

NIST Technical Note 1664

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Analysis of Occupant Behavior During a High-rise Office Building Fire

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Summary. Survey responses from occupants involved in a 32-story high-rise building evacuation during a fire were collected and analyzed to study the pre-evacuation period. First, qualitative findings on occupant behavior are presented. Also, descriptive statistics are presented on pre-evacuation times for this building as well as the frequency of performing certain pre-evacuation actions. The focus of this paper is on the prediction of pre-evacuation times. Multiple regression models were used to test whether specific occupant, building, and environmental factors predicted pre-evacuation times. This study found that the actions taken by occupants during this period, i.e., waiting, helping, and preparation actions, was a main factor that significantly increased pre-evacuation time. In addition, although the action of seeking information did not significantly influence pre-evacuation time, interaction effects were found among certain groups of occupants who sought information. Of those who sought additional information, older adults took less time seeking information (per action) than younger adults, occupants with disabilities took more time seeking information (per action) than occupants without disabilities, and occupants who perceived risk/danger took less time seeking information (per action) than those who did not perceive risk. This study also found that the initial location of the occupant (i.e., their floor) also significantly influenced pre-evacuation time, likely due to the information that occupants received on these floors. The effects of these factors on pre-evacuation times are quantified by stating how much pre-evacuation time was required for each factor (i.e., action taken or floor location). This study concludes with techniques to improve the current behavioral data collection instrument.

Introduction

The level of safety that a building affords occupants during a fire is determined in one of two ways: 1) the use of prescriptive codes and 2) the use of performance-based codes or design. In the first case, an engineer consults a set of building and/or fire codes to ensure that the building has the required number and width of exits, appropriate number and spacing of suppression and detection systems, etc. However, very few of these regulations are based on a scientific understanding of how occupants will use the building and take action during an emergency (i.e., occupant behavior). In the second case, an engineer determines whether the time when untenable conditions develop in the building (ASET or available safe egress time) exceeds the time needed for occupants to evacuate the building or a portion of the building (RSET or required safe egress time). Engineers use tools ranging in sophistication from back-of-the-envelope evacuation calculations to computer-based evacuation simulation models. However, due to a lack of data on occupant behavior during fire emergencies, these tools often simplify each evacuation scenario such that occupant behavior is mostly ignored and only the time required for occupant movement is accounted for.

In order to achieve a more accurate assessment of the life safety provided by a building (and its systems) during a fire, a better understanding of *occupant behavior during evacuation* is required. The purpose of this paper is to identify the factors that influenced pre-evacuation (or delay) time of occupants during an actual fire evacuation and to quantify the factors by stating how much pre-evacuation time was gained or lost due to each factor. Further analysis, similar to Kuligowski and Mileti [1], will validate the larger evacuation theory from this incident. This preliminary analysis is the first step in a larger project.

2008 Office Building Fire

In 2008, a fire occurred within the building envelope, outside of the 1st floor mezzanine walls, of a 32-story office building in the United States. This evacuation took place in the winter months in the late afternoon. Some occupants had already left for the day or were on their way out while others were

still working. On a typical day, the building houses a population of approximately 4400 people in over 25 different companies. Some floors contained occupants from only one company while other floors contained occupants from multiple companies.

The fire alarm system is designed as an emergency voice/alarm communication system. The emergency voice/alarm communication system has the capability to provide automatic pre-recorded messages upon receipt of an alarm signal indicative of a fire emergency. The emergency voice/alarm communication system also has the capability of making live voice announcements to the occupants. This building, due to its height, also incorporated a selective evacuation process that provides different pre-recorded automatic voice messages to different floors of the building depending on the floor of alarm origin. For example, a specific “fire zone” message will be broadcast through the fire alarm speakers on the floor of alarm origin, the floor immediately above the floor of origin, and the floor immediately below the floor of origin. Simultaneously, a “safe zone” message is broadcasted to all the other building floors.

Shortly after the fire was detected, occupants below the 5th floor received the automatic, pre-recorded voice alarm message to evacuate the building. Initially, occupants on the 5th through 32nd floors received the "safe zone" message that informed them that they were in a safe location and to wait for further instructions. Shortly after that initial message (less than 5 min), the fire alarm system received a second alarm initiated from a 6th floor fire alarm manual pull station which resulted in the 5th through 7th floor occupants consequently receiving a second automatic pre-recorded message. This message informed the occupants to evacuate down three floors and wait on that floor. In addition, occupants on the 8th floor and above also received a second automatic pre-recorded message that informed them that they were in a safe location and to wait for further instructions. Approximately 15 min later; a “live” voice announcement initiated from the fire command center, informed all the occupants to evacuate the building. Some occupants had previously evacuated the building, while others remained (and likely heard this message). In addition to the instructions on what to do, occupants received other environmental cues from the incident, including seeing smoke (especially below the 8th floor).

Pre-evacuation Theory from Buildings

The pre-evacuation time period for an occupant, sometimes called pre-movement time or pre-response time, is the time beginning when the occupant is alerted that something may be wrong and ending when the occupant begins purposive movement within the exit stair or exit^{*}. For some emergencies, occupants are instructed to relocate to another place within the building (e.g., three floors below), and the pre-evacuation time period is the time spent before purposive movement to a place of safety begins. For most occupants, depending on the building, the pre-evacuation period is spent on their building floor and evacuation time is spent in the means of egress (e.g., exit stair).

Whereas some RSET calculations assume a pre-evacuation time of zero for a building population, human behavior research of past emergencies shows that occupants spend time, sometimes a significant amount of time, engaging in actions during the pre-evacuation period [2]. Studies have collected data on pre-evacuation time for occupants evacuating buildings during emergencies and evacuation drills [3]. Resulting from these studies are distributions of pre-evacuation time data for use in RSET calculations. These data are frequently categorized by the type of building from which they were collected, including university buildings [4], hospitals [5], retail stores [6], apartment or residential buildings [7], office buildings [8,9,10], and hotel buildings [11], for example.

After further analysis of the pre-evacuation period, research shows that occupants perform a variety of activities [12,13]. These actions can include investigating the incident, warning others, searching for others, getting personal items, and preparing to leave. All of the actions mentioned take time to

* This definition of pre-evacuation time is for this analysis only. Other research on pre-evacuation time may define the boundaries of this time period differently.

complete; however, there is very little, if any, data available on the time necessary to complete each type of pre-evacuation action. For this reason, much of the RSET calculations still rely on overall time distribution data to describe the entire pre-evacuation period.

Additionally, research has been performed that identify the factors that are likely to influence (i.e., increase or decrease) overall pre-evacuation time [2,14]. These factors can originate from the actions that occupants perform during this period, the environment (including the building and the fire), and occupant characteristics. First, theory shows that occupants who take certain actions during the pre-evacuation period have increased overall pre-evacuation time [1]. Pre-evacuation actions and pre-evacuation delays have been linked in the fire field for decades [13]. Research has determined that actions performed during this period increase an occupants' delay time [15], and certain actions in particular, i.e., searching for information and confirming information about an incident, have been identified as ones that increase pre-evacuation delays [19]. Therefore, it is hypothesized that each action type performed by occupants increases their overall pre-evacuation time.

An occupant's pre-evacuation time can also be influenced by environmental factors, specifically the information that people receive about the incident [16] and the source of that information [6]. Theory shows that occupants who receive information on what to do during an incident [17], especially when this information is given via an emergency voice/alarm communication system rather than simply hearing sound tones from an audible notification appliance (e.g., horn, bell, etc.) [18], are more likely to follow this information. Therefore, it is hypothesized that occupants in the 32-story building were more likely to report a longer overall pre-evacuation time when given instructions via the emergency voice/alarm communication system to wait on their floor.

Also, theory has shown that occupant characteristics influence pre-evacuation actions, which can influence pre-evacuation times [2]. Pre-incident occupant factors (i.e., factors that exist prior to the incident occurring), such as demographics (i.e., older occupants and gender) [12], occupant disabilities [4], and previous experience/training in emergencies [19], can influence an occupant's engagement in pre-evacuation actions, which can then influence his/her overall pre-evacuation time. Also, some research has found that an occupant's perception of risk, a factor that occurs in relation to the incident (known as an incident factor), decreases an occupant's overall pre-evacuation time [10], while other research has not found a strong influence of risk on pre-evacuation timing [1]. Therefore, it is hypothesized that older occupants and occupants with disabilities will have longer pre-evacuation times; whereas occupants with previous experience/training and those with a higher perception of risk/threat will have lower overall pre-evacuation times. The data will be examined to see if there was any difference between pre-evacuation timing of men and women, since the previous research shows differences in pre-evacuation actions only.

Methods of Data Collection and Analysis

The building management sent out anonymous, self-administered questionnaires via email or hand delivery to occupants of a 32-story high-rise office building who were evacuated due to a fire incident in the building. The purpose of these questionnaires was to obtain information on 1) the background of the occupant (occupant demographics, previous training and education in fire safety, and previous experience in fire evacuations), 2) actions and decisions made by the occupant on his/her floor during the building evacuation, and 3) actions and decisions made by the occupant during the building evacuation via the exit stairs and/or elevators. Appendix A provides a copy of a questionnaire similar to the one distributed to the occupants after the building fire. These data were collected via paper questionnaires and out of 4400 occupants in the building, over 670 survey responses were received (a response rate of 15 %)†.

† This response rate is underestimated due to the fact that an unknown number of the 4400 occupants had already left work for the day and were not in the building when the fire occurred.

The sample for this study is a convenience sample, containing data from only those evacuees who decided to participate. Of the 670 surveys received, 375 occupants were included in the analyzed sample. Participants were removed from the sample due to the following reasons: 1) they were not present in the building during the incident or were already leaving at the time of the incident, and therefore did not participate in the pre-evacuation period of the incident, 2) they did not provide answers to any or all of the survey questions included in the final regression model, or 3) they identified themselves as evacuation coordinators. The original sample contained too few evacuation coordinators to include in this study's sample. Also, additional participants were removed from the sample due to response errors on the dependent variable.

Measurement

A total of 10 independent variables were included in the model to predict pre-evacuation time. These variables fell into four categories: pre-evacuation actions, environmental cues, incident-based occupant factors, and pre-incident occupant factors. Descriptive statistics are provided for each model variable in Table 1.

Table 1: Descriptive statistics for model variables

Variable name	Mean	Standard Deviation	Measure	Range
Dependent Variable				
Pre-evacuation time	10.42	7.63	Self-reported time (minutes)	1-45
Independent Variables				
<i>Pre-evacuation Actions</i>				
Wait/Cont. Action	0.93	0.79	Number of actions	0-2
Seek Information	0.66	0.83	Number of actions	0-4
Help	0.25	0.51	Number of actions	0-2
Prepare	1.81	1.01	Number of actions	0-5
<i>Environmental Factors</i>				
Floor (8 th floor and above)	0.65	---	Yes/No	0 or 1
<i>Incident Occupant Factors</i>				
Perceived Risk or Threat	0.53	---	Yes/No	0 or 1
<i>Pre-incident Occupant Factors</i>				
Gender	0.60	---	Woman = 1	0 or 1
Age < 36	0.24	---	Yes/No	0 or 1
Age 36-45	0.21	---	Yes/No	0 or 1
Age 46-55	0.33	---	Yes/No	0 or 1
Age > 55	0.22	---	Yes/No	0 or 1
Disability	0.21	---	Yes/No	0 or 1
Training	0.68	---	Yes/No	0 or 1

The dependent variable, pre-evacuation time, was measured by asking respondents how much time passed from the moment that they were alerted to the incident until they entered the exit stair, elevator, or corridor/hallway to the door (if they were located on the ground floor when alerted). Answers to this question were coded as time in minutes.

For the pre-evacuation actions category, respondents were asked to identify any and all of the pre-evacuation actions that they performed before moving into the exit. These actions were categorized as Waiting, Seeking information, Helping, and Preparing. Waiting was measured by asking respondents whether they engaged in any of the following two actions: 1) continuing the activity in which they were engaged prior to alarm and 2) waiting (e.g., for instructions). Answers to these questions were each coded as dummy variables (0 or 1) and then added to form a scale ranging from 0 to 2. Seeking information was measured by asking respondents whether they engaged in any of the following actions, including looking around, investigating the source of the alert, seeking more information about the alarm or incident, and discussing with others about the incident. Answers to these questions were each coded as dummy variables (0 or 1) and then added to form a scale ranging from 0 to 4. Helping was measured by asking respondents whether they engaged in any of the following actions, including giving instructions to others on what to do and looking for others in the building. Answers to these questions were each coded as dummy variables (0 or 1) and then added to form a scale ranging from 0 to 2. Preparing was measured by asking respondents whether they engaged any of the following actions, including gathering coat/shoes (i.e., getting dressed) or gathering valuables, gathering emergency coordinator supplies, saving files or turning off the computer, securing files or documents, and securing the office/room/space (e.g., shutting the door, turning off the lights, etc.). Answers to these questions were each coded as dummy variables (0 or 1) and then added to form a scale ranging from 0 to 5.

For the environmental factor, the floor on which occupants were located at the initial stages of the evacuation was measured. Floor was measured by asking respondents which floor they were located when they first became aware of a fire in the building from the initial alarm (ranging from 1 to 32). Then, since different information was provided to the occupants on the 1) 8th floor and above (i.e., to wait on their floor) and 2) below the 8th floor (e.g., to evacuate), a dummy variable was created to represent occupants' location on the 8th floor and above (given a value of 1) and occupants located below the 8th floor (given a value of 0).

Occupant factors were also measured in the questionnaire. Perceived risk was measured by asking occupants if they felt at risk at any time before entering the exit stair and answers were coded as yes or no. Also, occupants were asked a series of demographic questions: 1) their gender, 2) their age (using the following categories: 18 to 25, 26 to 35, 36 to 45, 46 to 55, 56 to 65, and 66+ years old), 3) if they had any medical or physical conditions that made evacuation more difficult and answers were coded as yes or no, and 4) if they had any evacuation training in the building, including evacuation or practice emergency drills (yes or no).

Limitations

There are four main limitations of this study. First, this analysis used a convenience sampling technique. Therefore, it is inappropriate to generalize these findings to the larger population in the building as well as other office populations. Second, pre-evacuation time was reported by the respondents as an open-ended question in the questionnaire. As with any post-fire evacuation study, occupants' memories of the incident may be imperfect. Thus, there may be some error between their actual pre-evacuation time and the time they reported. Third, the questionnaire asked only *if* actions/factors took place, not *when* they took place. Any variable that was subject to change with time, e.g., perception of risk, might appear insignificant in the model, but could have altered the pre-evacuation time. Last, this questionnaire did not directly ask about the occupant's management role in the building or whether fire cues (e.g., fire or smoke) caused occupants to become aware of the incident. The questionnaire will be modified for future incidents to account for additional influential variables.

Findings[‡]

The questionnaire provided both qualitative and quantitative data on occupant behavior during the incident. Data will be presented here on occupant knowledge and training before the incident occurred, occupant response to cues during the incident, occupant roles and actions taken in response to these roles, and the behavior of occupants, including those with disabilities, during evacuation.

Training/Knowledge

The questionnaire asked occupants about their previous fire emergency training in the building. The majority of the occupants in the sample noted having some form of evacuation training provided by the building (68 % of occupants in the sample) since they started working in the building. This training included viewing pamphlets or guides, videos, and seminars as well as taking part in evacuation drills. However, the majority of the occupants in both the analyzed sample and the original sample provided to NIST (62 % of occupants) reported not participating in any practice evacuation drills in the year prior to the fire incident.

Information

As noted earlier in this report, occupants on different floors received different information at the start of the incident. Occupants on floors 4 and below were given information via the recorded voice alarm message to evacuate as their initial message. Respondents also noted becoming aware of the incident through the following: seeing or smelling smoke and hearing from a colleague or a manager that something was going on. Respondents on the floors near the incident (the 2nd floor) said that they did not hear the fire alarm/message until their floor was completely filled with smoke. In many cases, it was a manager or instructor that guided occupants on what to do in response to the incident.

On floors 5 through 7, occupants initially heard a recorded voice message telling them that there was an emergency in the building, but that they were in a safe place and to stay on their floors and to wait for further instructions. However, these occupants were then given instructions via a recorded message from the voice alarm system to evacuate three floors down the building within five minutes of the first message. However, occupants noted how confusing this was to receive conflicting messages[§]. On the other hand, if the occupants received consistent cues (they saw or smelled smoke in addition to hearing the message to evacuate from the voice alarm system and/or from their manager or trainer), there was less confusion about what the occupant should do.

As was the case with the occupants on floors 5 through 7, occupants on floors 8 and above initially received a recorded voice message telling them that there was an emergency in the building, but that they were in a safe place. They were supposed to remain on their floors and wait for further instructions. Whereas some occupants waited for further information, some were told to leave by management before an additional information announcement was provided to their floor. About 15 min after the initial message to stay, occupants still on floors 8 and above were given a 'live' voice message to evacuate. However, directly following this message, occupants received *another* message

[‡] All percentages provided in this section pertain to the 375 occupant analyzed sample, unless specifically identified as pertaining to the larger 670 occupant sample.

[§] In fire emergencies, conditions in the building can change and in turn, response strategies originally disseminated to occupants (e.g., remain in place or shelter in place) may require revision. It is important to continually monitor the fire situation, occupant behavior, and the information that is provided to occupants during the event, because if necessary, building management and/or emergency officials can configure the content of the next message to ensure appropriate occupant response [16]. Research has shown that building management or emergency officials should make reference to the previous message, e.g., a message to remain in place; and state that, due to a change in conditions in the building, occupants are now requested to [describe the newly developed response strategy here], e.g., to begin evacuation immediately. This updated message makes reference to the previous message and addresses the fact that because conditions have changed, a new strategy is currently in place. If a new message is provided (e.g., evacuate now) without any indication that a change in strategy is necessary, this could be interpreted as conflicting with the previous message.

to stay. Many noted how confusing these conflicting messages were and reported seeking additional guidance on what to do (i.e., evacuate or stay).

Occupant Roles

In the face of conflicting information, many times people such as managers, training class instructors, and/or floor wardens/area monitors on the floor took charge and evacuated occupants from the floors. At least 33 % of the occupants received further instructions from managers and/or floor wardens/area monitors during the pre-evacuation period. Occupants especially looked to managers on floors 8 and above when the alarm system replayed the 'safe area' message after occupants received the building message to evacuate. Floor wardens/area monitors also took authoritative roles during this incident; however, many of them had already left the building since the incident occurred late in the work day. Only 3 % of the original sample (of 670 occupants) represented floor wardens/area monitors still present in the building that day during the fire incident.

Occupants with Disabilities

21 % of the occupants reported having at least one condition that made evacuation more difficult. These conditions included the following: temporary injury/condition, medical condition (including respiratory or cardiovascular conditions), vision impairment, hearing impairment, obesity, mobility impairments, and pregnancy.

According to the building's emergency evacuation plan, occupants with mobility impairments in this building were instructed to assemble with their 'buddy' in the freight elevator lobby to use this elevator for evacuation. During the fire, some respondents with disabilities noted that the freight elevators were not working** and/or they waited at the elevator for a long period of time before walking or getting assistance to the exit stairs. Also, comments were made by respondents with disabilities regarding insufficient training and ability of their assigned 'buddy' to help them during the incident. Only 3 % of the occupants used elevators for evacuation and the rest of the population (including occupants with disabilities) used the exit stairs for evacuation.

Evacuation trends on stairs

Most occupants used the exit stairs to evacuate the building during this fire incident. Seventy percent of the occupants said that they chose or found their exit based on their prior knowledge of the location of the exit. Others (approximately 20 %) mentioned that they followed others to the exit stairs and/or were instructed to a specific stair. Less than 10 % mentioned following exit signs to the stairs.

Occupants were asked about any conditions that they encountered during their evacuation (they were able to check more than one condition). Sixty three percent of the sample mentioned encountering crowding in the exit stairs, 43 % noted that other occupants were moving too slowly, and 18 % reported encountering emergency responders during their evacuation. Although not specifically listed on the questionnaire, 15 % of the sample noted that smoke was an obstacle in the exit stairs, as part of the "other" option for the question. Other obstacles, such as furniture obstructions on the exit stair, difficulty opening doors, uncomfortable handrails, poor lighting, and uncomfortable shoes were not reported as problems during this evacuation. Occupants who heard a message to travel down three floors (for example, occupants on floors 5 through 7) reported being confused about where to go (i.e., to another floor or outside of the building) once they left their floor. These occupants reported, however, that exit monitors were stationed inside the exit stairs to direct them the rest of the way out of the building.

** After speaking with building management, the freight elevator was working and was able to evacuate some individuals from the building.

Pre-evacuation Times

The main focus of this study was to identify the influences of pre-evacuation time or the time that occupants delayed on their floors before beginning evacuation in the exit stairs, elevators or exits to the outside of the building. Figure 1 shows the distribution of pre-evacuation times dependent on the occupants' starting location (floor).

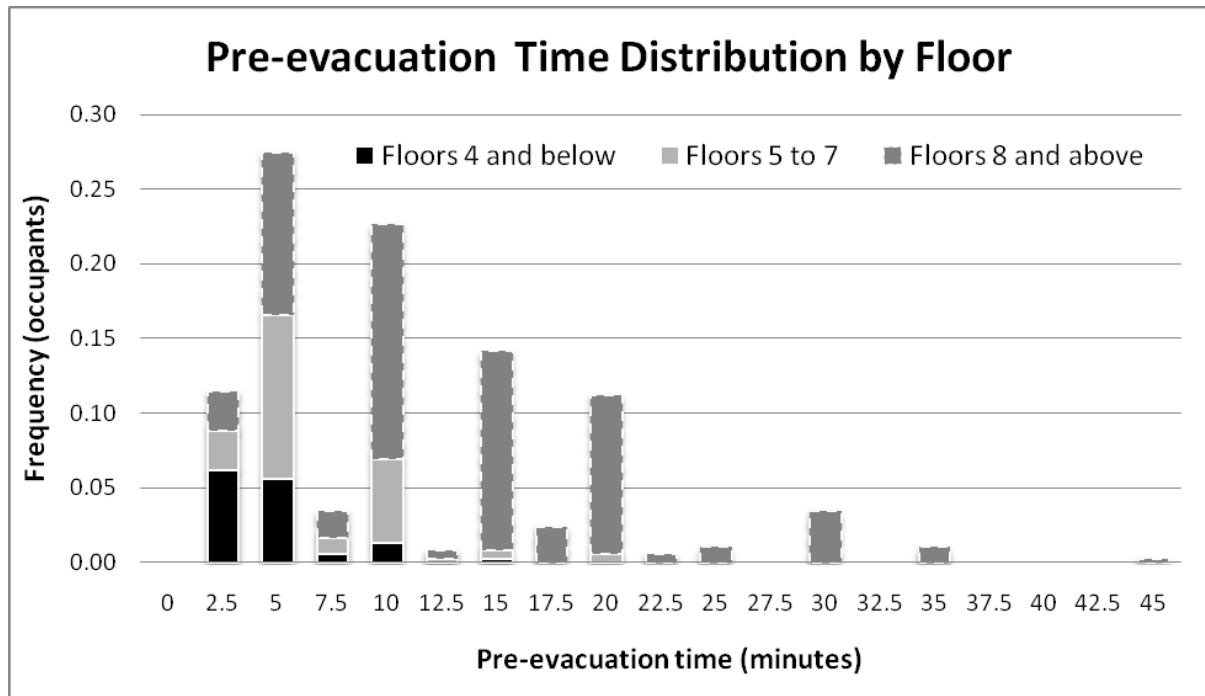


Figure 1: Distribution of pre-evacuation times by floor location

Figure 1 shows that reported pre-evacuation times for occupants below the 8th floor were 20 min or less. Occupants on floors 4 and below reported pre-evacuation times of 15 min or less with the majority of this population reporting times of 5 min or less. Additionally, occupants on floor 5 to 7 reported times of 20 min or less and the majority of this population reported times of 5 min or less as well. Even in the face of conflicting messages (floors 5 through 7), occupants below the 8th floor reported delaying between 1 min and 20 min before moving into the exit.

Figure 1 also shows that occupants on the 8th floor and above had a wider distribution of reported pre-evacuation times in comparison with those occupants below the 8th floor. Some occupants reported delaying for over 30 min before beginning evacuation movement, even though a message to evacuate was provided 15 min after the original message to stay on the floor. Additionally, some occupants on these floors evacuated within 2.5 min of the original message to stay, potentially due to management instructions or other cues that prompted their early evacuation. Some of the distribution could also be attributed to the time of day since some occupants regularly left during the time in question. Occupants on floors 8 and above reported delaying between 1 min and 45 min before moving into the exit.

Since actions presumably take time to complete, it is important to understand the types of actions that occupants performed during the pre-evacuation period. Figure 2 shows the frequency of action performance by the sample population, categorized by type of action and the number of actions performed. Preparation was the most popular action. Over 90 % of occupants engaged in at least one preparation action. Also, the majority of the occupants (65 %) engaged in at least one waiting action during pre-evacuation. A little under half of the occupants engaged in at least one information seeking action and under a quarter of the occupants engaged in helping actions. The legend of the graph shows the maximum number of actions possible in each action type, in parentheses. For example, occupants

could engage in up to 5 preparation actions, although occupants only engaged in a maximum of 4 actions, and some occupants (9 %) engaged in no preparation actions at all.

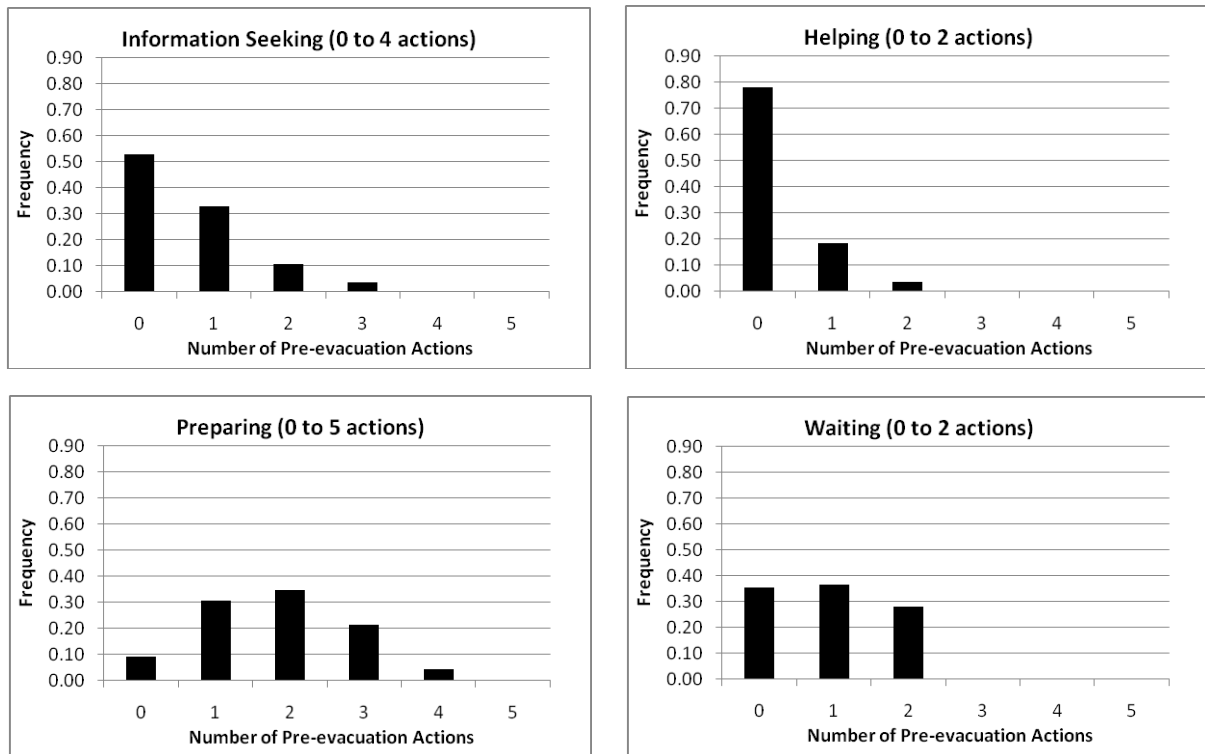


Figure 2: Frequency of performed actions by action type and number of actions

Similar to how Figure 1 provides a distribution of overall pre-evacuation time, Figure 2 provides a distribution of actions taken during pre-evacuation. However, these graphs do not identify why occupants took a certain amount of pre-evacuation times or why certain actions were taken. To answer the first question, statistical analysis was performed to identify the influences of pre-evacuation times in this fire incident.

SPSS Version 12.0.1^{††} was used to estimate the linear regression model gauging the net effects of actions, environmental factors, and occupant characteristics on reported overall pre-evacuation times (Table 2). The models are organized in hierarchical fashion. Model 1 includes the main independent variables, including floor and actions. In progression, Model 2 includes all incident and pre-incident occupant characteristics. This tiered model framework allows for the introduction of the main independent variables and then subsequent sets of variables to determine if the initial relationships still holds true. Table 2 includes the unstandardized and standardized coefficients for each variable as well as the standard error, in parenthesis. In each model, zero-order correlation matrices were examined for evidence of multicollinearity (when two or more independent variables are highly correlated), which was not found to be a source of bias. Also, plots of the standardized residuals against standardized predicted values as well as plots to test the normality of the residuals were examined to find that the assumptions of linearity and homoscedasticity (i.e., the error term does not vary with the values of the independent variable) were met.

^{††} Certain commercial entities, equipment, or materials may be identified in this document in order to describe an experimental procedure or concept adequately. Such identification is not intended to imply recommendation or endorsement by the National Institute of Standards and Technology, nor is it intended to imply that the entities, materials, or equipment are necessarily the best available for the purpose.

Of the ten variables in the regression model, four were significant at the 0.10 level or better. The coefficients of the model can be interpreted as the increase in pre-evacuation time (in minutes) for each integer increase in the independent variable. The final regression model (Model 2 in Table 2) explained 29 % of the pre-evacuation times included in this study.

Table 2: Dependent variable - Pre-evacuation Time

	Model 1	Model 2
Pre-evacuation actions		
Wait/Cont. Action	1.58/0.17*** (0.46)	1.56/0.16*** (0.47)
Seek Info	0.35/0.04 (0.44)	0.24/0.03 (0.45)
Help	1.16/0.08 ⁺ (0.67)	1.16/0.08 ⁺ (0.68)
Prepare	0.51/0.07 (0.33)	0.59/0.08 ⁺ (0.34)
Environmental factors		
Floor	7.37/0.46*** (0.72)	7.31/0.46*** (0.74)
Incident occupant factors		
Perception of Risk		-0.01/-0.00 (0.71)
Pre-incident occupant factors		
Gender (Woman = 1)		-0.81/-0.05 (0.72)
Age (36-45)		0.60/0.03 (1.00)
Age (46-55)		0.45/0.03 (0.92)
Age (>55)		0.05/0.00 (1.05)
Disability		0.73/0.04 (0.87)
Training		-1.41/-0.09 ⁺ (0.74)
Intercept	2.76** (0.86)	3.75** (1.26)
Adjusted R²	0.29	0.29

Note: Cell entries represent unstandardized / standardized slope coefficients with standard errors in parentheses. For each model, n=375. + p<0.10, * p<0.05; ** p<0.01; *** p<0.001

Model 2 shows that the types of actions performed by the occupant and the floor (or information received by the occupants) influenced their pre-evacuation time, more so than occupant factors. Waiting (e.g., continuing to work or waiting) significantly increased pre-evacuation times by 1.56 min per waiting action. These individuals waited to start their pre-evacuation activities and thus their total pre-evacuation time was greater than individuals who did not wait. Also, each action to seek information added 0.24 min to the pre-evacuation time, however, this result was insignificant. Occupants who engaged in helping actions had increased pre-evacuation times of 1.16 min per reported helping action, significant to the 0.10 level. Last, each preparation action that the respondents reported performing increased their pre-evacuation time by 0.59 min, significant at the 0.10 level.

The environmental factor (floor) influenced occupant pre-evacuation times in Model 2. Occupants on floors that received an initial recorded message to wait on their floor and no other messages from the emergency voice/alarm communication system until the live voice message to evacuate to wait on their floor required 7.31 min more of pre-evacuation time than those on other floors (that did not receive this set of messages). Finally, all of the occupant characteristics, except past experience were insignificant in Model 2, meaning that, for the average occupant, most occupant factors alone did not directly influence the occupant's pre-evacuation time. Occupants with experience in training/drills

spent 1.41 min less of pre-evacuation time than those without training, also significant to the 0.10 level.

Whereas the waiting variable was found to significantly increase pre-evacuation times to the 0.001 level, the relationships between pre-evacuation times and the other three action variables, seeking information, helping, and preparing, were either barely significant or not significant at all. And since theory has shown that performing actions increases pre-evacuation time, it became important to further understand this result. Steps were taken to investigate whether the combination of individual factors with these action variables influenced pre-evacuation time, known as interaction effects.

Interaction terms were used to identify the actual factors that influenced pre-evacuation time in this incident. Results show that the age, disabilities, and risk perception factors influenced pre-evacuation time through interactions with the following action variables: Seeking information and Helping. Only those results that are significant to at least the 0.10 level are listed here.

Seeking information: Of the occupants who sought information, a specific age group, reported disability, and perceived risk were identified as factors that significantly influenced pre-evacuation times. First, occupants 46 to 55 years old who sought additional information spent approximately 2.50 min less of pre-evacuation time per action of seeking additional information when compared with those younger than 45 ($p < 0.05$). Also, individuals with a reported disability took 2.06 min more of pre-evacuation time per action of seeking information compared with occupants who did not report a disability ($p < 0.10$). And, individuals who reported perceiving risk during the pre-evacuation period took 2.04 min less of pre-evacuation time per action of seeking information compared with those who did not perceive risk ($p < 0.05$).

Helping: Of the occupants who helped others, a specific age group was identified as a significant influence of pre-evacuation time. Occupants above 55 years old spent 3.2 min more of pre-evacuation time per helping action than those younger than 45 ($p < 0.10$).

Overall, pre-evacuation actions take time to complete. How much time, depends on the action itself and for some actions, on characteristics of the occupants performing the actions. Performing waiting actions, helping, and preparing for evacuation, regardless of occupant type, significantly increased pre-evacuation times. Also, the location of occupants (i.e., on the 8th floor and above) also significantly increased pre-evacuation times, regardless of occupant type, most likely because they were told initially that they were in a safe location.

On the other hand, certain occupant groups that engaged in seeking information took more or less pre-evacuation time (per action) than others outside of these groups. For this reason, the relationship between pre-evacuation time and seeking information appears insignificant in Models 1 and 2 (see Table 2). For the age variable, occupants over 45 years took less time to seek additional information (per action) as well as more time to help (per action) when compared with younger occupants performing the same actions. It is possible that occupants over 45 years old had a managerial role or seniority in the organization, or had a different motivation, which required them to allot different amounts of time to specific pre-evacuation actions when compared with younger occupants. Also, occupants reporting a disability spent more time seeking information (per action) than those without a reported disability. It is possible that occupants with a disability required more time confirming the incident before moving to an exit compared with nondisabled occupants. Last, occupants who reported a level of perceived risk during the pre-evacuation period spent less time seeking information (per action) than those who did not perceive risk. In this case, occupants with higher levels of perceived risk may not have required as much time to gather information, but rather relied on their risk perceptions to begin movement to the exit.

Overall, results from the regression model show that occupants delayed for significant periods of time before beginning evacuation movement. These delays times were caused by 1) the specific actions

taken during the pre-evacuation period, 2) the floor on which they were located (i.e., the types of information received during the event), and 3) whether they received fire emergency training from the building. These results can be used to inform evacuation models, evacuation plans, and training procedures.

First, the regression results show that occupants took time to perform certain actions before beginning evacuation movement out of the building. The performance of these actions increased occupants' overall pre-evacuation time (per action taken). The regression results show the length of time individuals took to perform each type of action during this fire. This type of information can inform evacuation models that simulate occupant behavior during the pre-evacuation period. At the moment, evacuation models that simulate occupant behavior require the user to supply the length of time occupants take to perform certain types of actions. With further validation of these results, behavioral evacuation models may begin to incorporate scientifically-founded time periods for the performance of certain types of pre-evacuation actions, such as preparation and helping others, in the scenarios that simulate occupant behavior/actions. This could then lead to more realistic model simulation of evacuation from business occupancies.

Second, the regression results show that occupants on floors that received a "safe zone" message waited longer than those who did not receive the message. This seems like an obvious result. However, regression results show that the time spent (7.37 min) is less than the actual time between the original "safe zone" message and the "live" voice evacuation announcement (15 min). Therefore, it can be seen that although some occupants followed the instructions given by this message, others did not and evacuated before the "live" voice evacuation message was given. This is likely due to the conflicting information received by occupants on some of the floors (e.g., being told that they were in a safe zone and then seeing smoke on the floor), not trusting the alarm system, and/or being told by an occupant on their floor to evacuate. This result suggests further analysis into the message content and dissemination techniques of the voice/alarm communication system to identify if any improvements can/should be made to the system.

Third, the regression results show that training played a role in decreasing overall pre-evacuation time. Regression results show that if the occupant reported receiving any form of fire emergency training from the building, including participating in evacuation drills, they had a reduced overall pre-evacuation time of 1.42 min. This result suggests that ensuring training for the entire building population could decrease delay times in the case of a future building incident. However, this finding requires further validation from additional studies of building evacuation.

Lessons Learned from the Building Fire

The fire in this office building revealed some issues with the emergency procedures within the building that had not been anticipated. The lessons learned from this case can be applied in other buildings that might have similar issues.

The emergency evacuation messages given to the occupants in some instances caused confusion and apprehension. The recorded message instructed occupants on the floors near the fire to evacuate while instructing everyone else in the building to wait. In this incident, occupants were told that they were in a safe location while they were also viewing smoke. Also, some occupants on floors 8 and above noted that at the same time that they received the "live" voice announcement to evacuate, they also heard the recorded "safe zone" message playing in the background. These contradictory cues can lead to occupants not trusting or believing the voice/alarm communication system; and this was seen on various floors where managers, fire wardens, and/or class training instructors delivered instructions to their personnel to evacuate (regardless of what the voice alarm message had stated).

Another potential problem identified involved how subsequent alarms received at the emergency voice/alarm communication system and their associated automatic pre-recorded voice message affects

overall occupant evacuation. Currently, depending on the location in the building of the subsequent alarm, occupants could be informed to relocate to a floor level where the initial alarm was received. Luckily, in this instance, occupants were informed by exit monitors at the stair door of the initial alarm not to enter the subject floor but to continue to exit the building.

This incident also demonstrated the potential limitations of relying on floor wardens/area monitors to perform tasks. Based on occupant comments, the fire occurred after some of the floor wardens/area monitors and managers had left for the day. This lack of authority figures could have been confusing if occupants were told to look to fire wardens for instructions on what to do. Building management could train additional individuals (e.g., company managers) so that there is someone present at all times that can provide other occupants with information about what they need to do (especially since company managers provided instructions to occupants during this building fire).

The fire also demonstrated some problems with the evacuation plan for people with disabilities. The emergency evacuation plan calls for disabled occupants to be assisted by “buddies.” In some cases, the “buddy” had left for the day or had temporary injuries. The emergency evacuation plan for the building had identified this as a potential issue and states that the disabled occupants should find another co-worker to assist them; however, some of the occupants did not recall this detail. Also, the use of the freight elevator was a problem for some occupants with disabilities. While the freight elevator was working in accordance with the emergency evacuation plan, some occupants reported that it was not working. This highlights the need to be able to communicate with people that are to use the elevator for egress so that they know 1) that the system is working and 2) the length of time they will be required to wait until the elevator arrives.

Questionnaire Improvement

In addition to identifying influences of pre-evacuation time, this study also helped to identify areas of the questionnaire that could be altered to improve behavioral data collection from actual fire incidents. Each question or set of questions will be presented here and the issues surrounding this question will be explained. Finally, for each issue, suggestions for improvement of the questionnaire will be discussed.

Set 1: Pre-evacuation timing questions

(3) How did you become alerted to the incident? Mark all that apply.

Alarm tone

Voice alarm message to evacuate

Flashing strobe light

Manager

Evacuation coordinator/fire warden

Colleague/resident

Smoke/flames

Other, please specify _____.

(10) How much time passed from the moment that you became alerted to the incident until you entered the stairwell/elevator/exit? _____min.

Set 1 shows the questions that are involved in asking the respondent how long they spent in the pre-evacuation period. Early in the questionnaire (Question 3), the occupant is asked to identify the cue or cues that initially alerted them to an incident in the building. Later in the questionnaire (Question 10), the occupant is referred back to that same moment that they were alerted and asked to recall the length of time that passed between that first moment until they entered the exit stair, elevator or exit.

Responses from this fire incident showed that some respondents became confused about the first moment when they were alerted to the incident. In most cases, occupants interpreted that first moment of alert to mean the very first message that they received (either the message to evacuate on floors 4 and below or the message to stay on their floors on the 8th floor and above). However, there were

some occupants on floors 8 and above who interpreted the first moment of alert to mean the moment when they received the voice message to evacuate (15 min after the first message to stay was given). This was determined by survey responses saying that the occupant heard the voice message to evacuate (given 15 min from the initial message) and then reported a pre-evacuation time of 2 min, for example. And to make sure all reported occupant pre-evacuation times were established from the same initial landmark, the occupants who interpreted the question from a different landmark (i.e., from the second message to evacuate) were removed from the sample.

A way to improve this set of questions is to provide more specific information as to what is meant by the first alert moment. It became clear from this study that “the moment that you became alerted to the incident” can be misinterpreted, especially in a fire incident when different information and various cues are provided to a population. A more specific question can be helpful as well as the addition of specific question responses. For example, it is not sufficient to only have “Voice alarm message to evacuate” as a response to Question 3. Rather, a response could be added to Question 3 that states “Voice alarm message to stay on your floor,” and this could bring clarity to the moment of initial alert time frame.

Set 2: Pre-evacuation actions question

(6) Please number the following actions from what you did first (1) to what you did next (2), and continue to number all of the actions that you performed until you entered the stairwell/exit. Please number the following actions (only those that apply) on the lines provided

- _____ Continued prior activity.
- _____ Waited (for instructions , to see what others were doing , to see if anything else would happen .
- _____ Looked around.
- _____ Investigated – looked for the source of the alarm. (Where did you go? _____)
- _____ Sought more information about the alarm/alert.
- _____ Followed instructions. From whom? _____
- _____ Gave instructions to others on what to do.
- _____ Discussed with others (inside the building , outside of the building).
About what? _____
- _____ Looked for others in the building.
- _____ Gathered coat / shoes, dressed. (What things? _____)
- _____ Gathered valuables. (What things? _____)
- _____ Gathered emergency/coordinator supplies. (What things? _____)
- _____ Saved file/turned off computer.
- _____ Secured files/documents.
- _____ Secured office/room/space (shut door , turned out light(s) , other? _____).
- _____ Moved to a stairwell/elevator/exit (Started evacuation).
- _____ Other, please specify _____.
- _____ Other, please specify _____.

In the second set of questions asking about pre-evacuation actions, respondents were asked to number all of the actions that they performed during the pre-evacuation period until they entered the exit. There were three problems identified with this question. The first is that occupants were not given the option to mark the same action more than once. It is possible that occupants started with the action “Waited,” and then “Sought more information...,” and then “Waited” again. Therefore, improvements could be made to the questionnaire to allow occupants to number each action more than once.

Also, the second problem involves the “Waited” action. In this incident, some occupants could have waited for 15 min; whereas others might have waited 20 s before performing another action. When trying to understand the influences to pre-evacuation timing, it is important to understand how long the occupant was waiting before performing another action. Seeking information or gathering items may take a finite amount of time. However, waiting in this incident could have taken hours (e.g.,

someone might have waited for the fire department to rescue them from their floor). The “Waiting” action could be altered to ask the respondent how long they were waiting before performing the next action.

Last, there were specific actions listed in Question 6 that could be combined to help with the clarity of the question. One example is the combination of “Investigated” and “Sought more information.” Another example is the combination of “Gathered valuables” and “Gathered coat/shows, dressed.” In these cases, it was difficult to analyze these separately and once the respondents had answered this question, it was clear that these actions were similar. Therefore, these actions could be combined in the next version of the questionnaire. Also, there are two actions that should be removed: 1) “Followed instructions,” since this is not a specific action and 2) “Moved to a stairwell/elevator/exit,” since this is captured in another section of the questionnaire.

Set 3: Additional information questions

(5) Once you were alerted to the incident, did you receive any instructions on where to go or what to do from one of the following? If yes, mark all that apply.

Voice alarm message

Manager

Evacuation coordinator/fire warden

A colleague/resident

An evacuation coordinator/fire warden

Other, please specify _____

(9) What was the main thing/reason that made you decide to evacuate?

The third set of questions asked respondents about additional information that they received during the pre-evacuation period. Question 5 provides a list of responses from which occupants can choose to identify the source of this information. The problems with this question are the absence of 1) the order or timing of when occupants received each additional piece of information and 2) the content of each piece of information. Many times occupants provided additional information about the content of the message in Question 5, 9, or the comments section of the questionnaire. From these comments only, it was determined that floors 5 through 7 got an additional message to evacuate three floors below less than five minutes after the initial message to stay. Therefore, improvements could be made to the questionnaire asking respondents to number, in order, any additional information sources and state the content of the message received from each source.

These three sets of questions are examples of how the questionnaire could be changed for use in future fire incidents. NIST will be making necessary changes to the questionnaire in the future to incorporate these and any other issues discovered throughout this work.

Conclusion

This study found that the main influential factors of pre-evacuation times were actions taken during the pre-evacuation period and initial floor location (likely due to the information that occupants received on these floors). For some actions, specifically seeking information and helping, occupant factors (before or during the incident) combined with performing these actions showed significant differences in pre-evacuation times. This study also quantified the relationships between factors and pre-evacuation time, showing how much pre-evacuation time was required for each factor or combination of factors.

Results from this analysis can begin to inform evacuation models that simulate occupant behavior during the pre-evacuation period. Data from this fire event show that occupants took time to perform certain actions before beginning evacuation movement out of the building. The performance of these actions increased occupants’ overall pre-evacuation time (per action taken). The regression results

show the length of time individual actions took to perform during this fire. At the moment, evacuation models that simulate occupant behavior require the user to supply the length of time occupants take to perform certain types of actions. With further validation of these results, behavioral evacuation models may begin to incorporate scientifically-founded time periods for the performance of certain types of pre-evacuation actions, such as preparation and helping others, in the scenarios that simulate occupant behavior/actions.

Results from this analysis can also be used to improve evacuation plans, including evacuation training. A key factor from this building fire was the information that was provided to occupants during the fire. Occupants are unlikely to follow the instructions (given via recorded, live, or in-person) if the information provided by the messages is conflicting. Research has shown that conflicting messages can cause occupants to delay (e.g., because they are searching for additional information) or perform actions other than what they were instructed to do (possibly putting them in harm's way). Therefore, it is important that any evacuation message is clear, contains the appropriate message content, and is consistent with other sources of information. In addition, some managers and/or floor wardens/area monitors throughout the building (many of which saw smoke on their floors) took charge during this event and instructed personnel to evacuate even after the "safe zone" message was given. Therefore, it is especially important to train company managers, similar to the training given to floor wardens/area monitors, since this study and other studies have shown that company managers play key roles in evacuation from business occupancies. Regression results also show that the respondents who reported receiving fire emergency training required less overall pre-evacuation time. This suggests consistent performance of building evacuation drills and distribution of evacuation plans and procedures to the building population on a regular basis.

This study identified necessary improvements to the current behavioral data collection instrument. Questions should fully define terms that could be misinterpreted (e.g., specify the first alarm), provide temporal clarity (e.g., how long they spent waiting), and provide a better understanding of what actually happened (e.g., ask what message the person heard). Specific questions were identified as confusing for some occupants and steps will be made to improve the survey.

Validation of this study and additional work on pre-evacuation behavior is needed so that a predictive model of the pre-evacuation period can eventually be developed. Future research should examine more closely the causes of why certain groups needed either more or less time to perform a given type of action. Evacuation plans and evacuation models can then account for these groups in a more accurate manner. With improvements in our understanding of human behavior in building fires, building codes, evacuation plans, evacuation models, and individuals who use these models will be better equipped to ensure the safety of occupants in buildings around the world.

APPENDIX A

Questionnaire on Emergency Evacuation Procedures

Questionnaire on Emergency Evacuation Procedures

Purpose

This survey is being conducted by the National Institute of Standards and Technology (NIST), an agency of the U.S. Department of Commerce, in order to improve the emergency procedures of this building. We ask that you complete this survey about your participation in the evacuation drill conducted on _____ (date).

Completing this questionnaire is voluntary, but your assistance would be greatly appreciated to help improve the safety of the building occupants.

Please return this questionnaire using the provided self-addressed, stamped envelope.

SECTION 1: Please answer the following questions about the time period between being alerted (e.g., from the alarm) to the incident in this building and entering the stairwell/elevator/exit.

(1) Where were you when you first became alerted (e.g., from an alarm) to the incident in this building? *(To be tailored to rooms in involved building)*

- | | | | |
|--|-----------------------------------|--|---|
| <input type="checkbox"/> Your own office/room | <input type="checkbox"/> Restroom | <input type="checkbox"/> Cafeteria | <input type="checkbox"/> Stairwell |
| <input type="checkbox"/> Colleague's office/room | <input type="checkbox"/> Elevator | <input type="checkbox"/> Basement | <input type="checkbox"/> Storage / copy area |
| <input type="checkbox"/> Meeting room | <input type="checkbox"/> Corridor | <input type="checkbox"/> First floor lobby | <input type="checkbox"/> Other, specify _____ |

(2a) On which floor were you located when you first became alerted to the incident? _____

(2b) What were you doing? _____ (e.g., working)

(3) How did you become alerted to the incident? Mark all that apply.

- Alarm tone
- Voice alarm message to evacuate
- Flashing strobe light
- Member of building staff (management or fire safety)
- Evacuation coordinator/fire warden
- Colleague/resident
- Other, please specify _____.

(4) What did you think was going on?

- Real fire emergency
- False alarm (the alarm is sounding by mistake)
- Test of equipment
- Regularly scheduled fire drill
- Security situation
- Weather emergency
- I didn't know what was going on
- Other, please specify _____.

(5) Once you were alerted to the incident, did you receive any instructions on where to go or what to do from one of the following? If yes, mark all that apply.

- Voice alarm message
- A member of building staff (management or fire safety)
- A colleague/resident
- An evacuation coordinator/fire warden
- Other, please specify _____.

(6) Please number the following actions from what you did first (1) to what you did next (2), and continue to number all of the actions that you performed until you entered the stairwell/exit. Please number the following actions (only those that apply) on the lines provided

- _____ Continued prior activity.
- _____ Waited (for instructions , to see what others were doing , to see if anything else would happen).
- _____ Looked around.
- _____ Investigated – looked for the source of the alarm. (Where did you go? _____)
- _____ Sought more information about the alarm/alert.
- _____ Followed instructions. From whom? _____
- _____ Gave instructions to others on what to do.
- _____ Discussed with others (inside the building , outside of the building).
About what? _____
- _____ Looked for others in the building.
- _____ Gathered coat / shoes, dressed. (What things? _____)
- _____ Gathered valuables. (What things? _____)
- _____ Gathered emergency/coordinator supplies. (What things? _____)
- _____ Saved file/turned off computer.
- _____ Secured files/documents.
- _____ Secured office/room/space (shut door , turned out light(s) , other? _____).
- _____ Moved to a stairwell/elevator/exit (Started evacuation).
- _____ Other, please specify _____.
- _____ Other, please specify _____.

(7a) Could you see others around you on the floor? Yes No

(7b) If yes,

How many? 1-2 3-5 6-10 11-20 21+

What were they doing? _____.

(8) Did you feel at risk (in danger) at any time before you entered the stairwell?

- Yes – high level
- Yes – moderate level
- No

(9) What was the main thing/reason that made you decide to evacuate?

_____.

(10) How much time passed from the moment that you became alerted to the incident until you entered the stairwell/elevator/exit? _____min.

SECTION 2: Please answer the following questions about the time period between entering the stairwell/elevator/exit and leaving the building.

(11a) How did you evacuate the building?

- Stairwell Elevator Walked directly outside to exit
 Other, please specify _____.

(11b) If you used an elevator, what was your primary reason for not using a stairwell?

- I have a condition that requires me to use an elevator.
 Elevators are more convenient.
 I could not find a stairwell. Other _____.

(11c) How did you find the stairwell/elevator/exit that you used to evacuate?

- I followed others.
 I followed EXIT signs.
 I knew the exit.
 I used the way I came in.
 I was instructed to use this exit.
 Other, please specify _____.

(12) If you left by a stairwell,

(a) Did you use... Stairwell ___ Stairwell ___ [*Designations, e.g., A, 1, north, blue, to be tailored to involved stairwell*]

(b) Please check any of the conditions you encountered during the evacuation:

- Furniture or other object(s) obstructed entry to stairwell.
 Crowding in the stairwell.
 Difficulty opening stairwell or exit doors (Which doors? _____).
 Uncomfortable handrails.
 Poor lighting.
 Emergency responders were coming up stairwell.
 People in front of you were moving too slowly.
 People were standing /resting on the landings.
 Confusion with which way to proceed.
 Shoes were uncomfortable for the required distance.
 Other, please specify _____.

(13a) During your evacuation, could you see others around you (e.g., in the stairwell)?

- Yes No

(13b) If yes, were they the same people from your floor?

- Yes No

(14) From the time you entered the stairwell/elevator/exit until you left the building, how many minutes passed? _____min.

(15a) Did you receive information or instructions that influenced your behavior while in the stairwell/elevator? Yes No;

(15b) If Yes, where did it come from (mark all that apply):

- Voice (public announcement) system in the building
 Member of building staff (management or fire safety)
 Another evacuee
 Manager of your company (*if a business occupancy*)
 Other, please specify _____.

(15c) If Yes, what was this information? _____.

(16) When you exited the building, which exit did you use? [Designations, e.g., A, 1, north, blue, to be tailored to involved building]

- Exit ____
- Exit ____
- Exit ____
- Other, please specify _____.

(17) Did any of the following conditions make your evacuation more difficult?

- Temporary injury/condition, please specify _____.
- Medical condition
 - Respiratory condition
 - Cardiovascular condition
 - Chronic condition
 - Other, please specify _____.
- Vision impairment
- Hearing impairment
- Overweight
- Mobility impairment/disability
- Pregnancy
- Other, please specify _____.

SECTION 3: Please provide background information about you and your experience with building evacuations.

(18) Have you ever been in a building fire before (where you saw smoke or flames and/or you felt at risk)?

- No
- Yes, in this building
- Yes, in another building

(19) What year did you begin living/working in this building? _____ or N/A (e.g., visitor).

(20) How many times do you remember the fire alarm sounding in this building in the last year?

- None
- 1 or 2 times
- 3 to 5 times
- 6+ times

(21) Have you received any form of fire emergency training for this building?

- No
- Yes, but not in the past 12 months.
- Yes, in the past 12 months.

(22a) If yes, how did you receive the fire emergency training (check all that apply):

- Pamphlets or guides
- Video
- Seminars or presentations
- Other, please specify _____.

(22b) How many fire drills have you participated in for this building in the last year?

- None
- 1 or 2
- 3+

(23a) Are you aware of the fire evacuation procedure for this building? Yes No

(23b) If yes, please describe:

_____.

(24a) Sex: M F

(24b) How old are you? 18-25 26-35 36-45 46-55 56-65 66+

(24c) Current status: Currently married Widowed Divorced Separated Never married

(24d) Do you have any children (under 18)? Yes No

(24e) Highest level of education: Some high school High school graduate Some college
 College degree Advanced degree

(24f) What is your native language? English Spanish Other, please specify _____.

(24g) Are you an evacuation coordinator/fire warden for this building? Yes No

Any Additional Comments:

Thank you for taking the time to help us improve emergency procedures and safety!

NOTE: This questionnaire contains collection of information requirements subject to the Paperwork Reduction Act (PRA). Notwithstanding any other provisions of the law, no person is required to respond to, nor shall any person be subject to penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number. The estimated response time for this questionnaire is 10 minutes. The response time includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this estimate or any other aspects of this collection of information, including suggestions for reducing the length of this questionnaire, to the National Institute of Standards and Technology, Attn., Erica Kuligowski, erica.kuligowski@nist.gov, 301-975-2309.

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