LAFD

Medical Supply Inventory Management
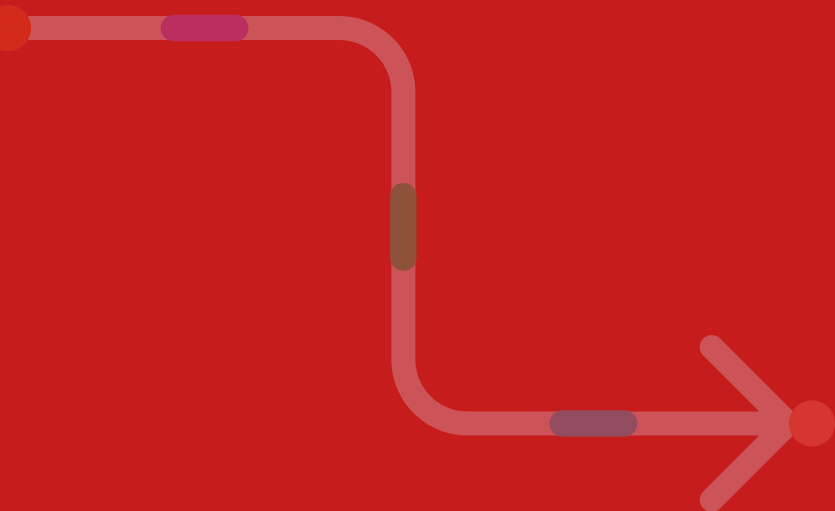
A Human-Centered Approach for Los Angeles Fire Department

from
Challenges
to
Solutions

ABOUT THIS BOOK

In April 2023 our team embarked on a 6 month project with the Los Angeles Fire Department (LAFD). This book provides a detailed look into the research conducted on LAFD's current inventory management system and design solutions that address the challenges identified. Drawing on knowledge acquired through our time in the MHCID program, our team has applied latest research and design methodologies to catalyze significant change in the inventory management system at LAFD.

We would like to thank UCI and the MHCID teaching staff for their constant support and guidance in this project.

We would also like to thank the Los Angeles Fire Department and firefighters and paramedics for their support during this project and dedicated service to the public.

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Executive Summary

The Opportunity

Over the course of six months, our team collaborated with the Los Angeles Fire Department (LAFD) to investigate the management of medical supplies used by paramedics. The primary goal was to address the issue of inefficiency with their current inventory management system. The system in place has given rise to several challenges for paramedics, including wastage of expired meds and unavailability of basic supplies for on-duty paramedics.

Key Findings

We applied user-centered research and design processes to understand the challenges within the medical supply chain system, uncover valuable insights, define necessary requirements, and ultimately develop conceptual design solutions. Throughout our journey, it became evident that LAFD faces challenges stemming from process-related, cultural, and technological issues. Although our initial focus was on technology, we came to recognize that people and process considerations are equally critical to the success of LAFD.

Recommendations

We have developed two conceptual design solutions that will serve as the foundation for the future inventory system to be implemented at LAFD. Our immediate recommendation is to address the supply issues, procure new technology, and rectify staff shortages. In the long term, we recommend focusing on improving delivery and transportation services, as well as standardizing physical storage procedures at the fire stations.

The successful implementation of an advanced inventory management system at LAFD will empower the organization to significantly enhance operational efficiency, and ensure the well-being of first responders. Ultimately, this will lead to an improved quality of service provided to the public.

2023 UCI MHCID **Capstone Project Team**

Meet the Team

We are an interdisciplinary group of individuals from UC Irvine's Master of Human-Computer Interaction and Design Class of 2022-23. Hailing from diverse backgrounds, we bring unique expertise to our team, united by a common dedication to making technology more user-centered, with a strong emphasis on creating 'technology for people.'

Our collaboration with the Los Angeles Fire Department has provided us with a truly unique and enlightening learning opportunity. With a shared passion for human-centric design, we are wholeheartedly committed to empowering users and enhancing their interactions with technology. Our team's primary aim is to bridge the gap between users and technology, ensuring a seamless and enriching experience.

Together, we are working toward a future in which technology harmoniously serves the needs of people, leaving a profoundly positive impact on their lives. Thank you for joining us on this journey, as we work towards a more user-friendly and empathetic technological landscape.

PM · Research
Shrimathi Vetrivelan

PM · Research
Ashley Autenrieth

Design · Research
Hanjin Choi

Design · Research
Mingyue Weng

Design · Research
Michelle Vo

Design · Research
Michelle Florero

The Inventory Management System at LAFD

The Los Angeles Fire Department (LAFD) provides firefighting and emergency medical services to the city of Los Angeles, California. Comprising 106 fire stations, the LAFD serves approximately 4 million people residing within its 471-square-mile jurisdiction.

The primary challenge the LAFD seeks to address is the extreme inefficiency within its management of medical supplies ordered by the central division (Supply & Maintenance) and distributed to paramedics at the 106 stations. This inefficiency spans from the wastage of expired medications to paramedics encountering shortages of basic supplies. The current inventory system has introduced numerous challenges and frustrations for paramedics. An efficient inventory management system is critical to ensure equipment, supplies, and resources are readily available and in optimal condition to respond effectively to emergencies.

A successful inventory management system at LAFD will allow the organization to make data-driven decisions, enhance operational efficiency, and maintain tighter control over their inventory, which can lead to cost savings, greater well-being of first responders and subsequent improved service to the public.

How might we

develop an improved medical and PPE supply chain for the LAFD that :

01

Enables paramedics to have the medical supplies needed to serve public while minimizing stress

An enhanced inventory management system must prioritize the constant availability of vital medical supplies for use during emergencies. The system's design should be centered on alleviating the burden on paramedics, thereby enhancing their well-being and ensuring that they consistently possess the necessary supplies to fulfill their duties effectively.

02

Empowers civilian staff with a process that is frictionless, efficient, and easy to scale

Implementing a process that integrates advanced technology and streamlined ordering procedures will result in a significant reduction in manual workload for civilian staff. This enhanced efficiency will boost their productivity, enabling them to carry out their duties with confidence. Moreover, it will foster stronger working relationships with firefighters and paramedics.

The Process

DISCOVER

April - May

Desk Research

Literature Review
Academic Research

User Research

Contextual Inquiry & Interview
Site Observation
• Shops
• Station

In-depth Interviews
• Paramedic x 4
• Station Captain x 2
• Shopkeeper
• CTO
• Shops Management x 4

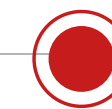## DEFINE

May - June

Data Consolidation

Data Analysis
Affinity Map

Insights

System Flows
Persona
Journey Map

DEVELOP

June - July

Exploring External Data

Expert Interviews
Analyzing Case Studies
Exploring the Tier System

Ideation

Concepts
Structure & Flow

DELIVER

July - August

Solutions

Strategy
User Scenario
Mockups
System Requirements

DISCOVER

Design excellence starts
with grasping the users'
perspectives

RESEARCH

This section offers an in-depth exploration of the research
methodologies employed by our team. These approaches enabled us
to collect pertinent data that served as the foundation for the project.
They played a pivotal role in ensuring the project's effectiveness,
feasibility, and ultimate success.

Research Overview

Effective project research encompasses a variety of methodologies, from literature reviews and surveys to hands-on interviews and stakeholder engagement.

We began this phase with desk research to understand fire departments and their operations, medical supplies and systems. Soon after, our team visited LAFD to conduct observations, semi-structured interviews and analyze physical artifacts. This site visit gave us a multi layered perspective of the organization and helped us identify primary and secondary users with whom we then conducted structured interviews. The final component of our research was a survey for firefighters and paramedics, which helped quantify data in a structured manner.

(Desk Research) — (Contextual Inquiry) — (User Interviews) — (Survey)
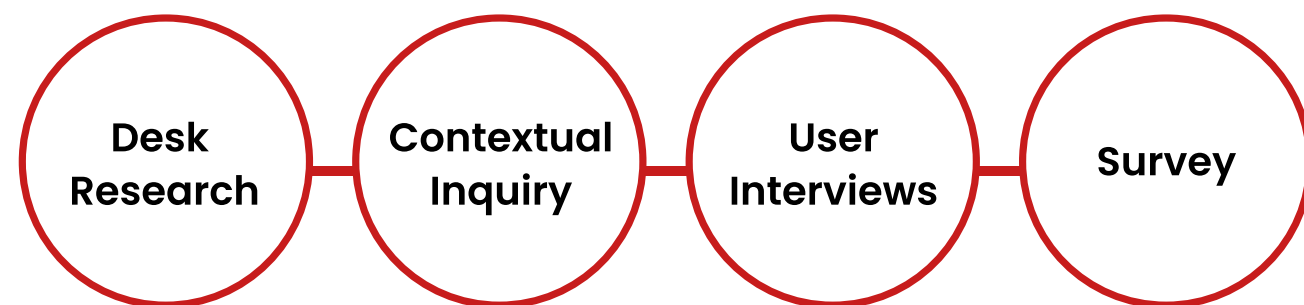
Foundational knowledge for primary research activities

Desk research on fire departments and their operations equipped us with the foundational knowledge necessary to build rationale in this project. This research was vital in our understanding of the field, and provided context prior to our site visit at the LAFD.

Our comprehensive evaluation encompassed existing research and scholarly articles on the following topics, as they pertain to fire departments:

Roles and responsibilities

Day-to-day operations

Management of medical supplies

Technology and systems

Training for staff and firefighters

2 Contextual Inquiry

Observations from the LAFD site visit

On April 20th, 2023, our team embarked on an all-day site visit to the Los Angeles Fire Department (LAFD), specifically the Supplies and Maintenance Division (The Shops), and Fire Station 20. During this visit, we engaged with a wide range of stakeholders, including fire Chiefs, Captains, administrative staff, as well as firefighters and paramedics.

Our tour of The Shops afforded us the opportunity to gain insights into the end-to-end management of medical supplies. We meticulously analyzed physical artifacts such as purchase orders and explored the use of technology, including the SRS system, as we toured the warehouse. Discussions with The Shops' inventory manager shed light on the various processes, challenges, and opportunities involved in supply fulfillment.

Subsequently, we proceeded to Fire Station 20, where we interacted with firefighters and paramedics, gaining invaluable insights into their daily routines. We observed the storage, transportation, and utilization of medical supplies, and learned about the paramedic's process for placing orders for new supplies.
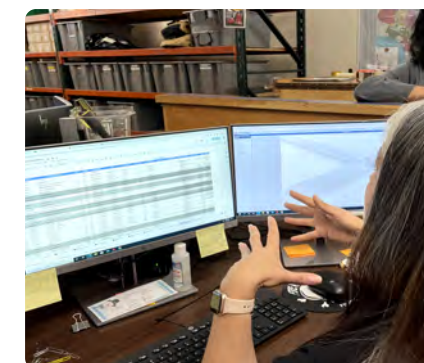
Supply and Maintenance Division

Order schedule on paper	PPE storage	Vendor deliveries
Supplies storage	Demo of technology	Crate packaged for station

Firestation

Non-standardized storage	Manual notes for reminders	Box of medical supplies
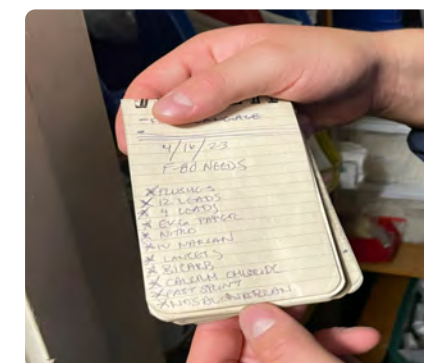
3 Interviews

In-depth understanding of LAFD and inventory systems

We conducted structured interviews to obtain firsthand insights and feedback from a diverse range of LAFD members. Our discussions encompassed conversations with key stakeholders and leaders, including high-ranking fire chiefs and the Chief Technical Officer, as well as firefighters, paramedics, and administrative staff. These interviews served as a crucial avenue for gaining an in-depth understanding of user needs, preferences, and pain points.

Each interview was conducted based on a carefully designed protocol. We crafted a set of open-ended questions with a sharp focus on user experiences, needs, and behaviors, aiming to elicit detailed responses and valuable insights.

In addition to user interviews, we also engaged in discussions with experienced researchers in the fields of supply chain management and related innovations. These conversations provided us with valuable insights into current industry trends and various types of solutions pertaining to inventory management.

In-depth User Interview

4 Paramedic	2 Station Captain	1 Shopkeeper
1 Chief Technology Officer (CTO)	4 Shops Management	**12 Total Users**

## Expert Interview

2 Supply Chain Researchers

4 Survey

Collecting metrics, insights and opinions on LAFD's systems

We designed a comprehensive survey to systematically gather structured and quantifiable data from firefighters and paramedics. Our approach involved formulating research questions that were not only meaningful but also aimed at yielding objective conclusions. These conclusions would subsequently serve as valuable guidance for the project's design phase and decision-making process.

Our survey design was characterized by meticulous attention to wording, logic, and structure, all geared toward ensuring the reliability and validity of our research findings. We utilized Google Forms to create an anonymous survey for data collection.

We conducted a thorough pilot test of the survey within our team to identify and address any potential issues. Following this, we shared the survey with LAFD stakeholders for their review and approval, after which the survey was distributed to firefighters and paramedics.
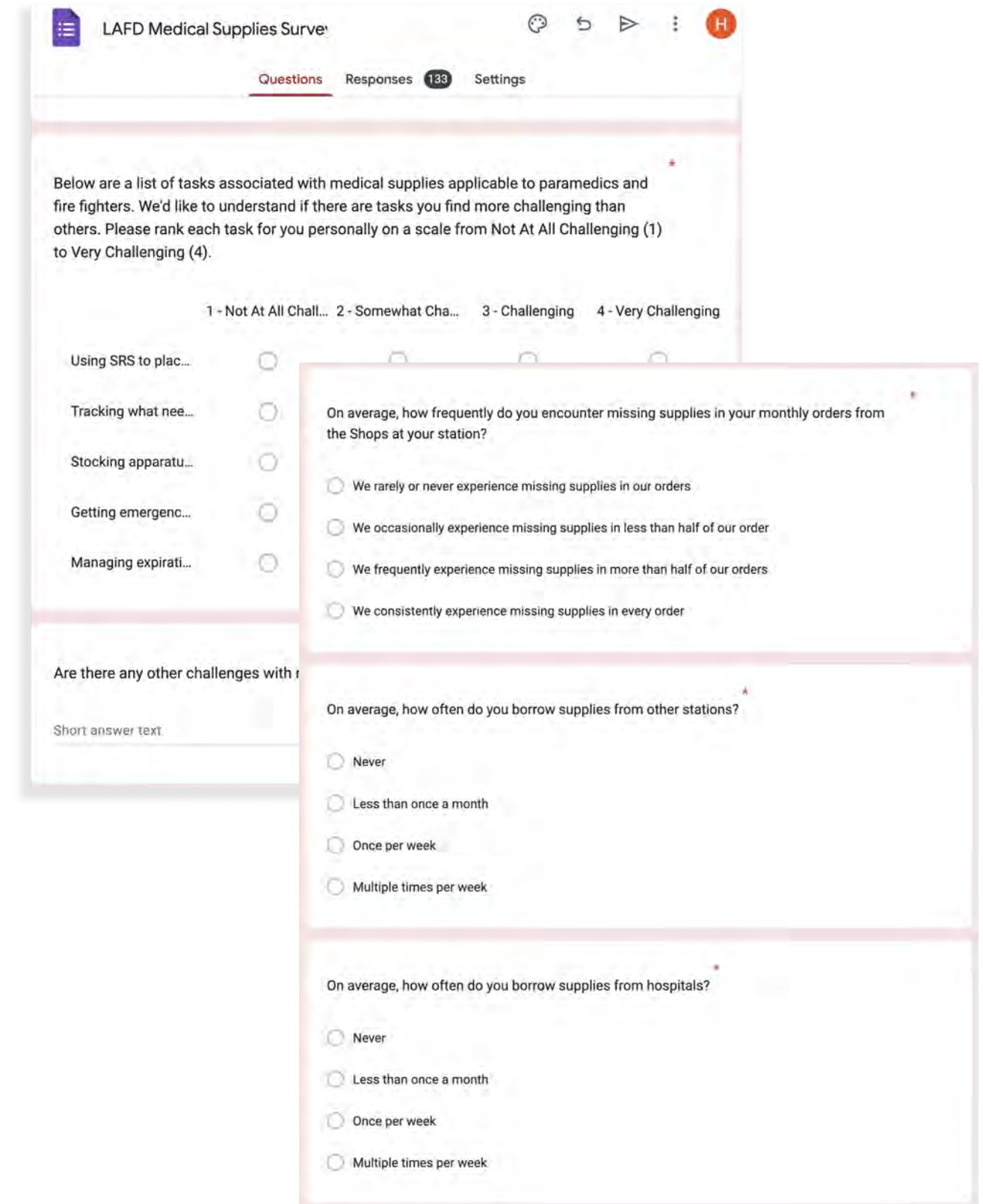
DEFINE

Empathize with users and
define the core problem.

KEY FINDINGS

This section offers a comprehensive overview of the key insights
gleaned from the research methodologies outlined in the preceding
section. These insights were derived through a rigorous synthesis and
analysis process, which is elaborated upon in the following pages.

Research Synthesis

We organized our findings and insights into these key research deliverables for the LAFD. Our belief was that representing the data in these formats would enable us to identify the pain-points, implications and themes in an effective manner. These are detailed on the following pages.

TECHNICAL ROADMAP	The lack of connectivity and data across platforms creates issues and large information gaps for all users.
USER GOALS & PAIN POINTS	Each user is negatively impacted by current process, but completely unaware of the impact on others.
SRS ISSUES	A system that everyone has adapted to but is too deeply flawed to improve.
CULTURE & TECHNOLOGY	Aspects of culture prevent frontline workers and civilian employees from seeing or admitting faults in the system.
SURVEY	Valuable time is spent procuring supplies. There is a mismatch between LAFD's sense of urgency to save lives and the practices of the shops.

Transcribing & Coding

We transcribed our interviews and discussions with LAFD personnel using DoveTail and subsequently coded them manually within our team.

Affinity Mapping

Using the coding and labeling from each transcript, we grouped key findings into themes, forming an affinity map


Journey Mapping

Since a key focus of this project is to assess the LAFD's "process", we spent time mapping out the journey- with virtual post-it notes- based on insights provided by LAFD personnel.

UX Audit

We conducted a technical audit of the LAFD's medical supply ordering system (SRS). This audit allowed us to isolate and code the usability issues associated with the current system
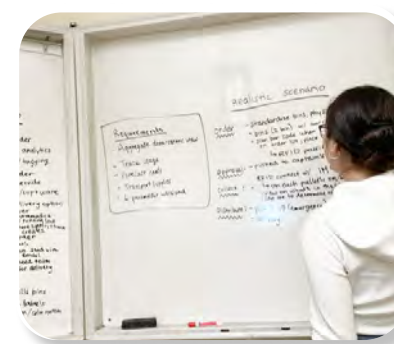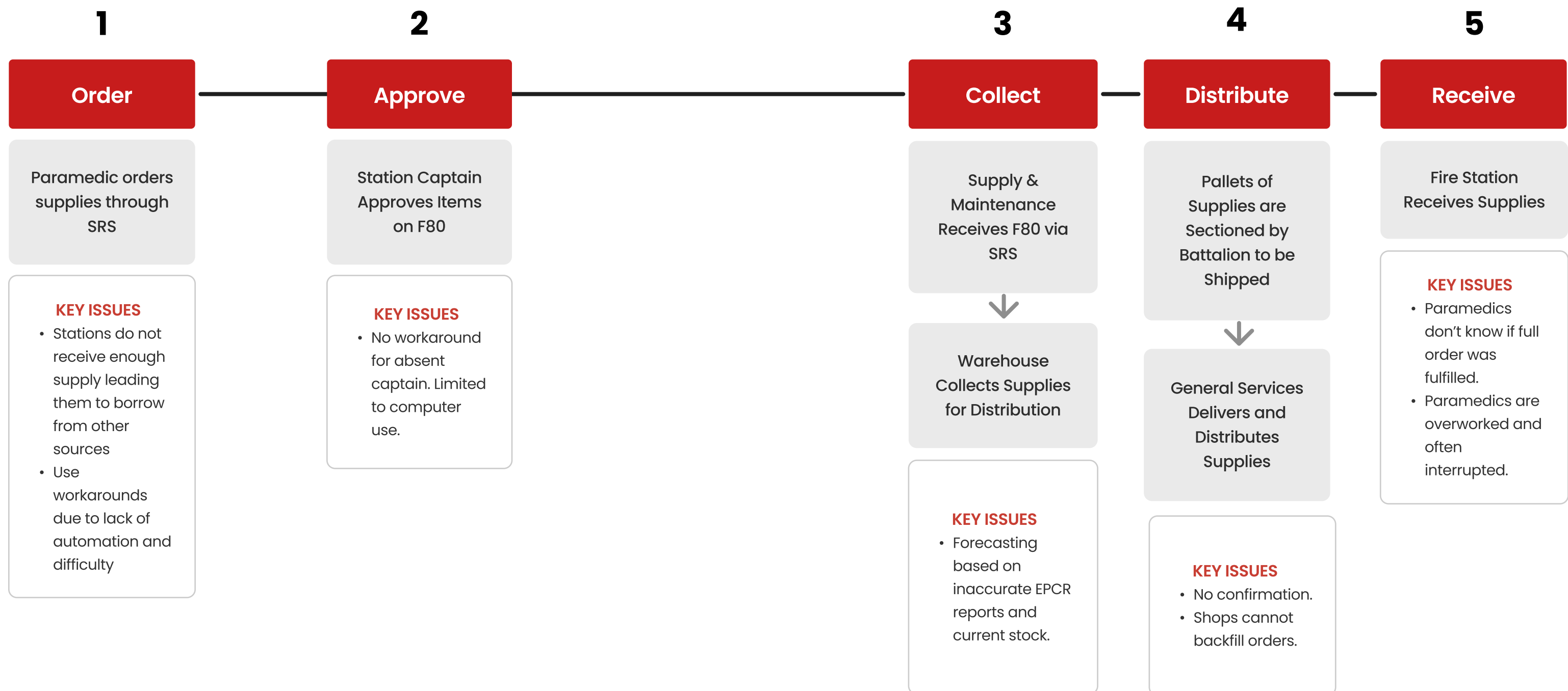

Brainstorming & White boarding

Over 2-3 weeks, our team reviewed our findings and engaged in discussions regarding the most effective visual representations of our insights.

Data Consolidation

In order to make sense of all the data we gathered through our site visits, user interviews, desk research and surveys, our team underwent a rigorous synthesis and analysis phase. This included the following activities:

Medical Supply Chain
Technical Map

We created this technical map to illustrate the key steps of the current process utilized by the LAFD.

The technical map highlights the key actions taken by the users (grey box) and highlights the "key issues" experienced by users at each phase of the process.

Our key conclusion was that the **lack** of connectivity, data and communication available to users through the system is creating information gaps, inefficiencies and workflow frustrations for all user groups.

1

Order

Paramedic orders supplies through SRS

KEY ISSUES
- Stations do not receive enough supply leading them to borrow from other sources
- Use workarounds due to lack of automation and difficulty

2

Approve

Station Captain Approves Items on F80

KEY ISSUES
- No workaround for absent captain. Limited to computer use.

3

Collect

Supply & Maintenance Receives F80 via SRS

↓

Warehouse Collects Supplies for Distribution

KEY ISSUES
- Forecasting based on inaccurate EPCR reports and current stock.

4

Distribute

Pallets of Supplies are Sectioned by Battalion to be Shipped

↓

General Services Delivers and Distributes Supplies

KEY ISSUES
- No confirmation.
- Shops cannot backfill orders.

5

Receive

Fire Station Receives Supplies

KEY ISSUES
- Paramedics don't know if full order was fulfilled.
- Paramedics are overworked and often interrupted.

Key Issues Identified within process

To further pinpoint challenges with the current medical supply process, we quantified the issues that arose from our coding process. The data visualization illustrates that the SRS system's problems and the manual nature of the process are the primary drivers of user experience inefficiencies.

SRS Problem

45

Manual Process

42

Inconsistency with Supply Orders

22

Staff Limitations

14

Disorganized

15

Lack of Documentation

15

Supply Shortage

17

To bring this data to life, we gathered these key quotes to demonstrate the frustrations and systematic issues experienced by LAFD personnel.

"

SRS PROBLEM

The ordering system itself can be a little bit **confusing**. There's a little bit of **disconnect between some of the wording** and some of the actual supplies themselves. Yeah, **it'd be nice to have pictures** like because some just kind of make it dumb proof like hey that picture is this thing.

"

INCONSISTENCY WITH SUPPLY ORDERS

We might get like two BVMs where we need like 12, we need like, like 20 narcans, but they only gave us five, you know, so it's like, kind of like a supply. **They're not giving us enough of what we need** concerning how busy our area is or and surrounding areas.

"

MANUAL PROCESS

Say you're at a fire station, you order all this stuff and you just put it on your shelf and you inventory it and your own medical supply locker. **I have no way, unless I manually go open up your locker and count everything out**. I don't know that you have five boxes of albuterol while the rest of the city's completely short unless I manually go and check that.

User Goals & Pain Points

To illustrate the experience of our core user groups we created these user profiles. Each profile summarizes the users goals and pain points as it relates to the current medical supply chain process.

We utilized a severity scale to illustrate the issues, ranked from most severe to least severe.

Paramedics & Firefighters

"We are human and sometimes we do miss things and we do make mistakes but that's just kind of a way that we try and maintain a certain standard."

Key Insights

• Waste vital energy ordering, procuring and managing supplies.
• "Hoarding" is a fair reaction to a poor system.

Goals

Have the supplies we need to complete protocols and save as many lives as possible.

Painpoints

The manual process of maintaining medical supplies is part of my duty, even if it prevents me from doing my job effectively.

Least Severe · Most Severe

Severity			
Lack of order status and transparency in system	**Multi-tasking** ordering, storing and managing medical supplies	Negotiating for supplies within the system	**Supply shortages,** especially critical medical items
		while on the job	

Station Captain
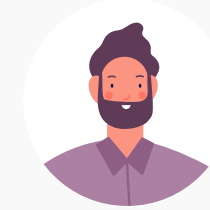
"It's difficult to get these guys up to speed on SRS. It's not intuitive. They are the most overworked."

Key Insights

• Frustrated by lack of data they need to understand station usage and needs.
• Deal with SRS training & technical issues regularly.

Goals

Ensure my station has the supplies it needs while minimizing burnout amongst my paramedics.

Painpoints

Getting my team to manage and order supplies is a challenge while handling the complexity and stress of this job.
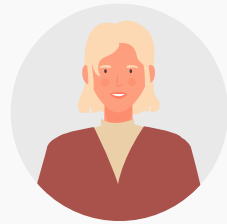
Least Severe · Most Severe

Severity			
Tracking how supplies are used within the station	**Approving** orders and remembering to do so	**Reminding** paramedics to complete orders	**Training** new members on the complexity of SRS

Shopkeeper

"I do my best to fill orders but sometimes we don't have what they need. I have no way to let them know."

Key Insights

- Frustration with system leads to lack of trust with fire stations.
- Take pride in manual workarounds to deal with all aspects of inventory management.

Goals

Efficient inventory management and order tracking system that's easy to use and scale.

Painpoints

The entire process is manual and relies on my extensive knowledge and experience to function.

Least Severe			Most Severe
Severity			
Staffing shortages & burnout	Ordering new supplies from vendors -- **"eyeball it"**	**Insufficient training** for new SRS users	**Lack of real-time tracking** and communication

Management

"I know we have the supplies in the LAFD, but we just don't know where...I have no way to get ahead of increased demand"

Key Insights

- Are completely aware of problems but lack energy and resources to prioritize.
- Concerned about inability to forecast and budget due to lack of data/reporting

Goals

An efficient and effective inventory management that ensures LAFD can serve public needs as they arise.

Painpoints

We struggle to forecast needs and get ahead of supply chain shortages, while also managing the supplies to have in the system.

Least Severe			Most Severe
Severity			
Storing the right amount of excess supplies	**Managing supplies** within the ecosystem - e.g., "hoarding"	**Predicting** supply chain shortages	**Forecasting** changing needs

Survey Findings

The survey data we gathered added new learnings which showed that regular shortages of basic medical supplies needed to perform job standards causes the most frustration, even more than the manual SRS ordering system. This was subsequently communicated to the LAFD.

DEMOGRAPHICS

133 Total Responses

88.7% (118) Responses Were From Station Captains, Firefighter Paramedics, Paramedics, And Firefighters
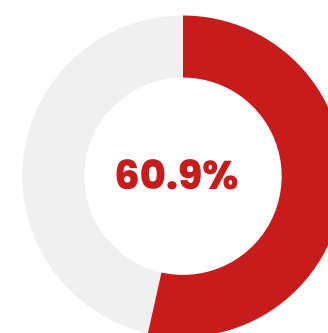
Ranked Most Challenging

46.6 %

Getting emergency orders while on calls

42.1 %

Stocking the apparatus

Others

Shops are unreliable/not trusted

81.2%
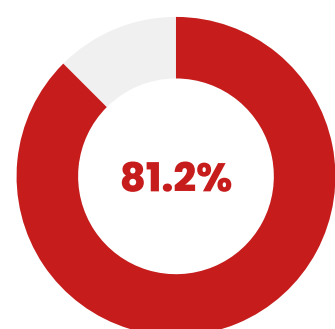
said they **experience shortages** in general medical supplies

69.2 %
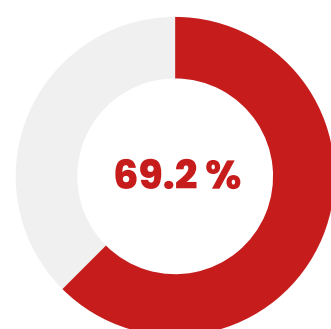
of respondents said they consistently **experience missing supplies in every order**

50.4 %

6.5 %
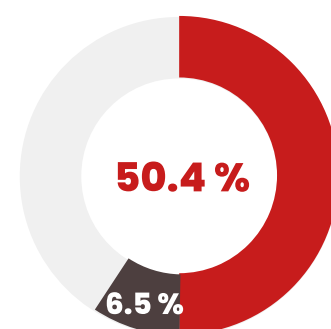
are **borrowing from other stations multiple times a week** but **Only 6.5% are placing emergency orders** multiple times a week

MAJOR OBSTACLES

60.9%

Supply shortages and not getting orders fulfilled

10.5%

Issues with the shops

9.8%

SRS UX issues

"We need change now." *- Paramedic*

"*Not able to get downtown when emergency supplies are needed due to coverage challenges.* **Not receiving deliveries on regular basis results in keeping expired meds as backup***.*"
- Paramedic

"*Oh and still waiting on that second set of turnouts we were told would be there 4 years ago.*"
- Paramedic

"*The Shops does not support the needs of the members in the field. They are difficult to deal with and lack the understanding of their role as support services.*"
*- Paramedic*

Supply Requisition System (SRS) Evaluation

What is SRS?

SRS, which stands for Supply Requisition System, serves as LAFD's ordering system for facilitating medical supply requests from fire stations. The current system lacks user-friendliness, featuring simple screens and a lack of basic usability. This outdated system leads to frustration and inefficiency in the ordering process for firefighters.

Our project goal did not entail developing this system from scratch, and due to security reasons, we refrained from conducting an expert evaluation of the system. Nevertheless, through interviews, we synthesized and evaluated the problems associated with the SRS system, leading us to identify five main issues with the system:

SRS
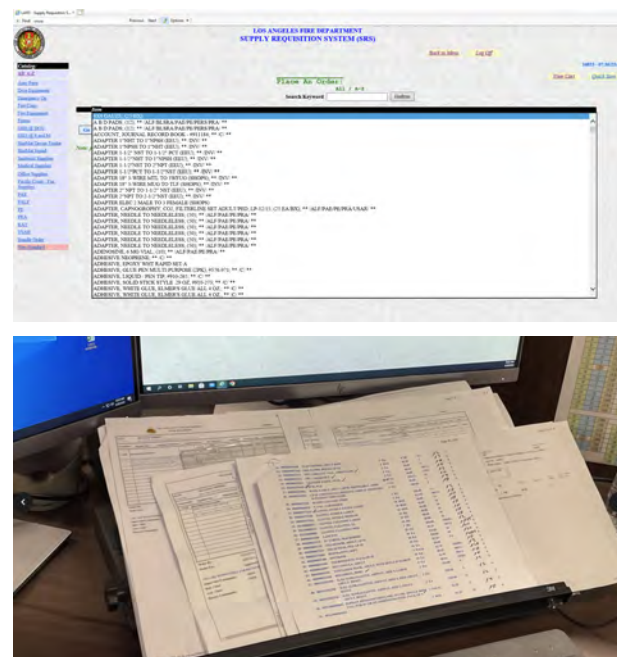
The Core Issues

Visual Hierarchy

Usability and Accessibility

Error Prevention   User Help

Consistency and Standardization

Visibility and Aesthetics

User Control and Freedom

1. Usability issues

Resulting in challenging and time-consuming ordering process

Essential user-centered features like easy item searching and user-friendly search functions are absent, making the ordering process time-consuming. The lack of auto-saving leads to process restarts.

2. Informal and verbally captured order requests

Leading to omissions and duplicates

The absence of wishlist or cart functions results in informal and error-prone order requests, which are managed using clipboards, notepads, or memory.

3. Lack of real-time updates in the system

Creating uncertainty in the ordering process

Lack of real-time updates necessitates manual approval checks, creating uncertainty.

4. Insufficient information connectivity between systems

Impeding work efficiency in shops

Inadequate system connectivity hinders work efficiency, making emergency announcements challenging and causing information fragmentation across platforms.

5. Lack of guidance and Inconsistent ordering and approval processes for different items

Leading to confusion and lack of standardization

Confusion arises from inconsistent ordering and approval processes for different items. Firefighters adapt, despite the system causing stress and inefficiency.

Cultural Context
at the LAFD

As part of our research, we delved into the organizational culture at LAFD. During interviews and interactions with various members, we identified several common cultural themes, which are detailed here. We observed that certain aspects of the culture, notably extreme self-reliance and a propensity for workarounds, could potentially pose as obstacles to the organization's efforts to enhance its operations.

Doubt

Lack of trust has **diminished the efficiency and value** of the entire supplies and maintenance system

Experiential Knowledge

Reliance on manual processes formed through practical experience creates **difficulty in embracing new technologies**

Self-sufficiency

Constant resourcefulness and banking on workarounds could **hinder the adoption of new approaches**

LAFD

Established Customs

Culture rooted in tradition may be **resistant to change**

Trust in Camaraderie

Leaning on other fire stations to ensure preparedness in challenging situations has become the norm

Research Conclusions

As we reflected on the entirety of our research, we came to the following conclusions. Ultimately the LAFD is challenged by process, cultural and technology issues. While we came into the project focused on technology, we realized that people and process will be critical to the success of a new inventory management process moving forward.

People

There is a serious breakdown of trust between shops and stations that needs to be addressed imminently.

Why doesn't S&M deliver what stations ask for?

Process

Station-level supply shortages of basic medical supplies (not controlled substances) are the biggest issue you currently face.

Why can't S&M keep more supply on hand and deliver stations what they order?

Technology

SRS is time consuming and antiquated, the lack of **data** and **communication** it provides are contributing to frustration and issues.

How can you support Captain Barna in the short-term to prioritize basic data collection?

DEVELOP

Defining requirements
and establishing our
design approach

WHAT'S
THE SOLUTION?

The "develop" phase is a bridge between the conceptual and
execution phases in design, where ideas take shape and become
tangible solutions. This section details the processes involved in
refining ideas, defining requirements and aligning on an approach
for the next phase: design.

Exploring the Solutions

Design Process

As we commenced the design phase, we outlined the functional requirements for a future inventory system. Prior to ideation, we conducted further research, studying case studies of external organizations facing similar inventory challenges. Subsequently, we held an ideation session to brainstorm various solutions, creating designs that aligned with the requirements.

Our aim was to craft conceptual design solutions, which serve as a starting point for problem-solving and the foundation for detailed planning and implementation. These proposed solutions will require further iteration, evaluation, and analysis for effective implementation.

Identify Problems → Specify Requirements → Ideate Solutions

→ Prototype → Analyze

Design Iteration
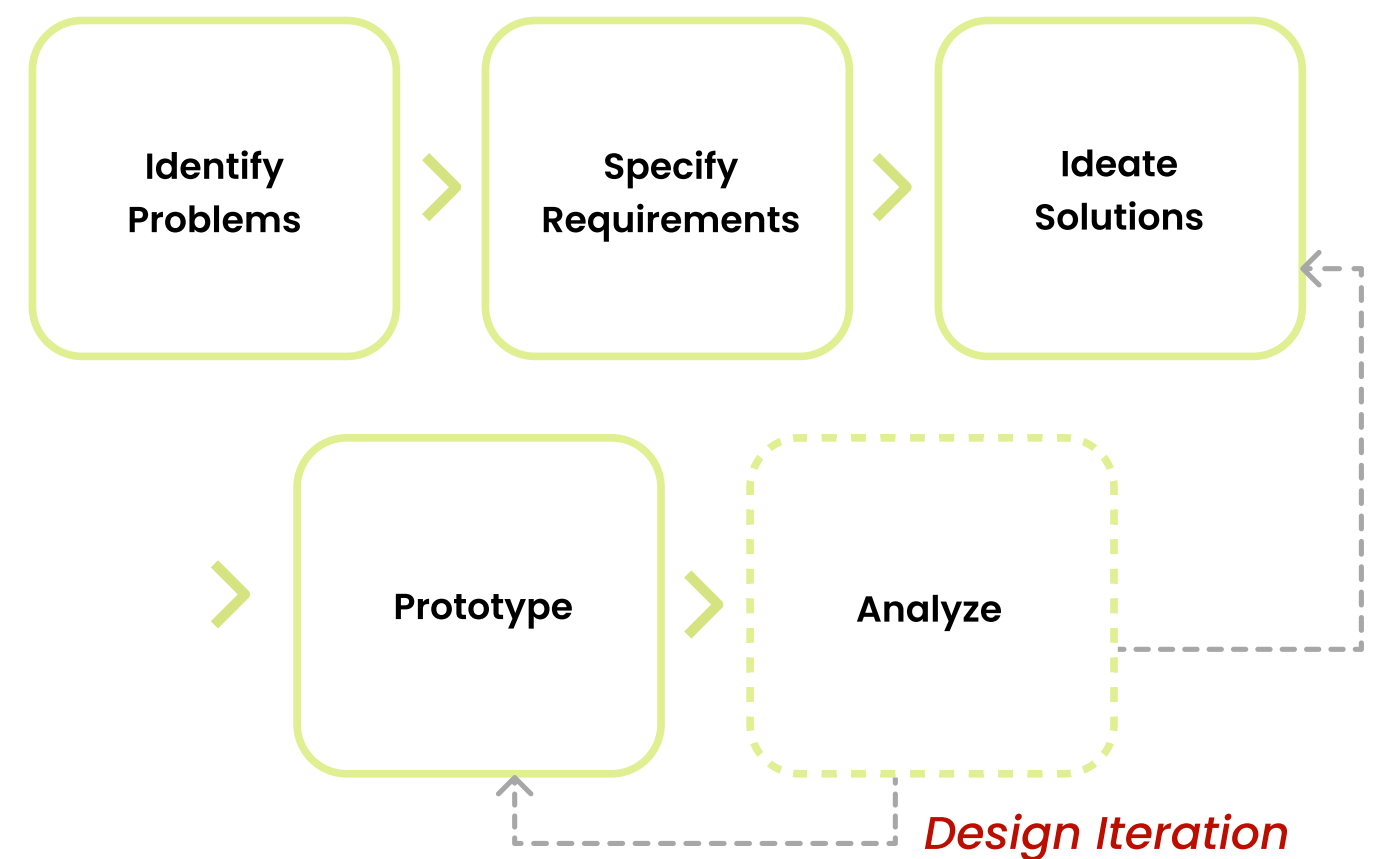
Jobs to be done

We employed the Jobs to be Done framework to gain a deeper understanding of user needs, system requirements, and desired outcomes for a future inventory management system. By identifying these jobs and their motivations, we can develop an effective system that benefits both firefighters and civilian staff

Forecast Needs & Predict Shortages

Predict future demand for products or supplies to ensure that necessary inventory is always on hand. Develop strategies to account for shortages due to factors like natural disasters, economic disruptions, or global supply chain issues.

Comprehensive, Accurate Data

Gather and analyze information related to the supplies available in an organized and comprehensive manner. This view will provide valuable insights for inventory management, resource allocation, and decision-making.

Efficient Transportation & Restocking

Efficient and well-managed transportation of supplies is crucial for maintaining smooth operations, reducing downtime, and optimizing resource utilization.

Track Usage at Station Level

Monitor how supplies are consumed at stations over time to ensure adequate stock levels are maintained without overstocking or running out of essential items.

Reduce Strain on Paramedics

Ensure the paramedics' well-being and performance by alleviating their workload and shifting responsibilities or automating tasks entirely.

Design Approach

Two-way approach to problem-solving

Through ideation and case study analysis, we embraced a dual-pronged approach to problem-solving. We formulated two distinct conceptual solutions to tackle LAFD's inventory challenges.

'Do Something' represents a practical option focused on taking immediate action. 'Do Everything' presents an ideal solution aiming to comprehensively address the entire problem.

The following table outlines the characteristics of the two solution types.

In the development of our UI mockups, our team used a combination of design systems from SAP Fiori, Shopify Polaris, and our own design assets. Our team used SAP Fiori for its industry-leading system in enterprise resource planning software, and Shopify Polaris for its user-friendly e-commerce experience for businesses. Since our mockups are conceptual in nature, these design systems were used as a framework of what best in class would look like. If the UI were to be developed, our team would create a design system that aligns with the LAFD's goals.

Do Something	Do Everything
Practical	**Comprehensive**
Immediate action to address a specific problem without overwhelming resources or time	Attempts to address all aspects of a problem, requiring significant time, resources and coordination
Risk Management	**Risk and Reward**
Requires long-term strategic planning that may involve risk and uncertainty	Requires long-term strategic planning that may involve risk and uncertainty
Fast Results	**Technology Forward**
Prioritizes tasks and issues to produce faster results	Leverages innovative technology (AI, RFID) to enhance operational efficiency

DELIVER

Transforming functional
requirements into
conceptual solutions

DESIGN SOLUTIONS

• USER SCENARIO •STORY BOARD • UI Mockups

This section provides a detailed exploration of our design solutions, which manifest the 'Do Something' and 'Do Everything' concepts. Each solution is vividly illustrated through user scenarios, storyboards, and mockups envisioning the future systems at LAFD.

Do Something Scenario

The Do Something Scenario focuses on solving for the LAFD's core issues (lack of data, connectivity and feedback) while working within the constraints of their current staffing model. In this scenario, we still rely on paramedics to place orders, but we enhance the entire end-to-end workflow with a fully connected inventory management platform, barcode technology and a physical storage solution.

Concept Overview

Core Components

Priorities

- Minimize cost
- Collect & leverage data
- Improve efficiency, level of care, paramedic workload

Constraints

- Leverage current staffing model
- Utilize paramedics & captains for monthly ordering & approval

Additions

- End-to-end full connected Inventory Management System (IMP)
- Potential increase of Shops and Maintenance (S&M) staff, including delivery
- Could require WiFi and additional smartphones for Captains & Paramedics
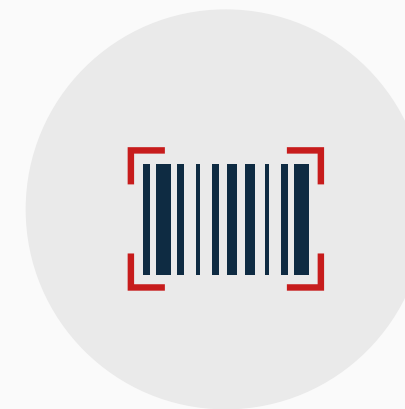
Barcoding System

Barcodes are used to produce data, and track supplies throughout the system.
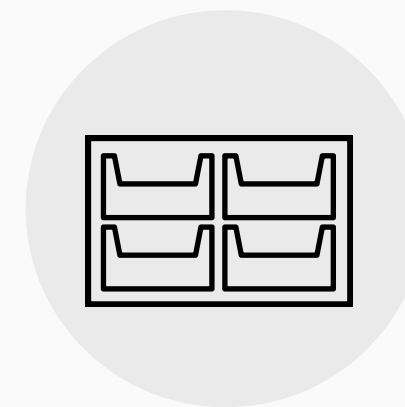
Standardized Physical Storage Solution

A standardized physical storage solution which are packed & prepped by S&M, and stored in a consistent manner at fire stations.
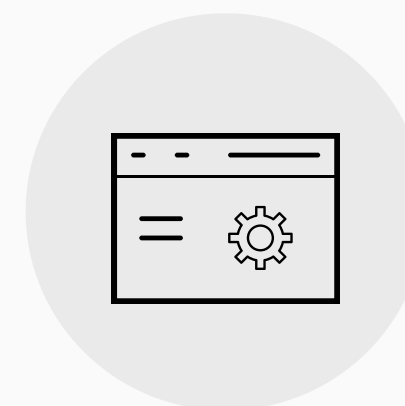
Inventory Management Platform (IMP)

Accessible through both mobile and web platforms, the IMP is an off-the-shelf end-to-end solution that offers comprehensive ordering, tracking, and management functions for all core users.

Do Something
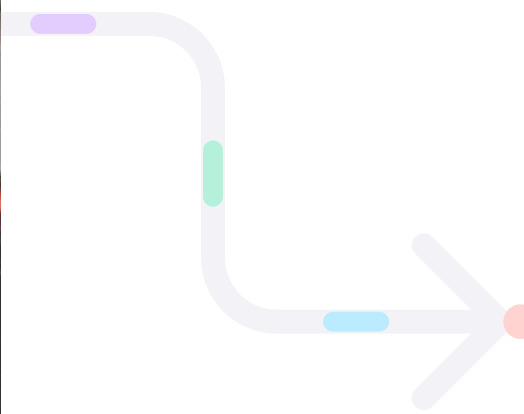
User Scenario

Ben, a **paramedic** at Station 12, is getting ready to review the monthly order. He approaches the storage unit and starts observing the empty bins. He launches the IMP on his phone and begins scanning all the bin barcodes that require refilling. After reviewing his order, he submits it for approval.

Ben's **captain,** Samantha, receives a notification to approve the order. The captain clicks on the "Approve" button and the order is pushed directly through to S&M. Once the order is approved, Ben also receives a notification that the order was placed to S&M, with an expected delivery date.

Meanwhile back at S&M, the lead **shopkeeper** logs into the IMP. She reviews the Station 12 order from Ben and can see that she has plenty of stock to fill this order.

The next morning, she leads her team in prepping and finalizing the bins for station 12 which are then loaded onto the truck by noon and delivered by 3p. When arriving at Station 12, the **delivery team** places the bins on their designated shelves and takes the empty bins back to S&M, scanning them to confirm usage before loading on truck.

Once the order is in, Ben and Samantha receive a message to their phone confirming order receipt.

Storyboards

We visualized the ordering process by creating a storyboard. The storyboard provides a tangible way to visualize how users will engage with our solution.

The paramedic scans the bins of supplies, pulling any bins that are empty
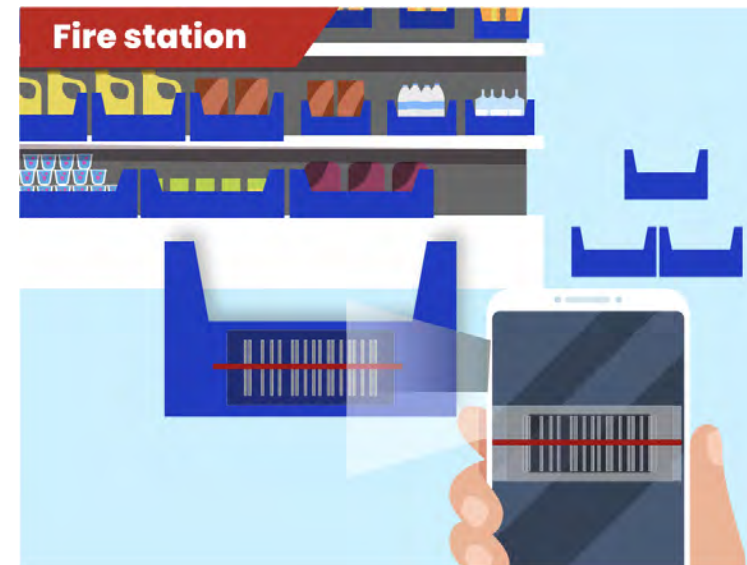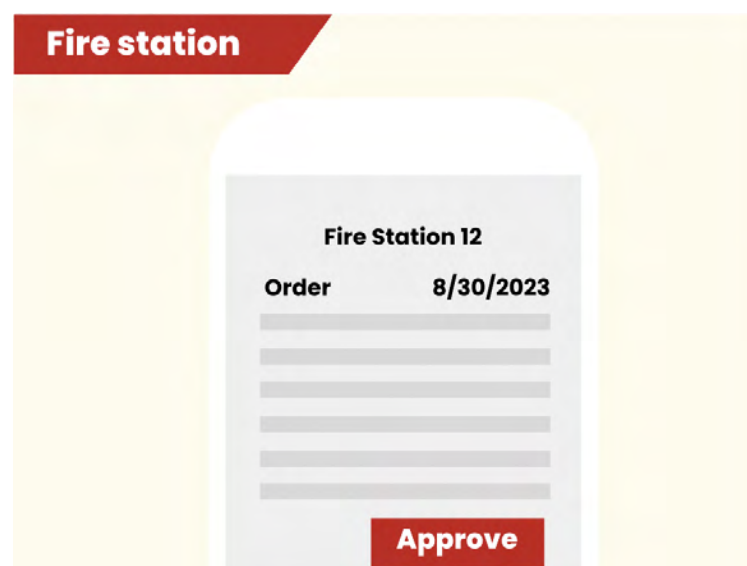

The paramedic scans the barcode on the bins using his phone.

The S&M team pull the bins for the order, scan the barcodes on the bins, selecting the designated station, and preparing for delivery.

The General Services delivery team load the truck in order to be delivered to station 12.

The captain receives a notification on her phone about the order and hits "Approve."

The shopkeeper reviews the order and can see that she has everything needed.

The delivery person unpacks the bins at the station and removes the empty bins.
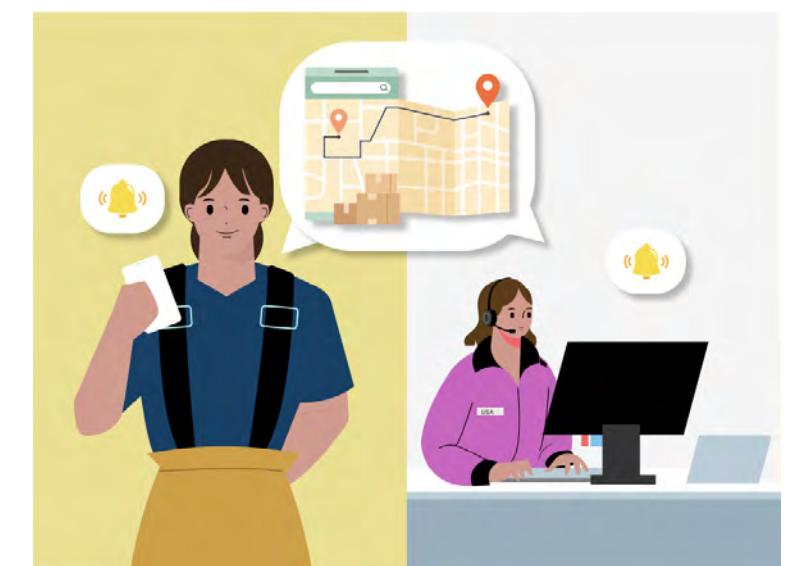
The captain and shop keepers receive phone notifications confirming delivery.

System Flow Chart

We utilized the System Flow Chart to better understand how will the information flow among different departments for the do something scenario. By identifying the information and system flow, it helps develop a solution that benefits both firefighters and civilian staff.

Scan Barcode for Order Placement
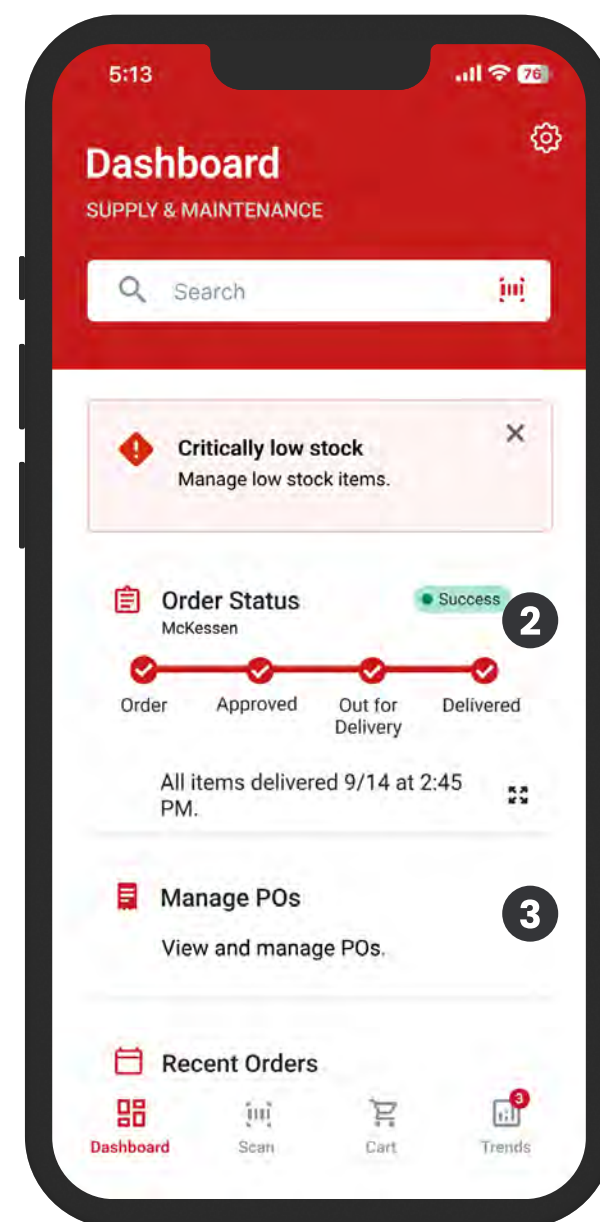
Supply Usage Rates & Needs by Location

Total Stock Usage Trends & Forecasting Data

Scan Inbound & Outbound Inventory

Fire Station

Station Level Orders via IMS

Supply & Maintenance

Total Stock Availability & Location

Order Confirmation & Status via IMS

Purchase Orders via IMS

Vendors

Inventory Availability

KEY

Flow Direction

Perpetually Generates

Location

Data

What IMS Provides

Process
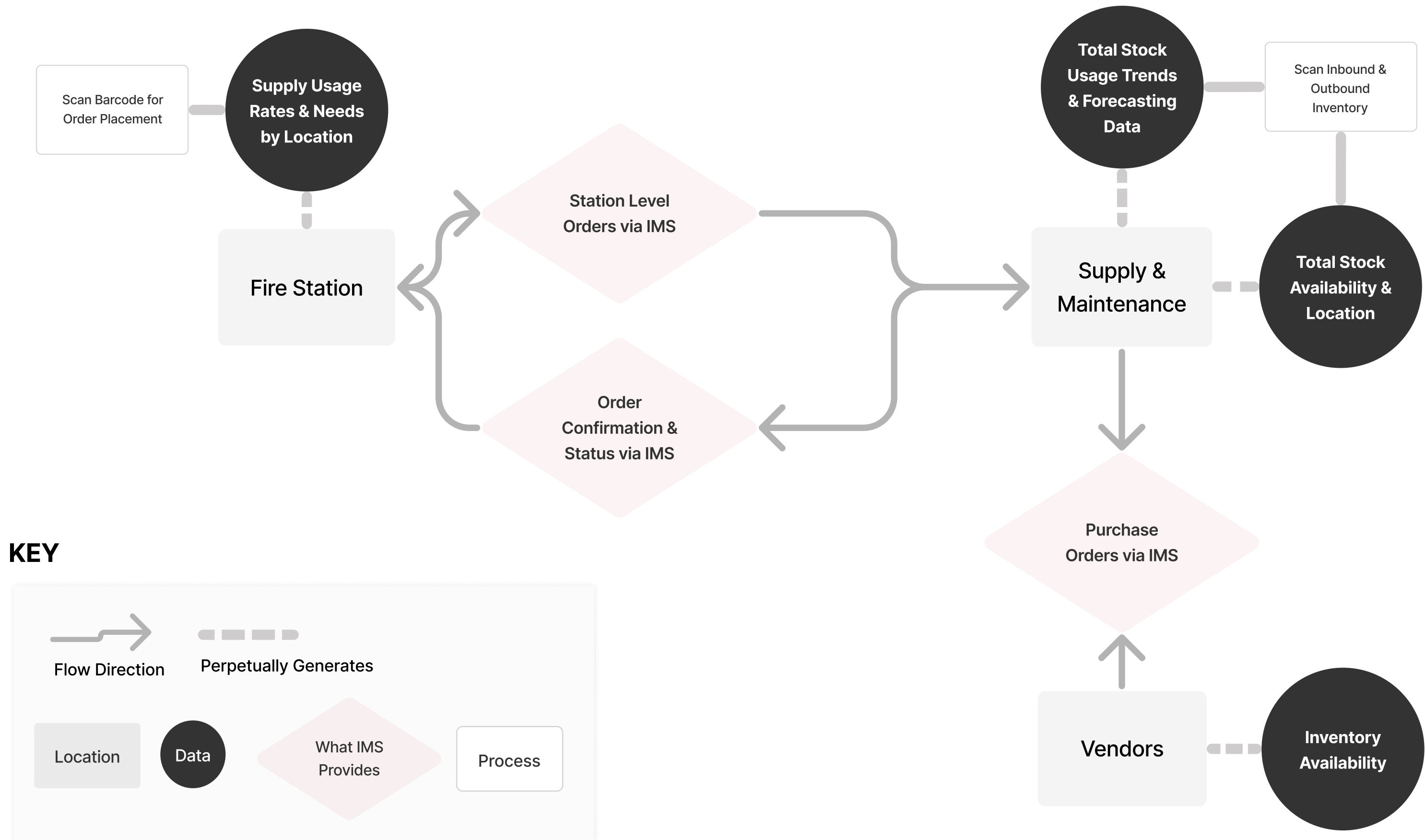
User Interface Mockups

Supply & Maintenance View

Critical shortages are highlighted

Live Status Updates

Ability to see usage & trends by stations

A closer look at the Inventory Summary
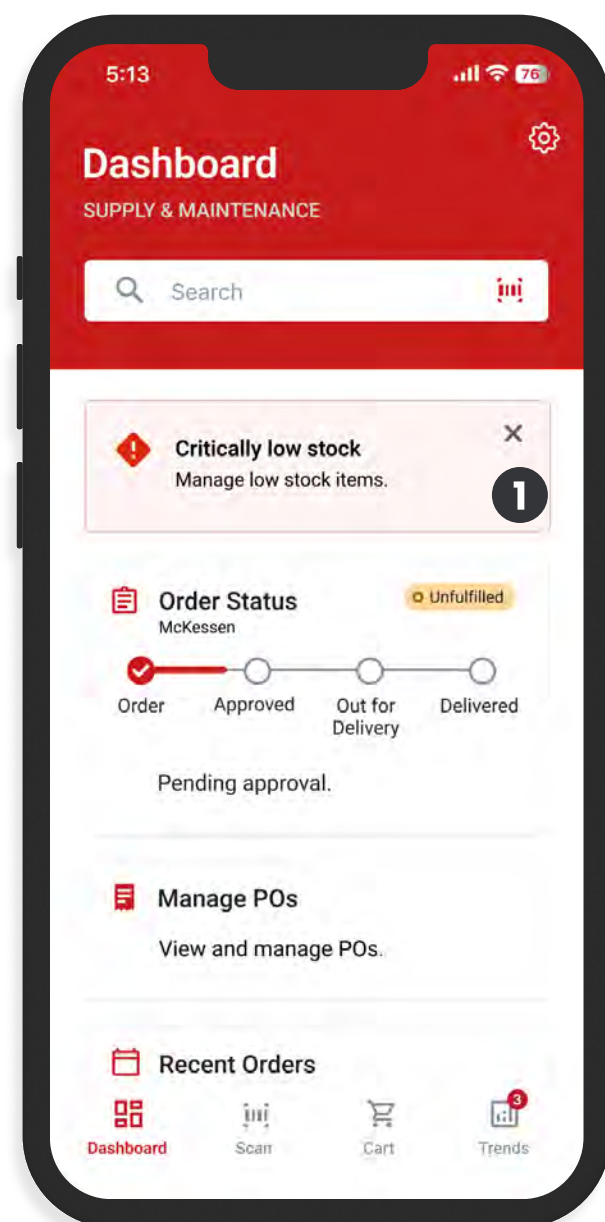
1 Notifications to take action on critically low items.

2 Progress bar shows live status updates and informs staff of successful delivery.

3 Option to view and manage POs from various vendors.
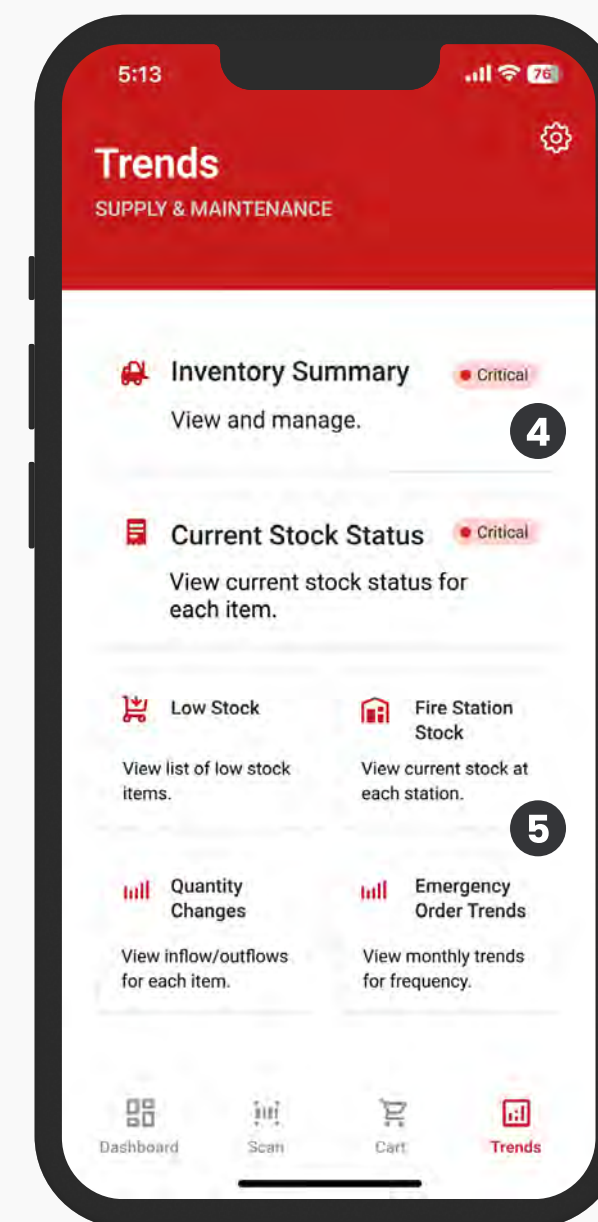
4 Tags notify staff if there are critically low items.

5 Staff will be able to view current stock at each station and order trends.
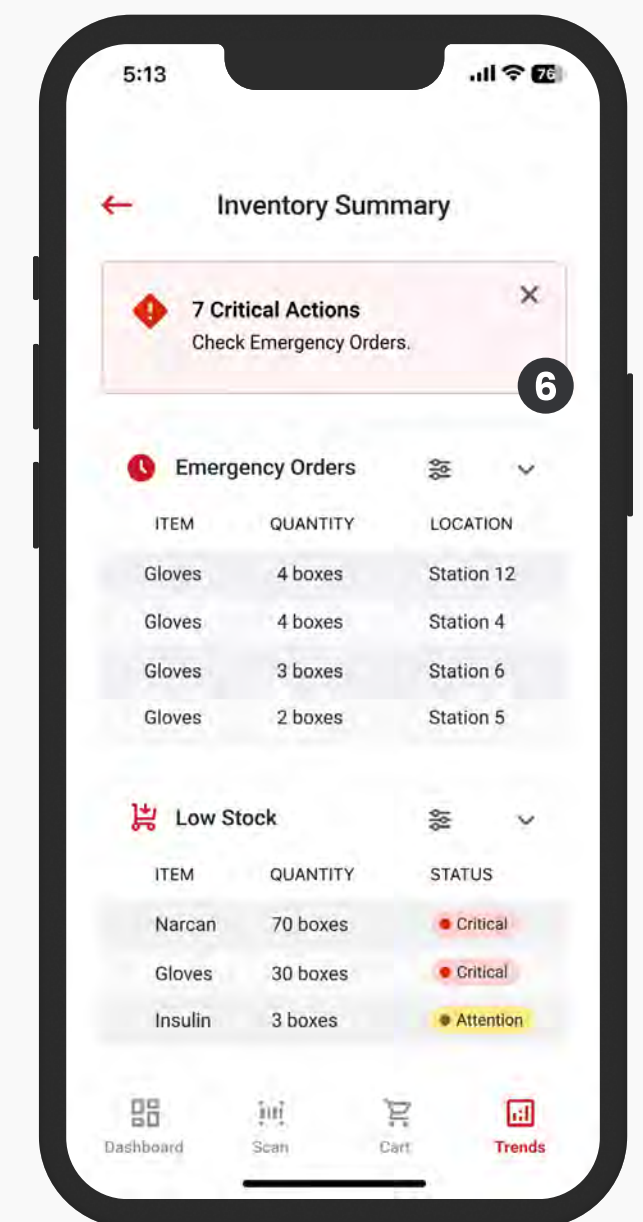
6 Inventory summary shows immediate actions that need to be taken, such as fulfilling emergency orders.

Paramedic View

Ordering is as simple as Amazon
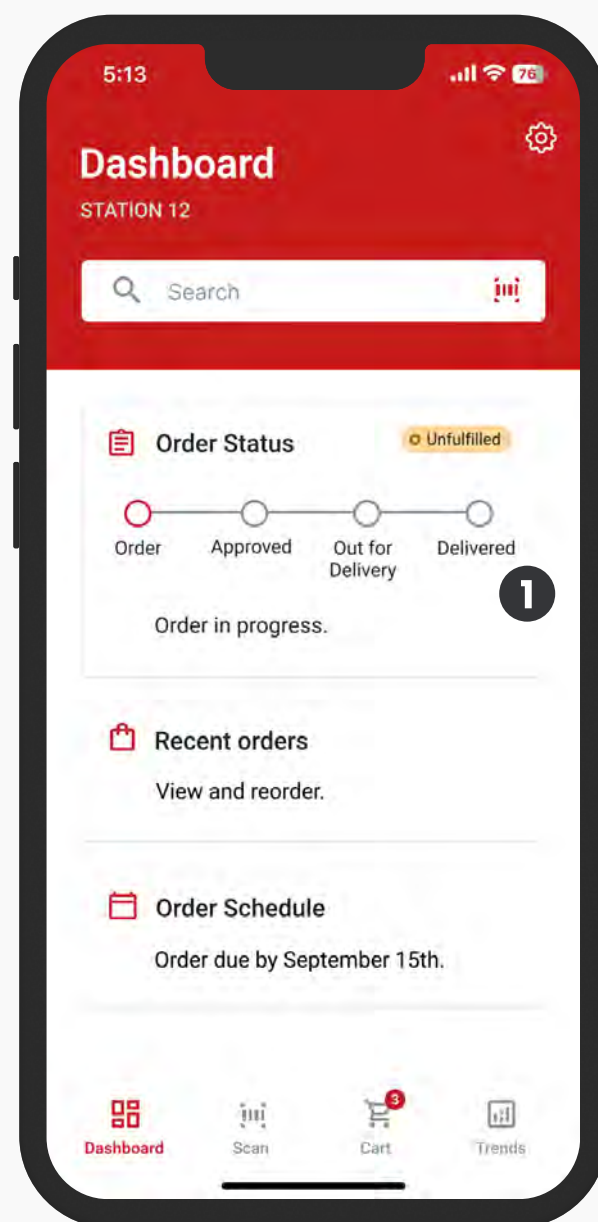
1 Visibility into their orders will let paramedics know when they will receive their order and order approval status.
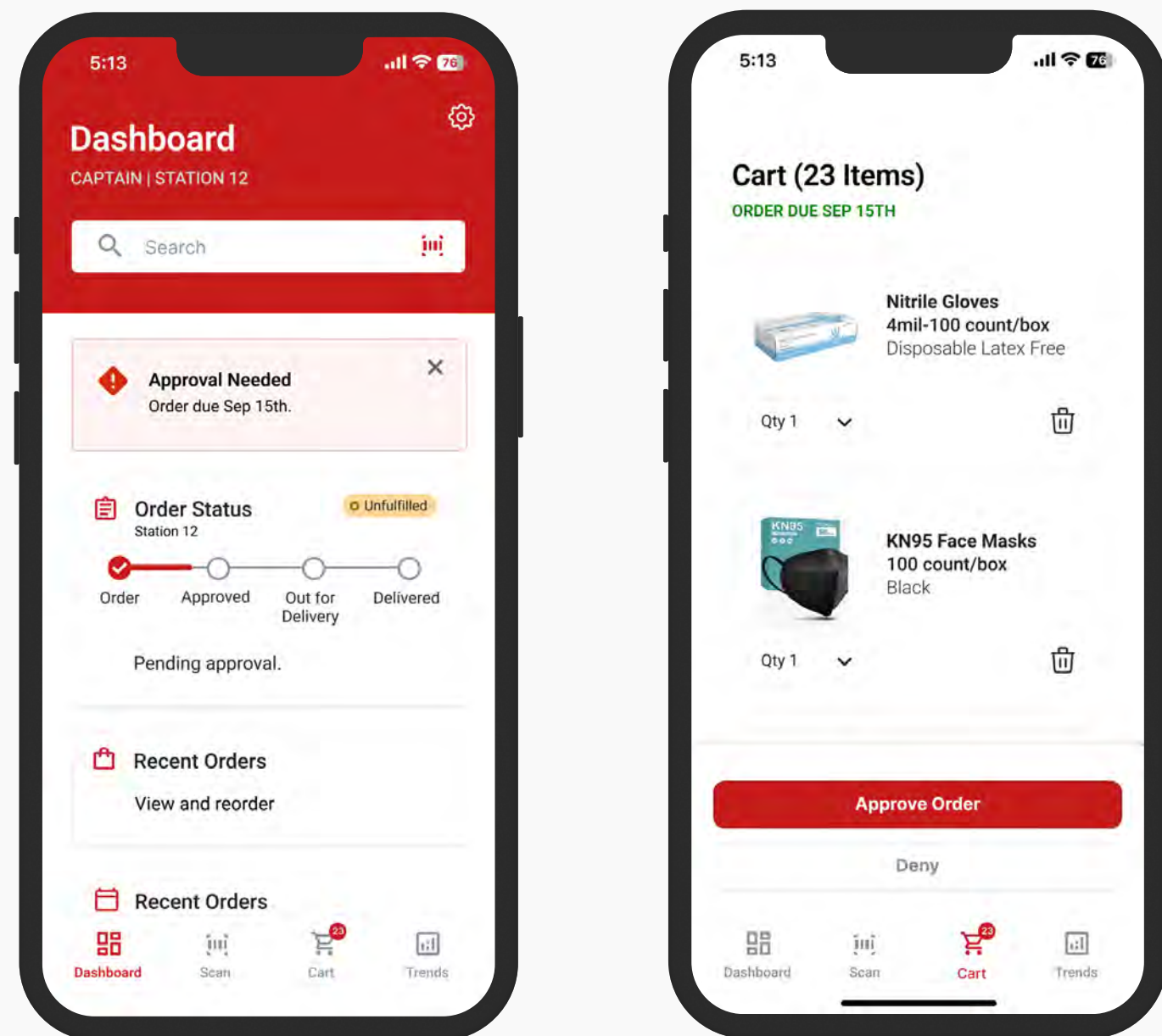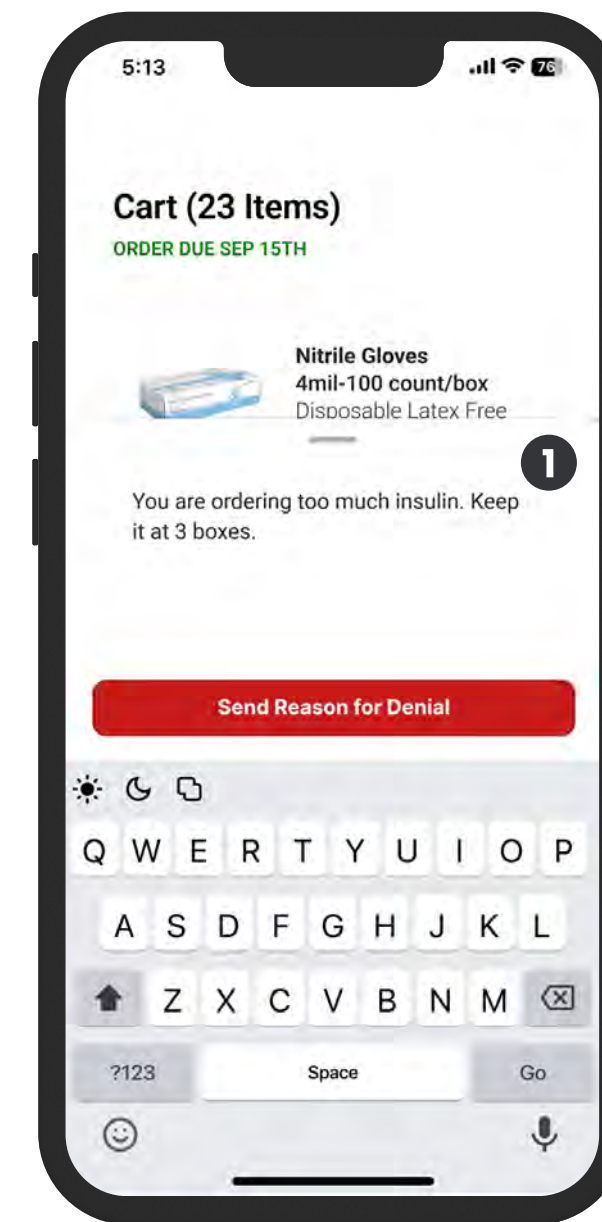
With a simple scan-to-order system
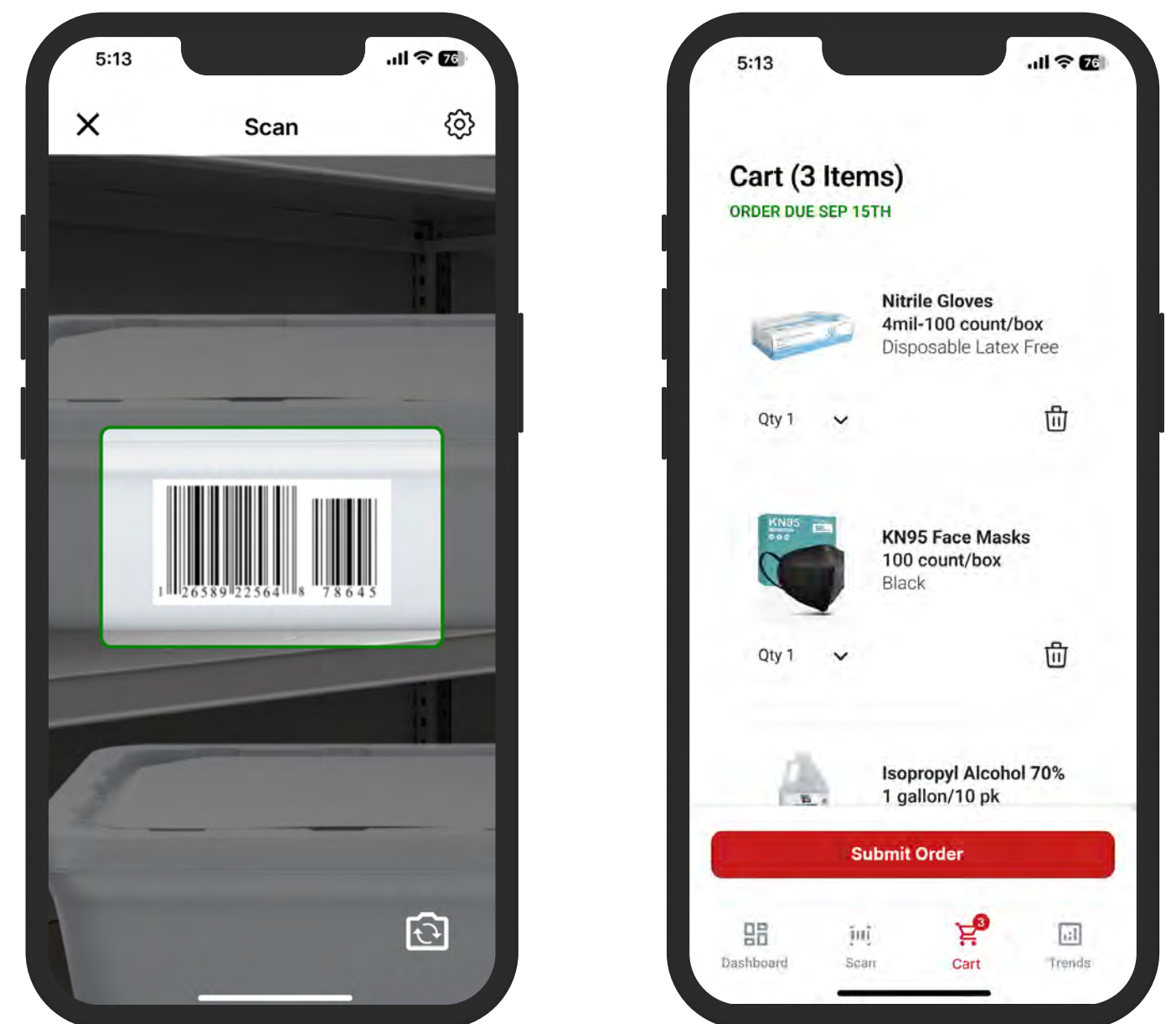
Captain View

Captains get reminders to approve with one-click

Captain View

A mobile experience allows the Captains to approve orders on the go

1 Captains have the option to deny the supply order with a reason so that paramedics can correct the order and resubmit.

Do Everything *Scenario*

The 'Do Everything' approach is an ideal solution designed to comprehensively address LAFD's end-to-end inventory challenges. This method involves reducing paramedics' responsibilities and necessitates a substantial investment in long-term strategy and innovation. It leverages technologies such as RFID and robotics to enable automation and employs AI forecasting to predict demand and proactively manage shortages.

Concept Overview

Priorities

- Shift responsibilities off paramedics
- Consistently maintain PAR levels to avoid any interruption of service
- Leverage AI and real time data to forecast demand

Constraints

- Invest in long-term strategy and technology
- Utilize Captains for order approvals

Additions

- Utilize RFID to detect inventory and collect real-time data
- AI models for demand forecasting
- Introduce warehouse automation for efficiency

Core Components

RFID

Inventory tagged with RFID tracks quantity, expiry date, and location data. Smart Shelves wired with RFID can accurately detect inventory levels.

AI Forecasting Using Real-time Data

AI Forecasting can optimize inventory, eliminating shortage and wastage. AI models can respond to dynamic market conditions and adjust to changes in demand patterns and seasonality.
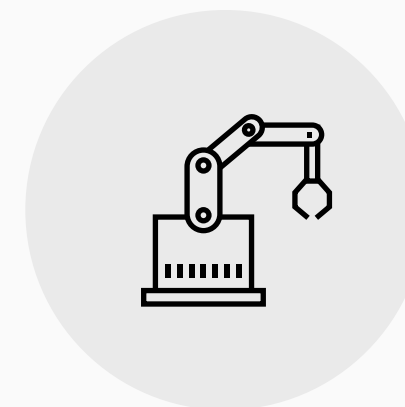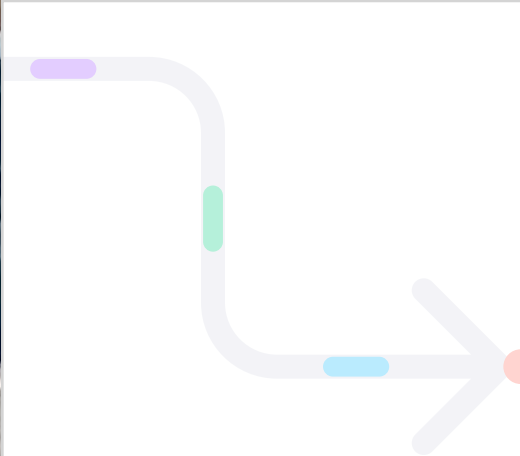
Warehouse Robotics

Picking robots can move items from specified locations and place them in containers to automate the fulfillment process in the Shops.
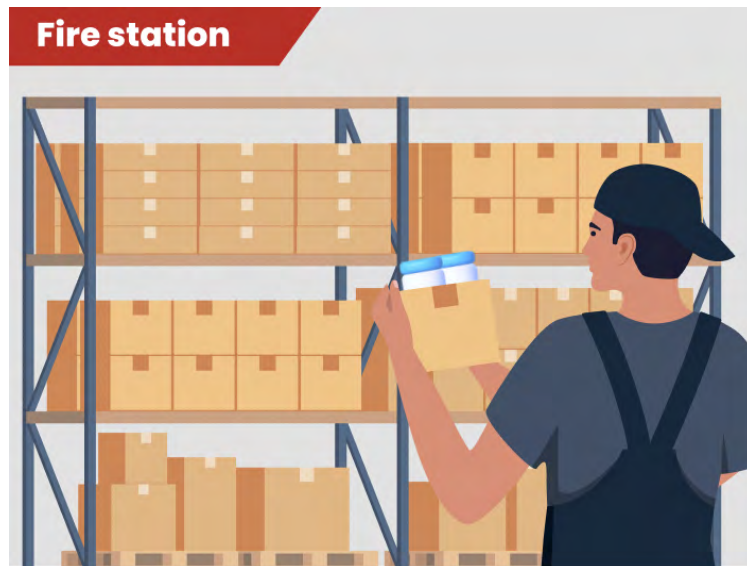
Do Everything

User Scenario

Ben, a **paramedic** at Station 12, wants to ensure that his station is stocked with the supplies. He removes several supplies from the Smart Shelf for the day. The shelf detects an item is approaching PAR level, and triggers a reorder. Ben's **captain**, Samantha, receives a notification for Station 12's order, approves it and the order is pushed to S&M.

Lisa, the **shopkeeper** at S&M, receives an alert for Station 12's order. She approves it, and a notification is sent to Station 12 informing them of the approval and estimated delivery time.

Lisa's staff prepares for Station 12's order with the assistance from a warehouse robot. RFID-tagged boxes of supplies are pulled from S&M's Smart Shelf and placed in the battalion palette for distribution. The delivery van makes a stop at Station 12 where the **delivery team** restocks the station's Smart Shelf with supplies. New inventory is detected and levels are automatically updated on IMP. Ben and other paramedics at Station 12 receive a notification confirming restock of supplies.

Back at S&M, Lisa suddenly gets an alert forecasting nationwide shortages on albuterol, along with predictive recommendations on how much albuterol should be ordered based on the shop's supply levels. She immediately places an order with her vendors via IMP to ensure the stock level of critical items are maintained.

Storyboards

The 'Do Everything' storyboard provides a tangible way to illustrate how users will interact with our solution. Despite introducing technology solutions for the LAFD, our approach underscores the continued need for human intervention, as evidenced by the involvement of S&M in every step of the process.

Fire station

At Station 12, Ben removes medical supplies from the Smart Shelf, automatically detecting supplies reaching below PAR levels, triggering a reorder.

Fire station
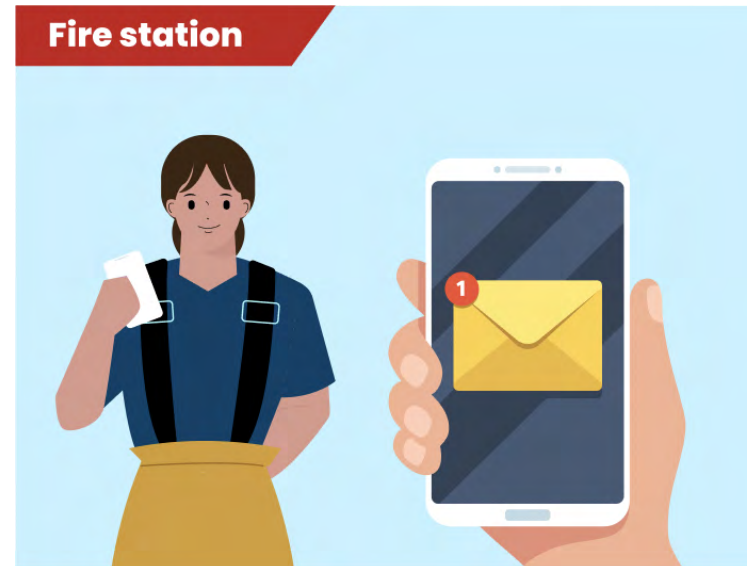
Samantha, Ben's captain, receives a notification to approve the order and presses "Approve" on the app.

The Shop

Lisa's staff assisted by a robot prepare the order by pulling RFID-tagged boxes of supplies from the Shelf and place the order on a pallet for distribution.
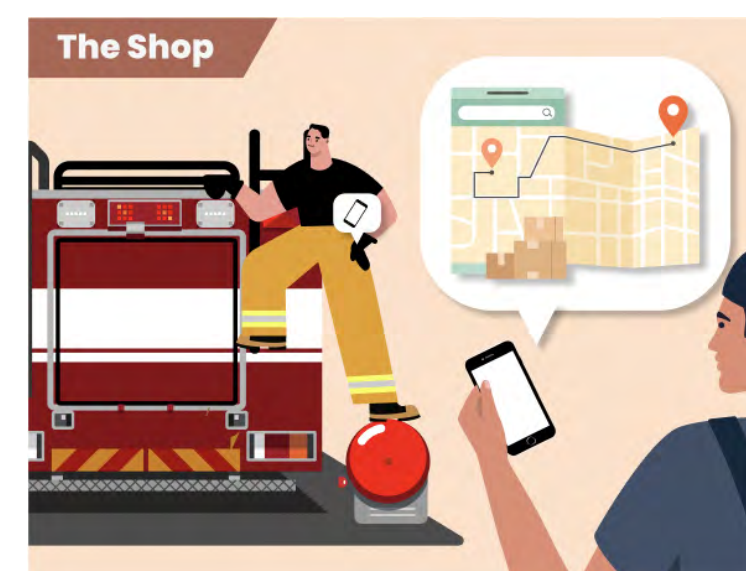
Fire station

The delivery team stocks Station's 12 Shelf with medical supplies, updating the station's inventory levels on IMP.

The Shop

At S&M, Lisa is monitoring the inventory levels for S&M and fire stations through IMP.

The Shop

Station 12

Approve

She receives a notification about Station 12's order on IMP, and approves their order.

The Shop

Ben and other paramedics from Station 12 receive a notification on the app confirming restock of supplies.
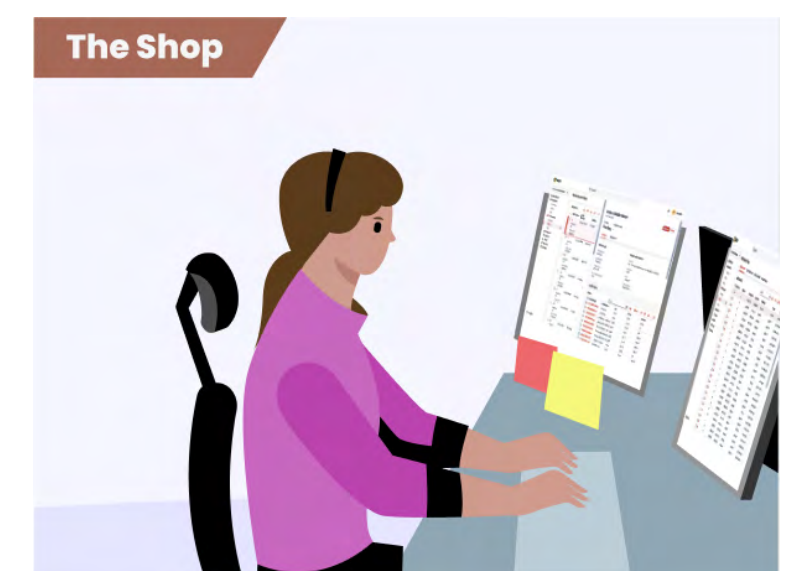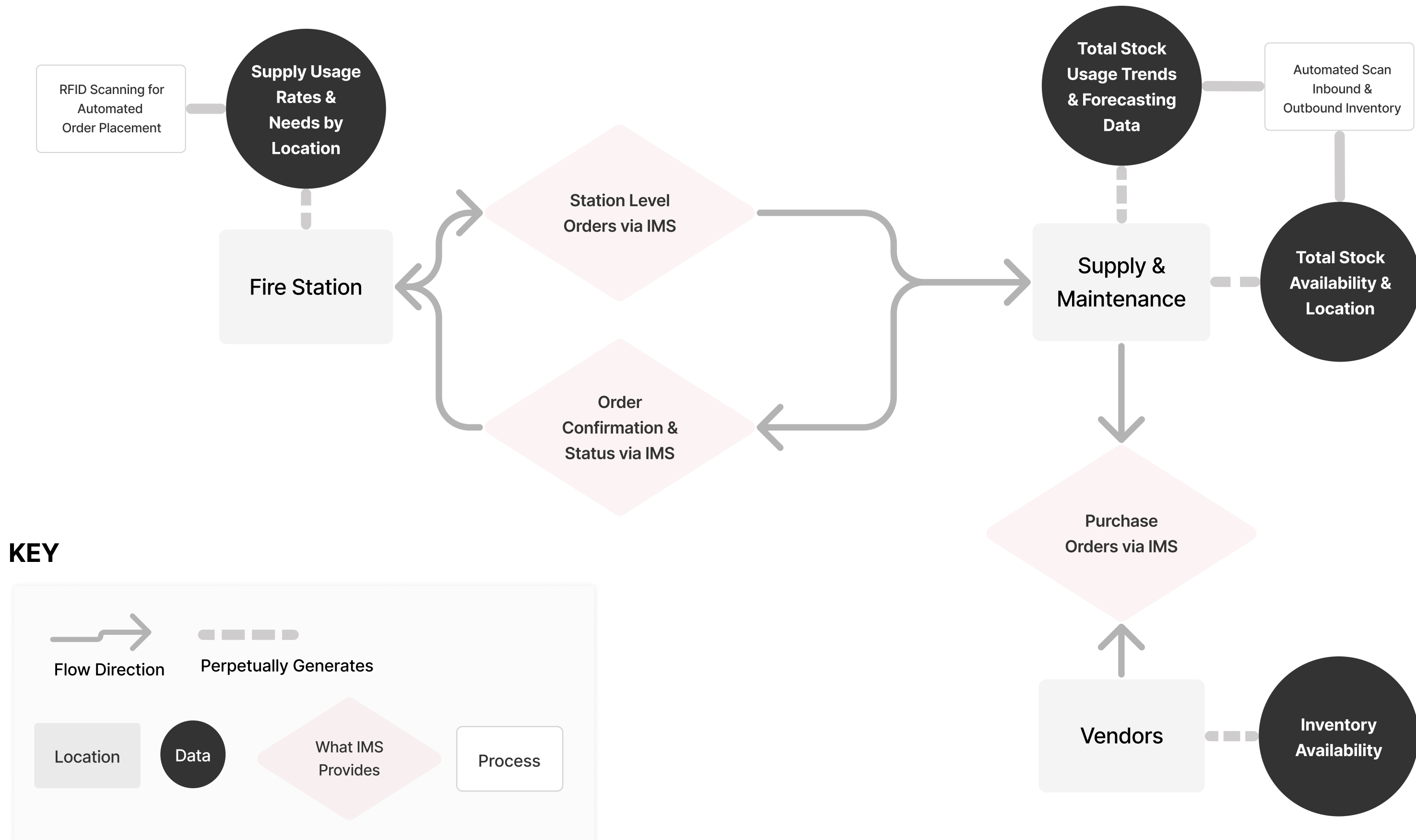
The Shop

The shopkeeper reviews the order and can see that she has everything needed.
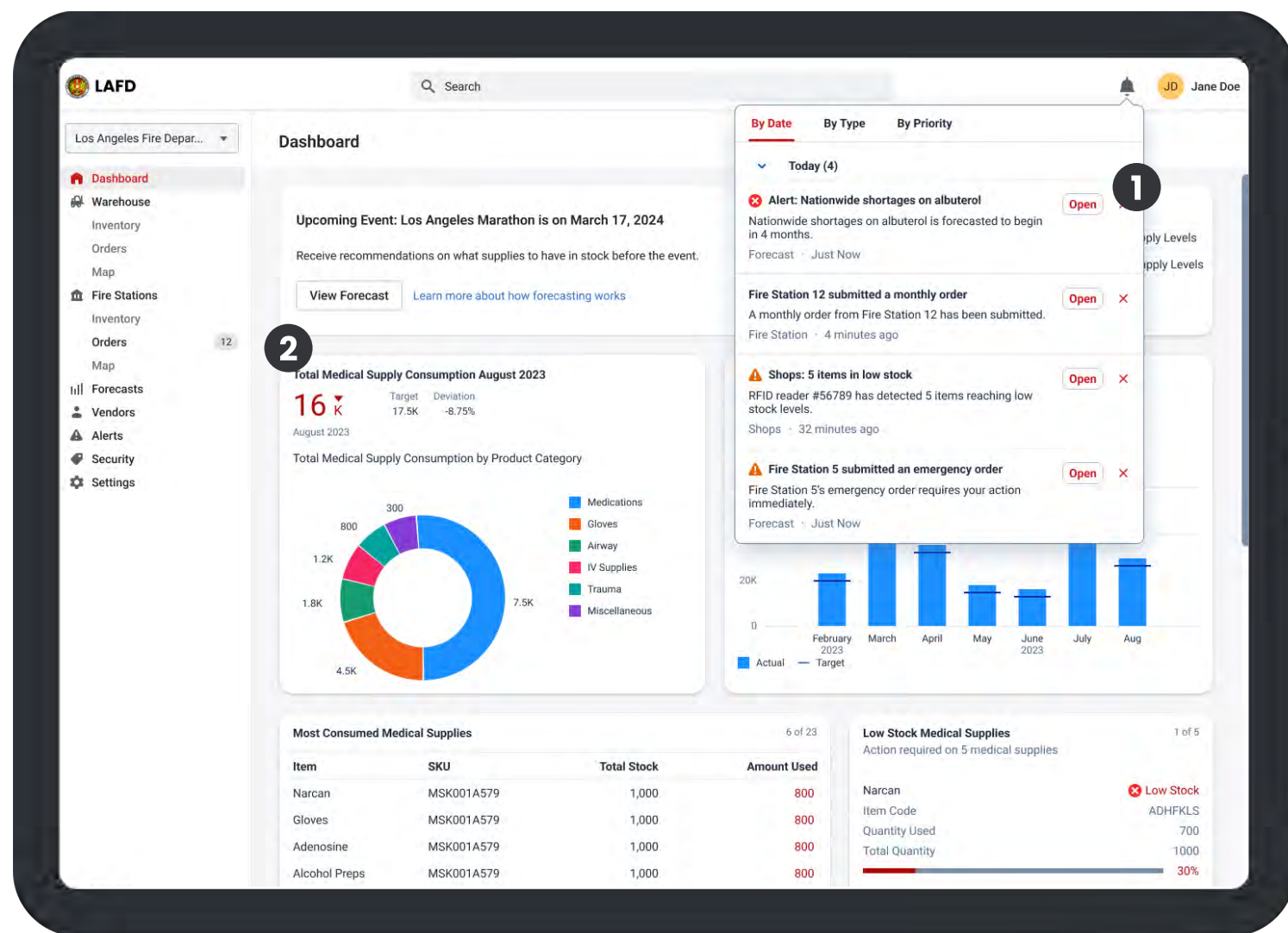
System Flow Chart

We utilized the System Flow Chart to better understand how information flows through different departments for the 'Do Everything' scenario. This approach aids in the development of a solution that benefits both firefighters and civilian staff by identifying and optimizing information and system flow.

RFID Scanning for Automated Order Placement

Supply Usage Rates & Needs by Location

Fire Station

Station Level Orders via IMS

Order Confirmation & Status via IMS

Total Stock Usage Trends & Forecasting Data

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User Interface Mockups

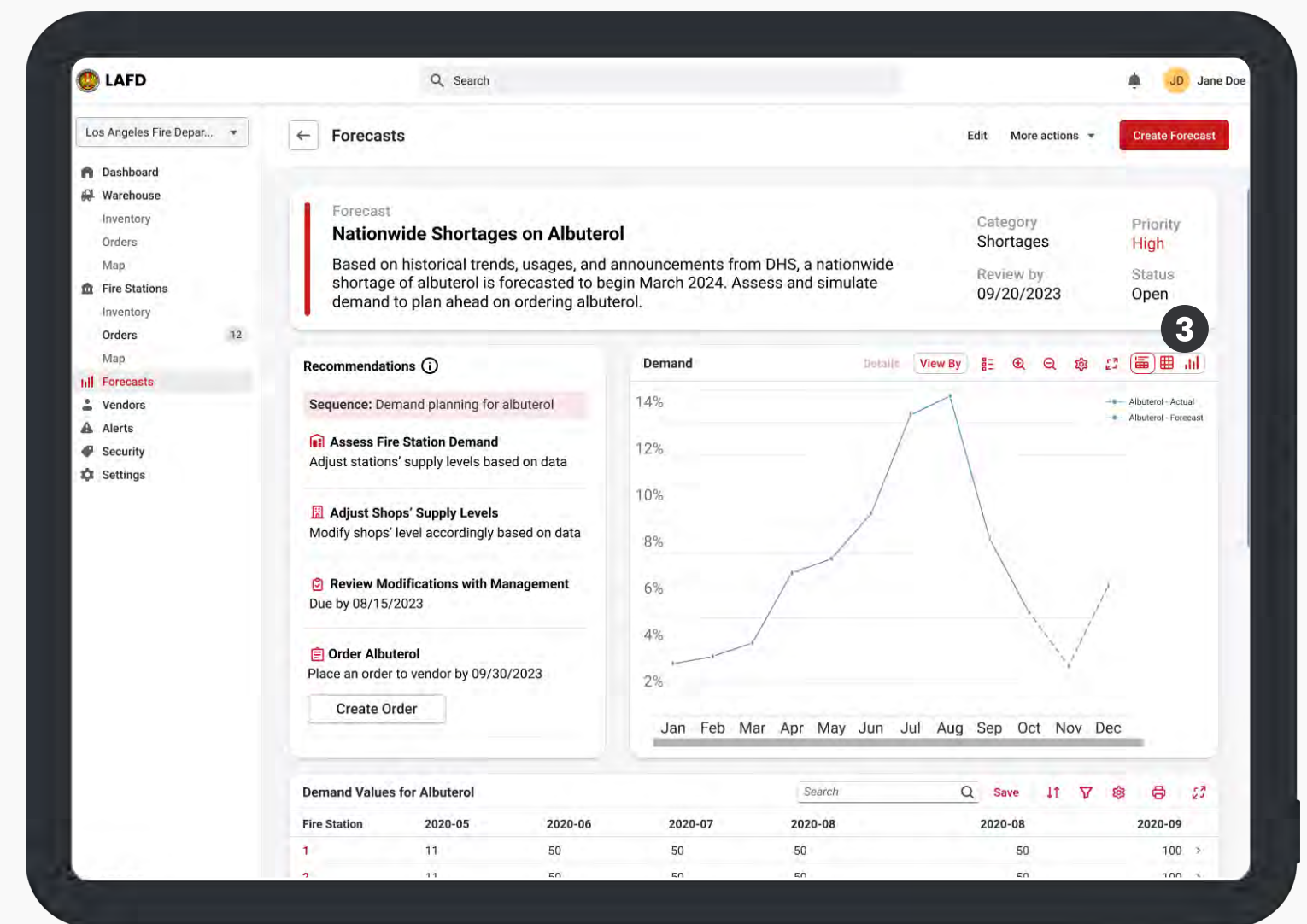## Supply & Maintenance View

AI-Driven Demand Forecasting

AI-Driven Demand Forecasting

1 Receive notifications on forecasts, announcements from DHS, automated reorder submittals, and low stock warnings

2 Customize dashboard according to LAFD's goals of managing medical supplies

3 Simulate forecasts and view predictive analytics based on machine learning of historical data and trends so LAFD can take actionable steps on how much to order.

Automation of Station Orders

Automation of Supply Levels Through RFID

4 Once RFID detects supplies reach below PAR levels, triggering a reorder, the shops receives automated reorders here

5 View of shared data statistics of all the fire station's medical supply consumption and stock levels

6 Receive alerts from fire stations approaching low stock levels

Automation of Supply Levels Through RFID

7 View a station's inventory to see which items are low stock, nearing expiration, and overall supply levels

Real-Time Tracking of Station Status

8 Sort by filters based on batallion, stock levels, and RFID activity to view status for all fire stations

9 Call to action to prompt shops to view a station's order and inventory levels

NEXT STEPS

Immediate
recommendations and
long-term strategy

RECOMMENDATIONS

This next section outlines the practical recommendations we provided the LAFD at the conclusion of our work. While our Do Something and Do Everything design solutions envision a future where budget, staffing, and time constraints are less of a concern, our recommendations are grounded in the current reality. We emphasize practical actions that LAFD can take immediately.

Now, Next, Long

As the LAFD moves to to address the supply chain issues, we would recommend taking action using the framework of Now (next 3 months), Next (3-6 months) and Long (1 year plus).

Most critically, the Now recommendations focus on immediately addressing the shortage issues by standardizing supply levels in priority stations. This can be done while beginning the technology procurement process and addressing trust issues.

The ultimate goal is to leverage data and an improved fully-connected system to take the human error (and emotion) out of the medical supply chain process.

NOW

Standardize supply of basic medical supplies at stations and S&M based on **any** data you have - population, past usage, paramedic orders.

RFP for an inventory management system, including existing suppliers.

Openly address trust issues and remind everyone of their duty to serve the public and the paramedics.

NEXT

Implement inventory management system, including ordering system if required to be separate.

Prioritize hiring, training and retaining the best people for S&M. Take time to get it right.

LONG

Bring delivery in-house so that you can hire and train the best people.

Standardize physical storage solutions at S&M and stations.

Acknowledgments

Throughout this project, we've experienced a range of emotions. Initially, the scope of the issues felt overwhelming. As our research progressed, we realized the severity of the challenges facing LAFD. Reviewing recent survey results from firefighters was particularly disheartening, as it highlighted the profound impact of these issues on those directly involved.

We greatly respect all of you who operate under constant pressure for public safety, turning the impossible into reality. As we wrap up our presentation, we genuinely hope that our research and findings can catalyze significant changes within LAFD moving forward.

Lastly, we extend our gratitude to the professors and all faculty members of UCI MHCID who supported us throughout this project, our fellow peers who shared the journey, and our understanding family members who assisted us despite our super busy schedules. We also want to express our heartfelt appreciation to the LAFD chiefs, captains, fire fighters, and paramedics, who generously participated in lengthy interviews and surveys, despite your demanding schedules.
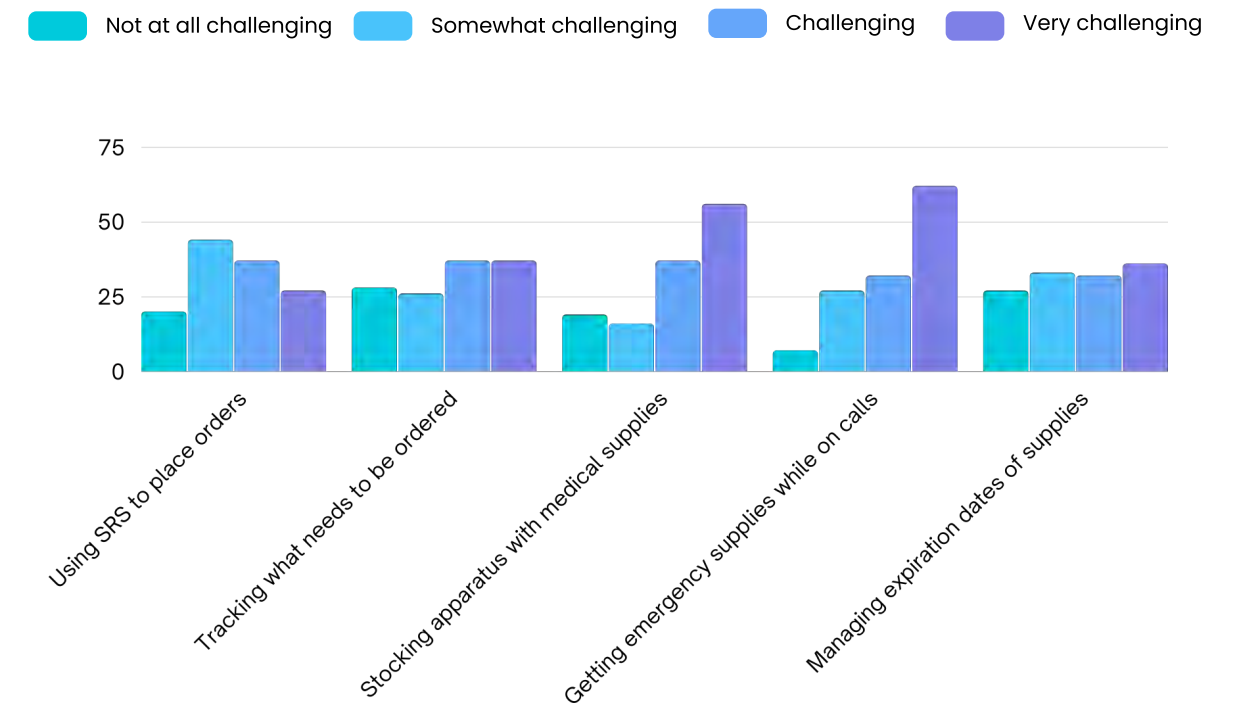
APPENDIX

SUPPORTING MATERIAL

Survey Responses

133 Total Responses

Link to complete survey

What Battalion are you in?

SOUTH BUREAU: Battalion 18
5.9%

CENTRAL BUREAU: Battalion 1
11%

SOUTH BUREAU: Battalion 13
10.2%

CENTRAL BUREAU: Battalion 2
3.7%

SOUTH BUREAU: Battalion 6
3.7%

CENTRAL BUREAU: Battalion 11
6.6%

VALLEY BUREAU: Battalion 17
6.6%

WEST BUREAU: Battalion 4
9.6%

VALLEY BUREAU: Battalion 15
5.9%

VALLEY BUREAU: Battalion 14
6.6%

WEST BUREAU: Battalion 5
8.1%

VALLEY BUREAU: Battalion 12
6.6%

VALLEY BUREAU: Battalion 10
11.7%

What is your role?

Other
10.2%

Paramedic
16.7%

Firefighter
13.7%

Station Captain
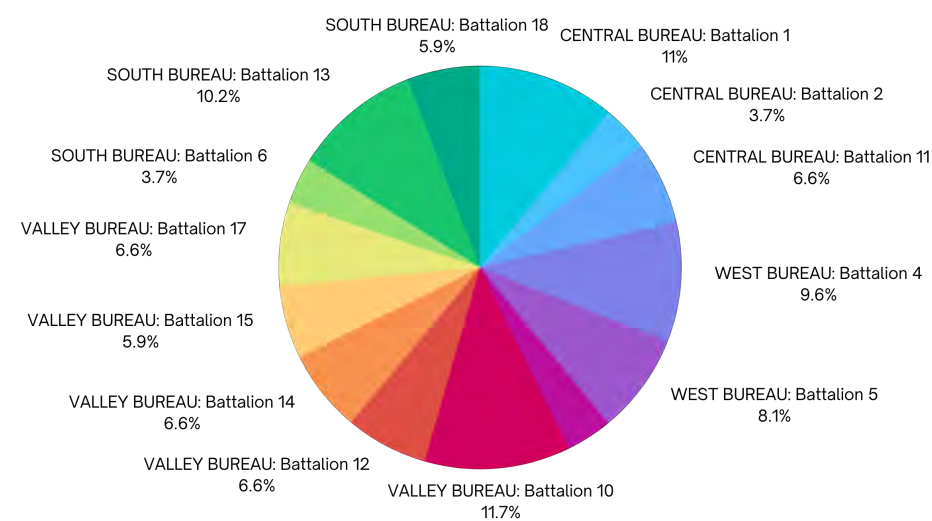31.2%

Firefighter Paramedic
28.2%

Below are a list of tasks associated with medical supplies applicable to paramedics and fire fighters. We'd like to understand if there are tasks you find more challenging than others. Please rank each task for you personally on a scale from Not At All Challenging (1) to Very Challenging (4).

Legend: Not at all challenging · Somewhat challenging · Challenging · Very challenging

X-axis categories: Using SRS to place orders · Tracking what needs to be ordered · Stocking apparatus with medical supplies · Getting emergency supplies while on calls · Managing expiration dates of supplies
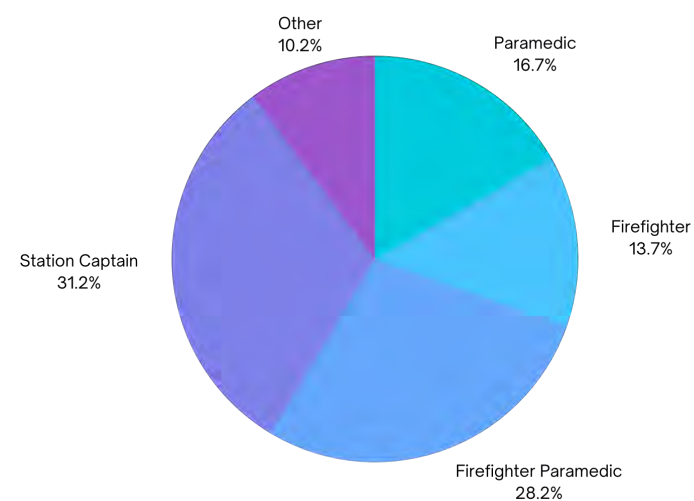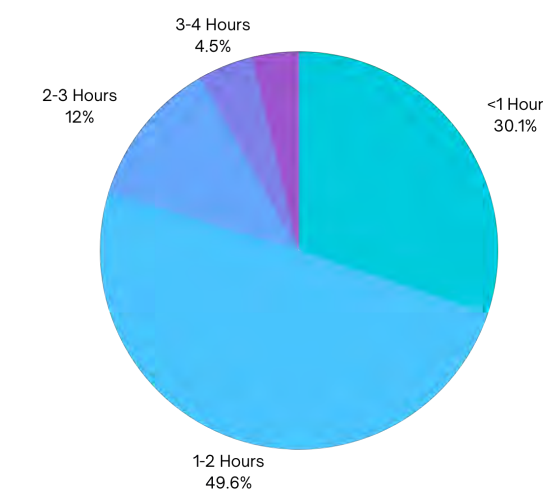
Are there any other challenges with medical supplies that you would like to share?
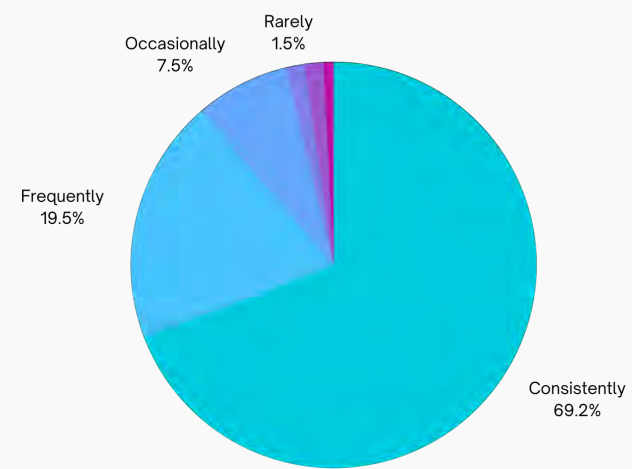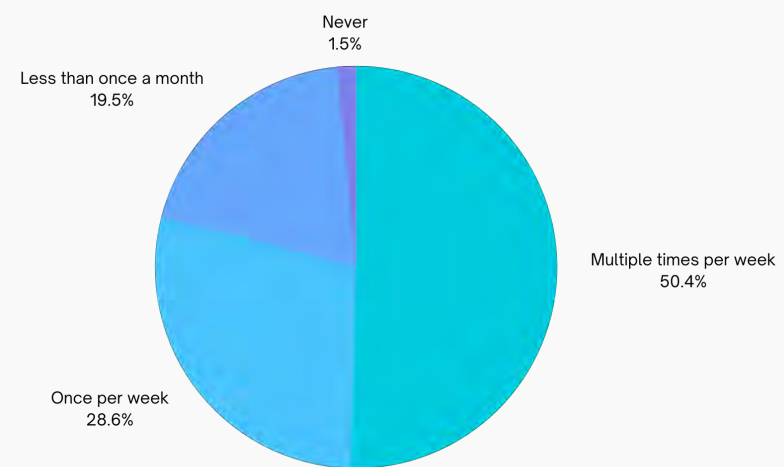
See full survey link for full responses.

On average, how much time per shift do you deal with medical supply related responsibilities (e.g., ordering, tracking, getting from other stations, storing, etc.)?
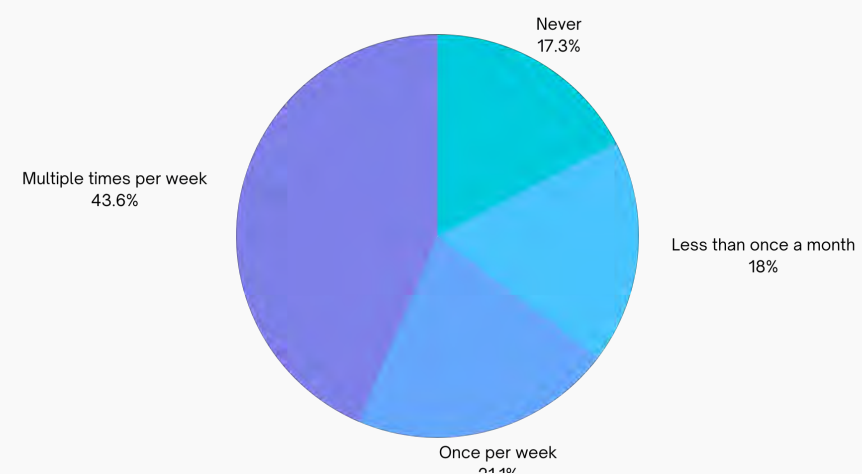

3-4 Hours
4.5%

2-3 Hours
12%

<1 Hour
30.1%

1-2 Hours
49.6%

On average, how frequently do you encounter missing supplies in your monthly orders from the Shops at your station?

Rarely
1.5%

Occasionally
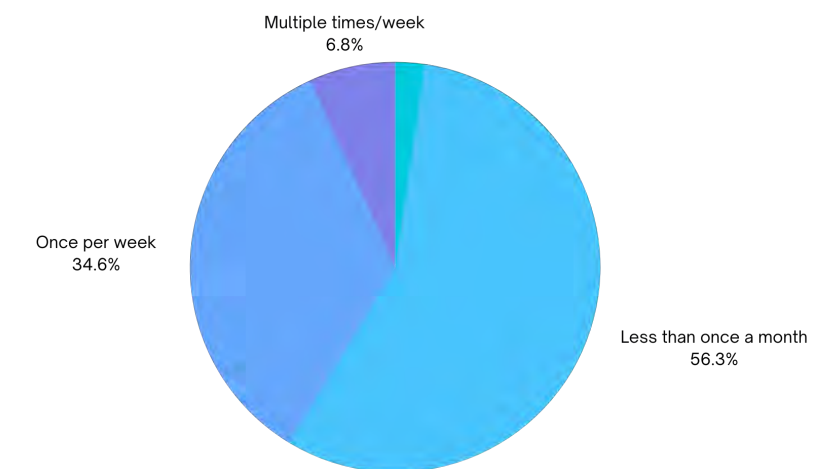7.5%

Frequently
19.5%

Consistently
69.2%

On average, how often do you borrow supplies from other stations?

Never
1.5%

Less than once a month
19.5%

Multiple times per week
50.4%

Once per week
28.6%

On average, how often do you borrow supplies from hospitals?

Never
17.3%

Multiple times per week
43.6%

Less than once a month
18%

Once per week
21.1%

On average, how often do you need to place an emergency order?

Multiple times/week
6.8%

Once per week
34.6%

Less than once a month
56.3%

What kind of medical supplies do you have the most shortages of?

Other
18.8%

General Medical Supplies (not controlled substances)
81.2%