Leveraging Student Feedback for Advancement of the UVA Emergency Management System

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***Abstract*—University students receive emergency messages from various mediums during events that range from severe weather to active attacker threats. Sources suggest that the number of messages sent to students during these emergencies may contribute to message fatigue and inconsistent adherence to recommended protective actions, highlighting a gap between institutional communication and student action during crises. To investigate this challenge, this study explores opportunities for improved alignment between the operational intent of the University of Virginia's Emergency Management (EM) system and student response behavior. Specifically, our team aimed to investigate opportunities for improvement of EM's operations and their alert system, UVA Alerts, with a primary objective of increasing the safety of students during emergencies. We first conducted a literature review on emergency management strategies at other universities, consulted with an expert on emergency and disaster response, and verified capabilities of EM over numerous meetings with the office's leadership. Then, we facilitated a focus group study with eight students to inform the design of a university-wide survey, gathering input from ~580 students on the alert system and the reputation of EM more broadly. While the collection of input from students extended beyond active attacker emergencies, the majority of this work centered on improving management and communication during active attacks. Throughout study design and recommendation development, our team used systems engineering principles across user experience and system evaluation domains to inform our decisions. Statistical analysis of survey responses, ranging from Friedman to Chi-square testing, across the student body revealed distinct patterns and variations in how students perceive EM and its alert messages. While differences across the anxiety level, gender, and class year demographic subgroups analyzed were mostly insignificant, there were many significant results across the student body whole which informed key recommendations. Highlights include that the majority of participants prefer frequent alerts with clear expectations on when a next update should arrive, wider geographical coverage, and more focus on factual information rather than provision of comfort. Ultimately, study results suggest that implementing our recommendations for advancement of UVA Alerts will improve student trust in the EM system and thus enhance overall student safety during emergencies.**

Keywords—communication, emergency management, response, safety, survey

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I. Introduction

Emergency management within universities is essential to creating safe outcomes during crises. While the intention of alert systems is to maximize student safety, the dissemination of inconsistent, unclear, or delayed messaging can easily undermine this goal. Therefore, it is a worthy mission to understand how universities can provide seamless technical delivery of messages, allowing students to consistently and accurately interpret content. In a rapidly growing social media landscape, misinformation also becomes exceedingly challenging to combat. Experts argue that in order to get students to pay attention to alerts, universities must prioritize digital literacy and clear, transparent information [1]. With universities determining their own methods for alert dissemination, there ultimately lacks a standard best practice for effective emergency communication across universities.

In spring 2025, the University of Virginia experienced two back-to-back active attack incidents on grounds, during which students reported confusion and anxiety related to emergency alert timing, frequency, and clarity [2]. An alert containing the typo "RUN. HIDE. FIGH" further threatened student trust in the communications system. In response to this challenge, our team surveyed UVA students and modeled alert dissemination as a stochastic Markov Decision Process in order to identify an optimal alert cadence. This model suggested that sending alerts every fifteen minutes during the first hour of an emergency most effectively maintained student safety and minimized anxiety (see *Appendix I*).

After this initial project, our team met with EM in fall 2025 to learn about the current state of the system, including: their defined role at the university, their capabilities and privileges, and their goals for this project. Meetings with our two advisors, one of which has significant experience in human factors research and the other in decision modeling and optimization, assisted us in synthesizing client information throughout this process. The team's past systems engineering coursework also helped considerably in both scoping and ultimately addressing the identified challenges with EM (see *Appendix II*). Throughout the same semester, our team was also conducting a literature review on crisis management across other universities, user experience (UX)-based best messaging practices, and social psychology trends in response to

emergency messages. While the majority of our eventual investigation covered alerts related to active attacks, our literature review spanned public health, severe weather, and energy emergency domains in order to give us a broader picture of emergency response challenges and opportunities. Existing literature suggests a lack of alignment across institutions during a crisis, causing delays or inaccuracies in information shared with stakeholders [3]. This gap between university intent and student interpretation indicates a need for student-centered, data-driven decision making. By aiming to better understand student interpretation of messages, our team strives to improve student safety outcomes. Finally, this process also involved meeting with an expert in emergency communications introduced to us by EM, who guided us toward our ultimate research strategy of *narrower qualitative* study followed by *broader quantitative* analysis. The entire scoping process described here served to inform our preliminary objectives, guiding our key methods of a small focus group followed by a large-scale survey (see *Appendices III* and *IV*).

II. Methods

A. Focus-Group Study

After defining the scope of the problem we intended to investigate, we designed and conducted a focus group study to identify pain-points among students in their experience with UVA Alerts. Another key goal of this study was to inform the areas of emphasis for our larger student survey to be conducted virtually. In each focus group session, participants discussed a range of open-ended questions regarding alert subscription, message traits, trust in the system, barriers to compliance, and their usage of other sources of information during an emergency (see *Appendix I*). The team analyzed notes from the focus group to identify common opinions or themes in each question. For example, in the "Message Traits" section of the study, we showed participants different message options highlighting tone, wording, length, visual components or emphasis, and inclusion of timing information (see *Fig. 1*). We then asked them to share their opinions on these example messages. These questions resulted in a particularly fruitful discussion, where most students agreed upon the usefulness of some form of capitalization, hierarchically organized information, a geographic or map feature, and more incident details overall when possible.

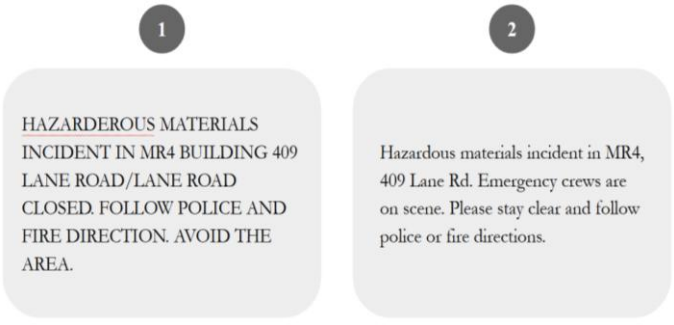

Fig. 1. Example message traits question.

Regarding participants, the focus group consisted of eight undergraduate students at UVA, one male and one female from each year (freshmen, sophomores, juniors, and seniors). We divided these participants into groups of four by underclassmen and upperclassmen so that the researchers could capture detailed, accurate results. Students received compensation in the form of $20 gift cards, in return for one hour of their participation in the study.

B. University-Wide Survey

Our team used insights from the focus group to refine the scope, structure, and content of a larger undergraduate student survey. Rather than re-exploring broader themes, the survey focused on the most salient issues raised in the focus group and put these into structured, measurable questions.

The survey consisted of 16 questions organized into five sections: demographics and baseline anxiety, message traits, message cadence, trust and reliability, and geographic coverage (see *Appendix I*). Demographic questions collected respondents' class year and gender, while baseline anxiety was measured using the Generalized Anxiety Disorder 2-item (GAD-2) scale [4]. These measures provided context for interpreting responses in subsequent sections and allowed for potential comparisons across demographic subgroups.

The core of the survey focused on message characteristics and preferences. Building directly on focus group feedback, we showed respondents mock UVA Alert messages and asked to indicate preferences related to capitalization, message length, hierarchy of information, inclusion of additional resources, use of maps, timestamps, and indications of when the next update would occur. We made the decision to frame all message variations within an active attacker scenario as this generally represents the most urgent and memorable emergency scenario that UVA students have experienced.

Additional sections addressed preferred messaging cadence during ongoing emergencies, factors that reduce trust and reliability in UVA Alerts, and reasons students seek alternative information sources during emergencies. A final section on geographic coverage was added after the focus group assessing student preferences for receiving alerts about near but off-Grounds incidents, prompted by a recent near-Grounds emergency that EM did not cover.

All questions used multiple-choice, Likert-scale, or ranking formats to encourage ease of response and enable quantitative analysis. Where appropriate, we added an "Other" option for the submission of open-ended feedback, allowing for qualitative insight when deemed necessary by respondents.

The survey was distributed via email by UVA Student Affairs to all undergraduate students living in Charlottesville, excluding graduate students, UVA Wise students, and commuters. This broad distribution strategy was intended to maximize response volume, given EM sharing their typical university survey open rate of ~30–50%. Since the survey was sent to the full target population, and participation was voluntary, we treated responses as a simple random sample of undergraduates living in Charlottesville. Accordingly, the

findings are considered representative of this population and applicable to broader EM decision making.

We received 582 responses for this university-wide student survey. Among these were 160 males, 412 females, and ten non-binary individuals. Responses by class year were more evenly distributed, with a range of 119-162 respondents per year. Two questions at the beginning of the survey served to determine student anxiety levels, revealing that 350 respondents displayed low anxiety, 158 at medium anxiety, and 74 at high anxiety. In return for their participation, each student had the option to win a raffle for the chance to win one of ten $20 gift cards.

III. Results

A. Focus-Group Study

We found that over half of the participants preferred to receive an update every fifteen minutes unless there was new information on an emergency. However, some expressed that they dislike receiving the same message repeatedly, and they thus would prefer updates to include any new pieces of information when possible. Most participants seemed to agree that the content of alerts is trustworthy, but many doubt the relevance or helpfulness of the alerts, citing the perceived buffer time of notifications as an important weakness. Students also implied differing views on the purpose of UVA Alerts, regarding whether it is to provide facts about an incident or to provide comfort during emergencies. On the topic of using alternate information sources, participants indicated that they do utilize YikYak and word-of-mouth correspondence. The results, themes, and pain-points identified from this focus group study informed the design of a secondary, larger survey of undergraduate students.

B. University-Wide Survey

1) Testing Impact of Capitalization

This question investigated whether students prefer messages that emphasize key information using capitalization. One option included the typical alert informing students of "Fire and Police Activity at the intersection of 11th and Lee Streets. Avoid the Area," and another option included "FIRE AND POLICE ACTIVITY" in capitalized letters instead. Because only four students submitted responses through the additional "Other: ___" option, we treated the primary two options as a binary variable and conducted a one sample test of proportions. We rejected the hypothesis that students equally preferred both options, $p < .001$, with 78.9% of students preferring the option with capitalization for emphasis.

Three Chi-square tests of independence were performed to examine the relationship between each demographic factor and capitalization preference. Only the relationship between school year and capitalization preference was significant, $p < .001$. Freshmen and sophomores were more likely to prefer standard capitalization than juniors and seniors. Regardless, students within each year do prefer capitalization.

2) Testing Length of Message

This question aimed to understand whether or not students prefer additional details in message, even at a sacrifice of message length. The first option given included a previously used message, "Shots Fired reported at Elliewood Ave. Avoid the area," and another option added more details: "Shots fired reported at Elliewood Ave. Avoid the area. Stay indoors, away from windows, and await further updates." While there were only six respondents that filled in the additional "Other: ___" option, we treated the other options as categorical running a Chi-square test. We rejected the hypothesis that students equally preferred both options, $p < .001$, with 80.4% of students preferring the more detailed message.

These results are constant across the year and anxiety levels according to Chi-square tests. Across gender, women are more likely to prefer more detailed messages than men, $p = .003$. However, both genders do prefer more detailed messaging.

3) Testing Hierarchy of Information

This question assessed the order in which students prefer to receive information components within messages. In the example we gave to participants, we included an event component ("Active shooter"), a location component ("100 Emmet St. S by Alumni Hall"), a description component ("White male in red hoodie"), and a directive component ("RUN-HIDE-FIGHT"). We then asked respondents to rank the components from first to last, corresponding to the order in which they would want them to appear in an alert message. A Friedman test suggested that there was a statistical difference in the ranking of each component by respondents, $p < .001$. The event ("Active shooter") was consistently ranked first, and the location ranked second. While the event description ranked next, there was no significant difference between the description and the "RUN-HIDE-FIGHT" directive.

By demographic, females were more likely than males to prefer the event description later in the message, while males were more likely than females to want the directive to appear last. There was a similar trend across class year, where juniors were more likely than seniors to prefer the event description later in the message, while seniors were more likely than juniors to want the directive last. There were no significant differences by anxiety group.

4) Testing Map Feature

This question focused on the potential merits of including a link to a map feature during emergency situations. Similar to the test for capitalization, the options included a message stating "Active attacker with knife near 100 Emmet St. S by Alumni Hall." The alternative message featured that same sentence with an additional statement directing recipients to a map link: "See map for location details: https://uva.link/alerts." An "Other: ___" option was also included but only received five responses. In order to analyze the rest of the responses, we conducted a one sample test of proportions, finding that 84.7% of respondents preferred the message with the map feature and that this proportion was significantly different from an even split of responses, $p < .001$.

5) Testing Impact of Timestamp Inclusion

This question targets the inclusion of a timestamp in the message and where students prefer it to appear within the message. We deemed this a necessary question to ask due to UVA's use of multiple different short codes from which to send messages, causing students to anecdotally report confusion in managing timing of message receipts. The first option included a timestamp at the beginning: "3:15 PM - Active attacker with knife near 100 Emmet St S by Alumni Hall. Take shelter immediately: RUN-HIDE-FIGHT," while another option moved the timestamp to the end: "Active attacker with knife near 100 Emmet St S by Alumni Hall. Take shelter immediately: RUN-HIDE-FIGHT. Alert sent at 3:15 PM." The final option excluded the timestamp from the message. We treated the three options as categorical data and ran a Chi-square test. We rejected the hypothesis that students equally preferred all options, with 87% of students preferring the options including the timestamp, $p < .001$. It is very clear that students prefer a timestamp inclusion, but where within the message was very split. There was a slight preference for having the time at the beginning of the message.

These results were consistent across class year, gender, and anxiety levels according to Chi-square tests.

6) Testing Next Update Feature

This question examined whether students prefer having a notice at the end of alerts telling them when they can expect a next update. One answer choice featured a normal alert message, while the other featured the same message with an addition at the end: "Next update in approx. Fifteen minutes unless major changes occur." Both a proportion test and a Chi-square goodness of fit test indicate that students prefer having a next update feature significantly more than not, $p < .001$. Five students utilized the "Other: ____" option for this question, through which one student did leave a very useful comment that it might be helpful to use the next update feature in tandem with the timestamp feature. Our team agreed that this would help with clarity on timing expectations.

Testing across demographics shows that females are more likely to opt for the next update feature than males. While there is no significance across class year, students with moderate and higher anxiety appear somewhat more likely than those with low anxiety to prefer the next update feature, by the Chi-square test of independence, $p = .029$. Notable interactions include that anxiety has a linear effect on males, with more anxiety correlating to a higher likelihood of preferring the next update feature. The same linear effect is clear for second-year students.

7) Testing Potential Trust-Reducing Factors

This question aimed to determine which factors might contribute the most to a lack of trust in UVA Alerts. The factors selected include buffer time before the start of an emergency and reception of the first alert, typos in alerts, a lack of established messaging intervals, a lack of new information in alerts, and inconsistent wording in alerts. We selected these factors primarily by results and themes from the focus group study. We presented respondents with a Likert scale for each factor and asked them to rate the extent to which the factor reduces their trust of UVA Alerts, with 1 and 5 representing "Not at all" and "Very much so," respectively. We conducted Friedman's Test for the ordinal variables and found that there is a statistically significant difference in the median values of the factors, $p = .000$.

We then conducted a post-hoc analysis using Paired Wilcoxon Signed-Rank tests with a Bonferroni correction to determine which specific factors have different medians. The most striking difference was between the buffer time factor and the typo factor, with buffer's median being 1.5 Likert scale ranks above the typos' median. The other three factors, lack of established messaging intervals, lack of new information, and inconsistency in wording had a difference of 1 rank lower than buffer time. Other pairings had only a difference of 0.5, with the lack of established messaging intervals and the lack of new information in messages having more of an impact on trust than typos. The lack of new information was also slightly more impactful than the inconsistency of messages. Through these tests and visualizations of the distribution of ranks for each factor, survey results showed that buffer time in the first alert seemed to have the most severe impact on trust of UVA Alerts. However, we must note here that this "buffer" is simply a *perceived* buffer by students. The university is actively committed to sending timely first alerts, and they follow federal guidelines in this topic area very carefully. See more on recommendations to address the student perception to follow.

Mann-Whitney tests across each demographic category and trust factor showed no significant difference except for gender and buffer time. With a p-value of 0.001, the test concludes that the distributions of the ranked impact of buffer time differ by gender, with female respondents exhibiting a stronger tendency to rank buffer time as significantly reducing trust.

8) Testing Opinions on Purpose of UVA Alerts

This question assessed students' view of the purpose of the UVA Alert system. In a checkbox format, we asked students to check either one of the following options or both: 1) "To provide facts about emergencies," and "To provide comfort or reassurance during emergencies." The result was 98% of students checking facts, 12% checking comfort, and 10.5% checking both. This meant that 88% of the students who checked comfort only chose it in conjunction with fact. These findings suggest that students view providing facts as the main role of UVA Alerts, with comfort perhaps falling as a secondary purpose. A notable 23 students utilized the "Other:___" option for this question. Eight of these students' responses specifically included the words "advise," "instructions," or "directions," with another student adding "where, when, or what do I do." Seven students used the words "timely" or "quickly," or emphasized that UVA Alerts should be the first alert they get.

A Chi-square test of independence showed no significant difference across gender, year, or anxiety group. However, an

unexpected interaction included that for fourth-years, there is a near linear connection where higher anxiety actually correlates to a lower likelihood of checking comfort.

9) Testing Offer of Additional Resources

This question evaluated whether students preferred the inclusion of an external link to additional resources on the RUN-HIDE-FIGHT protocol. We asked respondents to choose between a standard alert and an otherwise identical alert that included a link to further information. Overall, student preferences did not show a significant preference toward including additional resources. While 53.29% of respondents preferred the alert without an external link, a one-sample test of proportions indicated that this percentage difference was not statistically significant, $p = .155$. These results suggest that the inclusion of an additional resource link is not a universally preferred modification to alert messages. However, we should note that anecdotal comments as well as those from the focus group suggested that while many students might *think* they understand the RUN-HIDE-FIGHT protocol, they might not in practice. This would require more future testing in the Dunning-Kruger effect realm to achieve a full understanding of the knowledge gap (Norris, 2026).

Demographic analysis using a Chi-square test revealed variation by anxiety level: students with higher anxiety levels were more likely to prefer the inclusion of additional resources, whereas students with lower anxiety levels tended to prefer alerts without; students with moderate anxiety levels showed no clear preference, $p = .046$. While statistically significant, this effect applies to a relatively small portion of the student population, as only 12.76% of respondents fell into the high-anxiety category, which is expected to be somewhat representative of the broader undergraduate population. Additionally, a Chi-square test revealed differences by gender. Males had a substantially lower preference for inclusion of an external link, while females were split nearly evenly, $p = .009$. Further, a multi-factor ANOVA test examining the interaction between grade level and gender was not statistically significant at the $p = .05$ level. However, the near-threshold p-value ($p = .065$) suggests a possible pattern, with third-year females appearing less likely to prefer the inclusion of additional resources compared to females in other grade levels.

10) Testing Reasons for Using Other Sources

In this question, we asked students why they use other sources of information besides UVA Alerts. Their answer options included: to get faster information, to get more accurate information, to get more useful information, to get more detailed information, to get less confusing information, to get more people on platforms to consult with, an "I don't go to other sources" option, and an "Other:___" option. As we asked students to select all that apply, the results were not mutually exclusive. Therefore, we analyzed the results in the form of counts and percentages rather than traditional statistical tests. Ultimately, 96% of respondents admitted to using sources other than UVA Alerts. As the top two reasons for seeking alternative sources, 80% of respondents either desire faster or more detailed information. In the next tier of responses, 40-45% of students seek either more accurate information, more useful information, or people to consult with. Only 21% of students seek less confusing information. The nature of this question's design results in unreliable statistical conclusions when analyzed across demographic.

11) Testing Rate of Preferred Messaging

Building on the prior stochastic modeling which suggested that 15-minute update intervals optimize student safety and anxiety, this question further examined students' preferences for update frequency when no major changes occur during an emergency. Specifically, we asked respondents whether they would prefer to: 1) receive no update until a new change occurs, 2) receive an update every fifteen minutes stating that no major changes have occurred, or 3) receive an update every fifteen minutes including even minimal changes. We conducted a Chi-square test under the null hypothesis that each option would receive an equal proportion (one third) of responses. Results indicated a statistically significant deviation from equal preference, $p < .005$. More than two thirds of respondents selected option 3, indicating a strong preference for receiving regular updates that include even minor changes, rather than repetitive messages.

A Chi-square and multi-factor ANOVA test showed no significant differences or interactions across gender, year, or anxiety group.

12) Testing Geographical Coverage

This question assessed students' preferences regarding geographical coverage of UVA Alerts. Respondents chose between receiving alerts that cover: 1) only on-Grounds areas (fewer alerts but less coverage), or 2) on-Grounds areas and off-Grounds student housing (more alerts but more coverage). Using a one-sample test of proportions, results showed a near-unanimous preference for expanded coverage, with 90.8% of students selecting option 2, $p < .005$. 5 of 9 responses provided through the "Other: ___" option further indicated that students value flexibility and clarity, with several respondents expressing a desire for the ability to opt into off-Grounds alerts and emphasizing the importance of clearly indicating whether an incident is on- or off-Grounds within alert messages.

Chi-square testing revealed significant variation by gender, with females having a 14.85% higher preference for wider geographic coverage than males, $p < .001$.

IV. Discussion and Conclusion

Based on the previous statistical analysis of the university-wide survey, which was informed by the initial problem scoping process and focus group study, we can extrapolate key conclusions by question category. We found that structured alert formatting, consistent update timing, and fact-based messaging with actionable guidance are critical for UVA EM to maintain student trust.

More specifically, regarding message traits, our final recommendations include:

- Capitalization of key words
- Detailed messaging when possible
- Intentional hierarchy of information starting with the main event, then the event location, details, and a directive
- Inclusion of a map feature, a timestamp, and when to expect the next update
- Preference to receive updates that include even minimal changes when possible

In terms of trust and understood purpose of UVA Alerts, perceived buffer time before the first alert is the biggest threat to trust; however, we believe that extended public education regarding the EM message dissemination processes and requirements can improve student understanding and trust in this area. Next, lack of new information and seemingly random update cadence reduce credibility more than typos. Regarding the purpose of UVA Alerts, EM should generally prioritize the provision of facts over comfort. Students also commented qualitatively here about wanting clearer directions on what to do during an emergency. Relating to geographical coverage, students overwhelmingly agreed that UVA Alerts should encompass both on- and off-Grounds student housing areas. Finally, when seeking information outside of UVA Alerts, students claimed their main reasons for doing so are to obtain faster or more detailed information.

Overall, this project initiated a more open dialogue between EM and the UVA student body. Stemming from a shorter, less developed modeling project to determine ideal message timing, our team expanded to comprehensive feedback collection and analysis of message traits, trust factors, purpose perception, and other student preferences across different demographic subgroups. In the future, we hope to see a team develop a map feature and determine a new, defensible geographical radius for messaging based on student population density.

Also communicated to EM throughout this year-long project was more anecdotal feedback collected through both a Student Council survey and separate conversations, some of which comprised enhancing alignment between UVA Alerts and separate university operational announcements. Other anecdotal feedback related to improving the receipt of alerts, such as having students create a phone contact for messages arriving from different UVA numbers, along with the university sending out a final message after each emergency to close the loop on what occurred. While slightly farther outside the scope of our project, many observations regarded refining emergency educational development among students, faculty, and parents, as well as advancing physical building security. By grounding future alert design in student-centered data and systems thinking, this project shall help EM strengthen their relationship with students through UVA Alerts, ultimately advancing student safety during crises.

AI Acknowledgment

This team briefly used ChatGPT, Claude, and Copilot for guidance in conducting statistical analysis via Minitab software.

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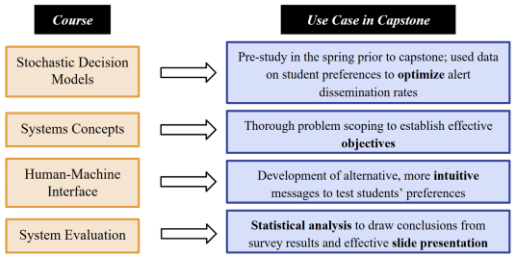
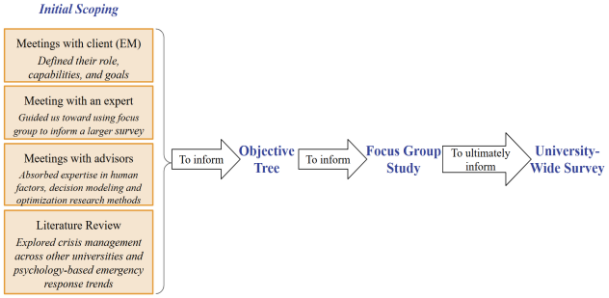
Appendices

I. To obtain access to the team's initial stochastic modeling process or the full list of questions prompted in the focus group and university-wide survey, please contact Robert Riggs at rr3bd@virginia.edu.

II. *Use Case for Team's Systems Engineering Courses:*



III. *Methodology for Gathering Information:*



IV. *Objective Tree*