                     | 4         |
| Other  | 3         |
| Not willing to challenge authority                           | 2         |
| Individual not at workstation                                | 1         |
| <b>Prepare and send message – Management and regulations</b> |           |
| No regulatory requirement to communicate                     | 7         |
| Inadequate Standard Operating Procedures                     | 5         |
| Other  | 1         |

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