H4HS Problems

Since Fall 2020

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COLORADO SCHOOL OF MINES

Fall 2020
6 Problems

FEMA, Delivering Emergency Power

Problem 1: State Emergency Support Function (ESF) #12 needs a way to deliver emergency power requiring minimal sustainment to isolated communities in order to reduce risk to locals until emergency management teams can reach them.

Problem Scoping and Discovery: The team conducted over 100 interviews with FEMA, CISA, DOE & SERTC. The students learned that power requirements of essential devices should be calculated with the combination of battery storage and solar power in order to provide a comprehensive solution. They also highlighted that the most critical pain point for ESFs was communication is most essential during a disaster. Upon discovery, they decided to focus their efforts on deployability.

Outcome: The team developed a beta product in the form of a drone that delivers essential relief kit consisting of a solar tarp, battery storage, and thermal pads weighing only 5.5kg at the cost of $919.99. Team is developing potential test case with 40 Utah Department of Transportation drones.

Results: The student team formed a company, Blackout LLC, with mentorship from early seed investors , to further develop, field, and deploy a solution for FEMA.

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FEMA, Addressing Wildfire Risk

Problem 2: The Montana Forest Action Advisory Council needs recommendations to offer to agencies and other partners on how to best work together across ownership boundaries to address wildfire risk and forest health issues while representing the values of a diverse array of interests.

Problem Scoping and Discovery: Based on discovery interviews within FEMA, the team learned that a major pain point involved sub-optimal application of funding to this problem over the past 20 years. They identified 4 obstacles to optimization; vision, data accessibility, data clarity & non-comparative data.

Outcome: The team developed a graphical way to compare wildfire risk, project funding, and population density to organize and optimize the impact of wildfire mitigation funding. The team developed a database addressing the four obstacles of vision, organization, data, and standardization.

Results: The team's recommendation informs and compliments current FEMA Region VIII efforts to implement more purposeful data organization and tracking procedures. FEMA recently added a data management billet to address data issues and implement the recommended solution.

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FEMA, Cyber Incident Response

Problem 3: Emergency managers at all levels of government and cyber incident responders need an incident command system that facilitates their communication.

Problem Scoping and Discovery: During cyber incidents, roles are often unclear, and a lack of specificity about the actual problem usually exists. The team scoped the problem to a specific use case: cyber incident response to a ransomware attack on Hospital information systems.

Outcome: The team created a beta product of a dashboard application developed on Figma that allows emergency managers to communicate essential information to relevant stakeholders during a cyber incident and provide incident commanders a tool to coordinate the actions of a response team.

Results: The student team identified that a cyber incident commander's response dashboard could save valuable time and money if properly developed and fielded. The student team made all data and discovery available to both FEMA and to the Colorado School of Mines for potential continued development by a senior design team.

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FEMA, "War Gaming" Crisis Management

Problem 4: The National Preparedness Division needs a safe and interactive way to run large-scale emergency simulations in order to improve crisis management skills and validate the response capabilities of the various communities.

Problem Scoping and Discovery: Through end-user and customer discovery, the student team pivoted away from emergency simulations to educating the general public on disaster hazards and preparedness in a non-resource intensive way.

Outcome: To address this re-scoped problem, the team developed a minimally viable product to test delivery of education by engaging the public in an activity that they already enjoy, gaming, while delivering disaster preparedness awareness & training.

Results: The team recommended two possible paths to deployment:
1. The team creates disaster preparedness games with FEMA.
2. FEMA partners with existing gaming companies who already have a large following and work to refocus currently popular games on disaster preparedness.

FEMA, Accommodating Evacuated People

Problem 5: Responding American Red Cross teams and Emergency Managers need a way to safely accommodate evacuated individuals when neighboring towns and standard practices are not an option in order to avoid the spread of COVID-19 and save people from natural disasters.

Problem Scoping and Discovery: Based on extensive customer interviews, the team re-scoped the problem to focus on providing timely disaster relief information to assist individuals who might voluntarily and preemptively evacuate from a danger zone if they were provided timely and accessible information.

Outcome: The team developed an MVP in the form of a Tableau dashboard that provides live updates on local wildfires by pulling in information from across multiple sources. The dashboard provides a timeline of updates, a map featuring locations of interest, and an embedded Google Map that provides directions.

Results: The dashboard has been presented to Emergency Managers within Colorado receiving overwhelmingly positive feedback. A request for future development included personalization of relevant information at the county level and implementation of a web-scraping tool to provide live updates.

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FEMA, The Next Generation of Training

Problem 6: The Colorado Division of Homeland Security and Emergency Management (DHSEM) Training and Exercise Program Team needs a way to deliver their G-Courses virtually in order to ensure that they can be delivered consistently to all regions of Colorado.

Problem Scoping and Discovery: The team conducted discovery interviews with instructors and students, and learned about the greatest challenges to transitioning their course to a virtual environment. They shifted their focus to finding a solution that addressed deficits in student engagement, participation, and student-instructor collaboration.

Outcome: After gleaning instructors' needs for a virtual platform, the student team designed a collaborative workbook compatible with Microsoft Teams, which was identified as the meeting platform most aligned with instructors' preferences. The workbook would allow students to work together while providing real-time updates to the instructor to assess engagement.

Results: The team has recommended their Microsoft workbook solution be streamlined to counties in order to increase the likelihood of a statewide transition from Google as a virtual training platform.

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CISA, Combating Covid-19 Misinformation

Problem 1: To combat the spread of COVID-19 misinformation and disinformation, particularly among Chinese diasporas.

Problem Scoping and Discovery: Throughout the semester, a team of cybersecurity and information systems graduate students at Carnegie Mellon University conducted over 40 stakeholder interviews and developed and built a fully functional online MDM training curriculum hosted on the Learn to Win platform.

Outcome: The course was designed to take 30-45 minutes to help citizens, government, and industry define Misinformation, Disinformation, and Malinformation (MDM), understand why it is important to slow the spread of MDM, and identify some of the most prolific creators of MDM.

Results: The student team gave over the Intellectual Property rights so that CISA personnel could coordinate with technical stakeholders, transfer the curriculum to a federal government-accessible learning management platform, and incorporate it into workforce and stakeholder training programs

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CISA, Small Business Cybersecurity Challenge

Problem 2: CISA's Office of Stakeholder Engagement program coordinators need to understand the gaps in their cybersecurity outreach efforts to small businesses in order to figure out the most effective way to educate small business owners about fundamental cybersecurity issues and best practices.

Problem Scoping and Discovery: The team conducted 72 informational interviews to refocus their discovery to identify a digestible and incentivized approach to promote small business cybersecurity principles since many small businesses are failing to adopt the proper practices.

Outcome: The team developed a website wireframe for a cyber training tool designed to determine the most vulnerable segments of the 16 critical infrastructure sectors. The website is easy to use, integrates the NIST framework, CISA information products, and the CMMC structure of a multi-tiered graduated approach.

Results: CISA personnel are identifying stakeholders interested in integrating the student team's solution.

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CARNEGIE MELLON UNIVERSITY

Fall 2021
3 Problems

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TSA, The Latency Issue

Problem 1: Determine a way for TSA officers to review and identify images processed at security checkpoints from geographically dispersed locations in near real-time.

Problem Scoping and Discovery: The team conducted 31 informational interviews and validated that TSA cannot review CT images created by security checkpoint machines across geographically dispersed locations. With the existing technology, there is a latency issue between the capture of an image and when it can be remotely viewed.

Outcome: The team developed a secure remote access beta product that would allow TSA operators to remotely control CT machines. They found that secure remote access, with the help of several technologies including endpoint security, virtual private networks (VPN), zero trust network access (ZTNA), and optical fiber technology, would allow for remote control of CT machines in near real time while sustaining operations. They also recommend incorporation of edge computing and 5G networking to improve the speed and decrease the latency of images.

Results: TSA has already invested in some of the infrastructure needed for this solution. The team did not have the ability to replicate the TSA environment or test these solutions in a TSA environment, they recommend that TSA test these solutions at the TSIF facilities. After testing, the team recommends that the TSA deploy this solution through a pilot program at smaller regional airports and slowly expand it to larger international airports.

H4HS

FEMA, Quantifying Carbon Capture

Problem 2: Find a way for FEMA personnel to quantify the economic and environmental benefits of their property buy-out risk mitigation program.

Problem Scoping and Discovery: After the team conducted 24 informational interviews, they refined the problem statement to consider whether land from a flood buyout program could generate revenue in a carbon offset market, and further, whether this could increase equity in buyout programs.

Outcome: The team created a stochastic model that determines conditions under which a community could benefit from entering a carbon market. The model outputs expected costs and payouts from market participation. The results show that although market participation is not profitable at current market prices, communities can avoid paying several hundred dollars in ongoing maintenance costs as long as yearly carbon market operational costs are below the cost communities currently pay to maintain vacant lots.

Results: The team highlights that future iterations of the stochastic model could consider non-financial benefits including habitat creation, wetland restoration, outdoor recreation access, etc.

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TSA, Cybersecurity Information Sharing

Problem 3: Find a streamlined way for TSA to prioritize cybersecurity information to inform industry partners and prevent cybersecurity incidents promptly.

Problem Scoping and Discovery: The team conducted 37 informational interviews and found that the current cybersecurity alert dissemination process within the TSAs Policy, Plans, & Engagement (PP&E) Section is manual, subjective, and repetitive. The current process involves a manual review of numerous agency alerts that delays communication with stakeholders, provides partners with no categorization of alert criticality, and offers no confirmation that the alert has been received.

Outcome: The team recommended 2 solutions:
1. The two platforms (CSAP and CTIX offered by Cyware Labs.) that combine threat intelligence collection, multi-delivery alerting, community feedback, accountability, and advanced automation capabilities providing a comprehensive information sharing mechanism between TSA member organizations.
2. ScoutPRIME is a vulnerability identification platform that allows members to monitor the attack surface of an organization, as well as manage and mitigate cyber risk.

Results: The team is working with the problem sponsor to incorporate this solution into current TSA practices.

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CARNEGIE MELLON UNIVERSITY

Spring 2022
2 Problems

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FEMA, Reunification After a Disaster

Problem 1: National preparedness teams need improved coordination between emergency response stakeholders in order to reunite families quickly after a natural disaster.

Problem Scoping and Discovery: The team conducted 25 interviews and realized there are too many non-governmental agencies involved in disaster relief. The team narrowed the scope to counties who are the main entities people connect to when looking to be reunited with survivors and produced three compelling insights:

1. People turn to who they are most familiar with, so family members of survivor victims don't tend to think of FEMA and go straight to their local county.
2. The county teams, such as the head of Emergency Operations in Nashua County, do not rely on social media companies as a communication partner since those private companies have limited resources dedicated to emergency response.
3. The reason social media communication has worked is due to the easy access without the firewall of needing to log in to a different platform.

Outcome: The team recommended focusing the solution on standardizing community awareness by creating an agreement that relieves the burden off of National FEMA employees who are helping assist during a disaster, because, disasters are local. This agreement should be a mechanism triggered by the potential of a disaster and not have to wait for the president's order. This is already happening with the University at Albany who is working with FEMA to standardize disaster messaging for emergency managers to spread awareness to their communities locally.

Results: Wendy Rodriguez, a student on this CMU student team, is looking to continue working on this problem as part of her thesis.

H4HS

TSA, Efficient Detection of Threat Objects

Problem 2: Identify a more efficient way for Transportation Security Officers (TSOs) to quickly identify obscure and threatening objects (TSA prohibited items) during baggage check.

Problem Scoping and Discovery: The team conducted 29 informational interviews which refocused the problem from identifying threatening objects faster to retention of TSO officers. The team originally evaluated a screening technology solution for TSA Officers to quickly identify obscure or threatening objects in luggage, but upon further discovery, the team identified that the root cause of the screening delays problem was not the screening technology itself, but a reduction in workforce. TSO retention is low due to the lack of a continuous rewards system relating promotions and salary structure. In addition, it is challenging and uncomfortable for TSOs to apply for their own promotional bonuses. The current structure greatly reduces TSOs employee satisfaction.

Outcome: The team learned that there are quite a few policy and technology approaches to this problem that TSA is already working on but one of the gaps where the team could contribute greatly was that TSOs currently do not have a distinct training path towards higher positions that optimizes their skillsets. For this reason, the team recommended a human resources solution that focuses on employee satisfaction. The team developed a personality and skills assessment tool that would help TSA place TSOs in work streams that optimizes their strengths and gives TSOs the best chance of succeeding in their work.

Results: The team has proposed integrating a personality test to help teams and one of the students is using this topic for her Master's thesis.

H4HS

Texas A&M University and Rochester Institute of Technology

Fall 2022
7 Problems

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TSA, More Mobility

Problem 1: DFW Airport experience teams need a more efficient way to accommodate those with mobility needs to ensure seamless passage through security checkpoints for all passengers.

Problem Scoping and Discovery: The team conducted 46 discovery interviews Transportation Security Officers, airline passengers who use wheelchairs, and industry professionals. They found that TSOs often have to pat down individuals in wheelchairs, causing discomfort, distrust, frustration, and reduced efficiency in lines. They discovered that a market solution exists that may meet the needs of both TSOs and disabled passengers - [plastic wheelchair developed by Pax Assist](#) compatible with Rohde-Schwarz QPS 12 scanning equipment.

Outcome: The team calculated the estimated cost savings that DFW would see by purchasing 500 wheelchairs per terminal based on their current passenger flow data, and hypothesized that the reduction in man hours needed to conduct pat downs for every wheelchair-using customer could save the airport $30,000 per day and $10.95MM per year.

Results: Thanks to student recommendations, the Dallas (DFW) airport has begun the procurement process to purchase several plastic wheelchairs to test the student's solution and determine the cost-saving potential for larger-scale deployment.

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TSA, Beating Bias in Artificial Intelligence

Problem 2: TSA's screening officers need more reliable means to screen varied hairstyles and textured hair in order to prevent unnecessary delays and unintentional discrimination.

Problem Scoping and Discovery: The team conducted 54 interviews with TSOs, officials from the TSA Office of Civil Rights and Liberties, and DHS S&T. They also conducted an on-site visit to Las Vegas Airport to observe the scanning process. They found that the AI training data for AIT scanners had an insufficient number of images of people with thick and textured hair, which had led to a disproportionate number of African American women being selected for pat down and submitting discrimination complaints.

Outcome: The team proposed a series of data collection drives in which people can volunteer to have their image scanned and added to the AIT database. Once a substantial data pool is put together, the team proposed a hackathon competition in which industry computer scientists could compete to create a new image-recognition algorithm that would use the more inclusive data set.

Results: The problem sponsor William Hastings suggested this problem be resubmitted for another semester so a new student team can continue doing research that builds off of this semester's data.

TSA, Consolidation of Configurations

Problem 3: TSA is seeking to standardize image processing on their Checkpoint Computed Tomography (CT) baggage scanners in order to invest government resources intentionally.

Problem Scoping and Discovery: The team conducted 30 interviews with TSA engineers, equipment manufacturers, and international partners at Heathrow airport in London, and conducted 1 on-site visit to Easterwood Airport in College Station, Texas. They found that technology already exists to implement open architecture - Stratovan's Open Platform Software Library (OPSL). The team has suggested that TSA's Requirements and Capabilities Analysis (RCA) department needs a better understanding of vendors' resistance and concerns with this new system.

Outcome: The team proposed a comprehensive report that would bridge the gap in understanding between RCA and the CT scanner vendors, and highlight OPSL's features, capabilities, and developmental maturity.

Results: The team's findings have been used in a briefing to the TSA administrator on the state of open architecture, and the problem sponsor has requested that the team's presentation be archived in TSA's open architecture repository.

H4HS

TSA, Translation to Manifestation

Problem 4: Transportation security officers (TSOs) need a way to efficiently engage with individuals with limited English proficiency in order to guide them through the screening process.

Problem Scoping and Discovery: The student team conducted over 50 interviews with passengers with language barriers, subject matter experts, and TSOs at both Helena and Denver airports. They learned about the language access binders that TSOs are expected use to translate with ESL passengers were difficult to navigate, and oftentimes put aside in favor of real-time translation tools like Google Translate. According to their findings, the current process results in heightened feelings of fear and confusion in passengers with language barriers (including the deaf and hard of hearing).

Outcome: They determined that the problem could be addressed through new technology - a digital language access tablet equipped with machine translation software - and cultural awareness training that would better equip TSOs to engage with this subset of passengers.

Results: The team recommended that Helena Regional Airport pilot their new process and, if successful, serve as a model for national implementation.

H4HS

HSI, Data [for] Migration

Problem 5: HSI's PLEPU needs a way to more efficiently record and process temporary parole data to expedite the temporary entry of non-U.S. citizens into the United States.

Problem Scoping and Discovery: Thei team's project focused on a centralized system to record, store, and process data for humanitarian and law enforcement parole applications for HSI. The team took a deep dive into the current systems in place and mapped out the flow of data through the parole application process. After 56 discovery interviews, the team determined that preventing future data loss was crucial to any potential solution.

Outcome: . The team developed a new workflow that involves digitizing all paper records and implementing a cloud-based storage system to prevent parole data loss.

Results: The problem sponsor has expressed that the students' interview insights validated their IT department's thinking about how to improve their data structure. The problem sponsor also highlighted that H4HS student engagement increased unit morale and gave HSI personnel "hope for positive change."

H4HS

CISA, Next-Gen 9-1-1

Problem 6: Public Safety Answering Point (PSAP) 911 call takers need a way to prioritize multimedia incident information to dispatch resources effectively and quickly.

Problem Scoping and Discovery: The team visited their local emergency communication department, took a trip to Washington, DC, to visit the Office of Unified Communication, and conducted 83 interviews with people affected by their chosen problem.

Outcome: The student team determined that in order to implement effective multimedia processing technology, there would need to be new enforceable technology standards at PSAPS that include common communication protocol and a standard application programming interface. To factor for the quality of life challenges for call takers, they recommend a push for the national classification of telecommunicators as first responders and for competitive pay requirements.

Results: The Executive Assistant Director for Emergency Communications at CISA will add student recommendations to their 911 technology upgrade strategy. CISA was so happy with the team that they shared internship opportunities with two students.

H4HS

FEMA, Disaster Risk Projection

Problem 7: FEMA Region I Planning Team needs a process to evaluate the overall risk of increased tornadoes, floods, and blizzards in New England urban environments to better anticipate long term climate change-induced disaster impact.

Problem Scoping and Discovery: The students conducted 44 interviews with FEMA personnel and state and local emergency planners and discovered that climate change data is available to all levels of government, but the most relevant information is not always communicated to local officials. The team conducted research on several different alternatives including improvements to hazard mitigation planning at the local level and real-time communication processes during disasters, but ultimately discovered that more data pointed to a need for more frequent two-way communication between the federal, state, and local governments.

Outcome: The team proposed a new plan involving regular intergovernmental meetings and improvements to preparedness documents provided to local and state-level planners

Results: The problem sponsor and senior leader at FEMA Region 1 expressed that the students' insights helped them better understand the way their problem affected different stakeholders in the region, and said that the data the students presented offered evidence that the problem was not as severe as they originally thought.