User Experience Design to Synchronize Government Acquisition Strategy and Schedule

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Abstract – **The government acquisition process requires a significant amount of research and planning due to its inherent complexities and interdependencies. In particular, in creating a request for proposals (RFP), contract specialists must manage a multitude of tasks and deadlines. The current tools fail to appropriately support their workflow. To create a tool to help better synchronize project planning, we followed an iterative process in designing a novel user experience for use on mobile devices. The design incorporates the three primary phases in generating an RFP, i.e., market research, requirements development, and acquisition strategy and planning. The final design supports a) the retrospective review of project status at high- and low-levels of detail, b) the promotion of personal achievement through goal setting, c) a high level of customizability with numerous filtering options, and d) gamification to engage and guide users. Data visualization indicators were devised to distinguish the completion status of tasks, person-specific goals, interdependencies between actions, and the task completion timeline. Prototype usability walkthroughs with contract specialists evaluated the effectiveness of these design elements.**

Keywords—user experience design, human factors, data visualization, task management, gamification, government contracting.

I. INTRODUCTION

The US government spends about 500 billion USD per year on acquisition contracts with private companies. Because the process is so complex, acquisition personnel struggle to organize and plan their schedules. In particular, each project is unique, such that one model is not suitable for all acquisitions. Furthermore, there is little tactical information to assist newcomers and there are several moving parts to be done in parallel. Additionally, team communication and task blockers are difficult to manage [1], as personnel are often expected to complete vague and ill-defined tasks without clear beginning and endpoints [2], with complex interdependencies. Given this challenging environment, there are currently no suitable tools available, commercially or proprietary, to meet these demands.

The current software and methods that contractors use varies by the company. General project management software such as JIRA, Asana, Monday.com, and Microsoft Project support agile development and timeline planning, but lack the level of customizability crucial in government contracting. Other software companies have attempted to develop a product more tailored to this process. For example, Deltek, a software company that specializes in enterprise software and information solutions for project-based businesses, developed contract management software known as Costpoint. This software strives to integrate and automate financial, project, contract, and business development information into a centralized repository [3]. While Costpoint and other contract management software address many of the issues with general project management tools and provide more tailored management of the RFP process, such contract management software programs remain insufficient. In particular, there is no overall mapping or visual representation of the entire project and its status, there is no personal incentive for achievement, users are unable to customize their experience, and the aesthetics are often outdated, which together contribute to a rigid design, and ultimately a poor user experience.

The work presented herein seeks to address the aforementioned deficiencies by designing a mobile interface that provides the following: a novel representation mapping of the entire project and its status, an incentivization and promotion of achievement through goal setting, a personalized experience through the use of filter options and custom pages, and a modern interface that leverages aspects of gamification to engage the user.

II. METHODS: REQUIREMENTS GATHERING

The acquisition process is incredibly complex and the spatial constraints of mobile design make it difficult to incorporate large amounts of information. Therefore, the first steps focused on gathering informational, functional, and design requirements through interviews with stakeholders. Several constraints were identified, as follows.

One major barrier is the experience of acquisition personnel. Each year, new employees enter the workplace for the first time, having no experience with the acquisition process. Therefore, the design must be configured to both educate and inform the user, while positively and encouragingly motivating them to complete their required tasks. Pivotal information and functional requirements are identified and prioritized as described below.

A. Information Requirements

Project status: An overview is necessary to detail the current state of a project, in terms of which tasks have been completed, which are in progress, and which have yet to be started. The status must also provide insight as to why the

project may be in a given state by detailing any blockers or inadequacies in completing current tasks.

Timeline management: Personnel need the tools to manage their project timeline and must be aware of crucial deadlines to ensure their project is progressing as anticipated and on-track for timely completion.

Task ownership: Generating RFPs requires considerable collaboration between personnel. A key pain point occurs when personnel are unsure on which tasks they are responsible for completing. It is essential that a tool holds users accountable by clarifying who owns each task at a given time.

Task prioritization: Prioritization allows personnel to better manage their busy schedules and alleviate some of the innate confusion regarding the next task. The acquisition workflow need not follow linear process, and personnel are encouraged to complete tasks in parallel.

Task dependencies: Acquisition personnel need to be aware of which documents or tasks inform one another and which tasks are dependent upon external information gathered through research. Users must also be aware when a completed task requires revision as many tasks and documents inform others.

RFP categorization of tasks: The three major RFP phases include Market Research, Requirements Development, and Acquisition Strategy and Planning. Categorization as such allows personnel to understand progress with the overall project, and the status of documents per phase.

Advice from experienced users: The learning curve in acquisition planning is steep and newcomers often desire guidance. Users should be able to examine previous projects for inspiration or assistance on how to complete certain tasks.

B. Functional Requirements

Numerous functional requirements were generated, but the three most prominent consist of an intuitive task management system, an engaging gamified environment, and a rewarding goal-setting capability.

Task Management System: The task management system enables a means of organizing tasks so new users can quickly determine which tasks are yet to be completed. This is meant to ensure that tasks' deadlines are easily perceived and that team progress is continually updated. Task interdependencies must be made readily apparent to all users, thereby enabling acquisition personnel to plan accordingly.

Gamified Environment: Because task management systems are typically bland environments where users are only able to delineate between tasks and set their deadlines, the introduction of gamification was utilized to create a fun and exciting application, while keeping task management intuitive.

Goal-Setting Capabilities: The stakeholders prioritized rewarding personnel. By enabling users to select which tasks they deemed to be most important, whether due to an approaching deadline or a personal goal, acquisition personnel are able to delineate between high priority tasks and tasks that could be put on hold. By completing these specified goals on time, users are rewarded by bringing praise and a sense of accomplishment to a laborious and painstaking process.

III. METHODS: DESIGN AND IMPLEMENTATION

The design methodology sought to represent the aforementioned requirements in a series of iterative wireframe prototypes. The scheduling aspect of a task management system emerged as the cornerstone of the design. The first design iterations heavily utilized the aspect of gamification to develop a novel way of organizing tasks. The gamification aspect therefore dominated the first phase of wireframe development. These first wireframes focused on intertwining the demands of task management with the playful aspects of a gamified environment. Incorporating gamification into almost every component of the application ensured that each feature was fun, visually appealing, and helped with the completion of tasks. However, in the subsequent phases of design development, leading to the final design, more emphasis was placed on the task manager and less on gamification. Herein we discuss the design process leading up to the presentation of a final design, which underwent usability evaluation with acquisition personnel.

A. Alternatives Generated

Throughout the design phases of ideation and iteration, numerous concepts were generated and explored. Each concept offered a different representation of a task management system while also affording the information and functional requirements. Two major design iterations preceded the final design. The first iteration involved the development of three preliminary gamification-based design ideas and the second developed a single idea in depth.

The first design concept used building blocks to depict a city-scape where buildings represented various projects for the user and the floors in each building represented a group of tasks (Fig. 1A). The second design concept represented the three RFP phases (market research, requirements development, and acquisition strategy and planning) as three boats moving toward an island (Fig. 1B). With progress in one area, a corresponding boat moved toward the end goal. This helped the user visualize progress toward goal completion and where they might lag behind expectations. The user could pinch gesture to a zoomed-out view that shows how close the three boats were to the island and projection completion. The third design concept represented the three primary phases in building an RFP with three kitchens (Fig. 1C). In each kitchen, cooks would prepare different parts of a meal. Progress is shown per task by a pie chart adjacent to the chef. Users swipe gesture between the three kitchens to see progress on each RFP phase.

After these first iterations, focusing on gamification, a sticky note-based design was created (Fig. 2A-B). To balance playfulness with productivity, the level of gamification was decreased. This design was ultimately modified into the final design by changing the sticky notes into cells of honeycombs with a bee-themed design. This incorporated the same concept but with an exciting new theme. The honeycomb is analogous to the government contracting process since it portrays people being busy and working on different parts of a project simultaneously. This design is easy to understand but also has a fun, engaging feel to motivate personnel.
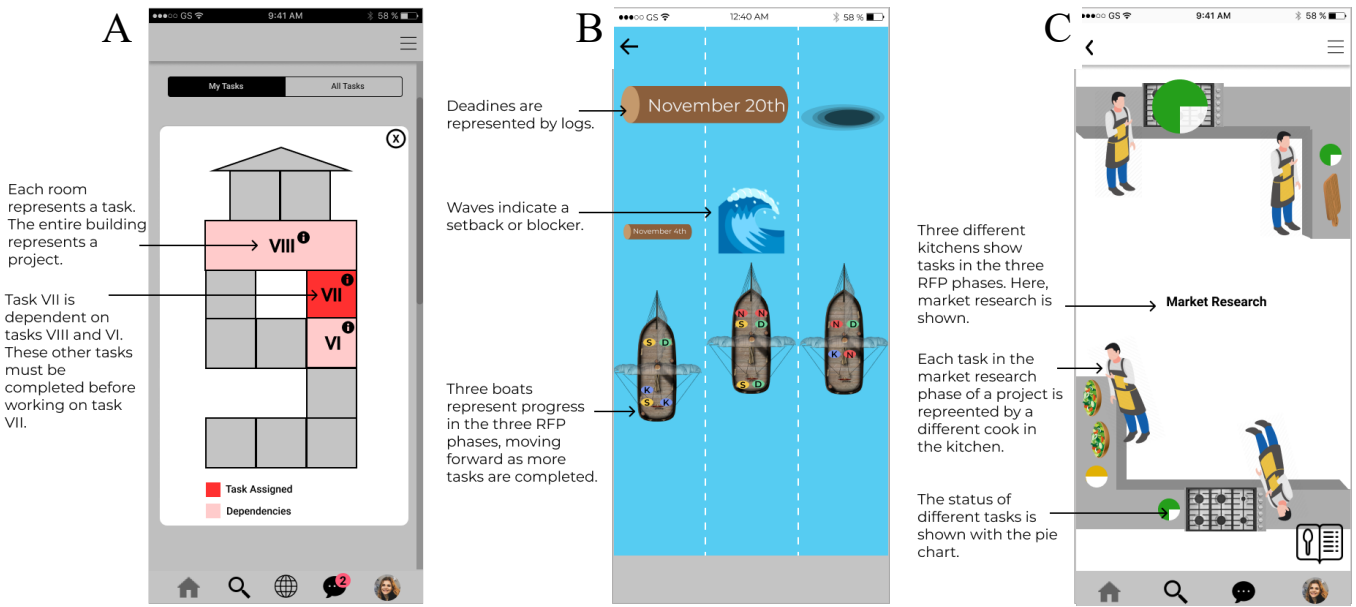
Fig. 1. Preliminary Designs: Initial Iterations. **Panel A)** uses a design patterned after blocks constituting a building, where each floor represents a group of tasks and each room represents a specific task which make up the entire project. Dependencies are indicated by rooms above or beneath one another. A building represents a project, and another view shows a city of projects underway. **Panel B)** uses boats to visualize progress in the three phases of the RFP. Users zoom out of the view shown to see overall progress toward a goal per the three phases. The wave in the middle lane depicts a blocker in that RFP phase which may set one's progress backward. The November 20th branch spanning the first two lanes indicates a deadline. **Panel C)** depicts a kitchen with different tasks underway simultaneously by different chefs to show interdependencies in the acquisition process. Each chef's progress on a task is given by a pie chart. The entire kitchen represents the market research phase. Users swipe to see the other two kitchens that together constitute the entire project.
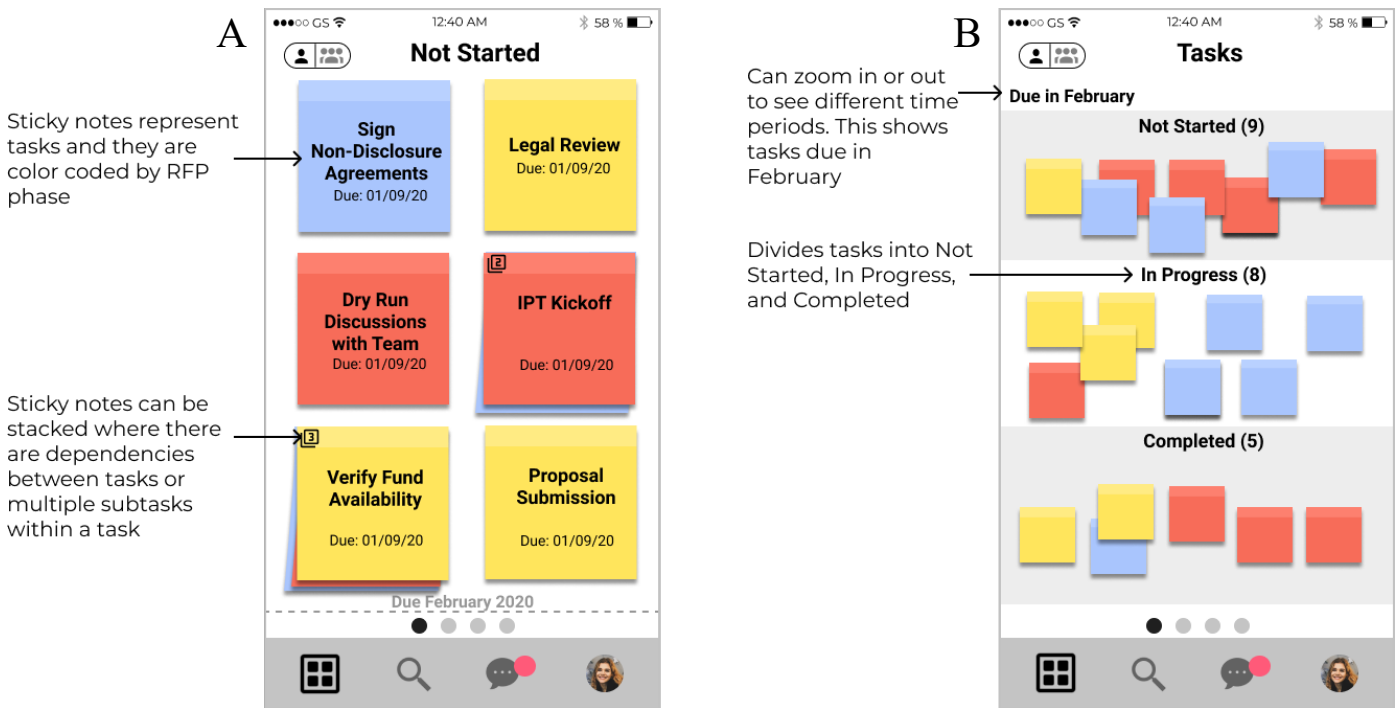

Fig. 2. Preliminary Designs: Second Iteration. This design utilized the concept of sticky notes representing tasks, which ultimately evolved into the final honeycomb design. **Panel A)** shows tasks Not Started. Sticky notes are stacked to indicate interdependencies between tasks. The user can click on a sticky note to receive more information about the task. **Panel B)** shows the full view of project tasks that are Not Started, In Progress, and Completed. This view can be filtered to a particular period of time, such as all tasks due in February. The tasks are moved from the Not Started section to In Progress and then to the Completed section as the user makes progress on the task.

B. Final Concept and Design

The final design incorporates the concepts of schedule visualization in a higher- and lower-level view, achievement rewards, high customizability, and gamification. Each area is address in detail below.

High-level and low-level view. The final design aims to assist government workers in managing a timeline for each RFP and visualizing the overall progress of the project at its current state. This is done via a high-level data display with indicators per task. These per task indicators show the RFP phase, its completion status, its task dependencies, if it was set as a goal for the week, and its urgency (Fig. 3A). Hue indicates which RFP phase the task falls under, for market research (yellow), requirements development (purple), and acquisition strategy and planning (teal). Each task newly begins an outlined hexagon. As the task becomes more complete, its hue darkens. When an entire row of tasks is completed, it moves to the bottom of the screen. High priority tasks protrude outwards to grab the user's attention. Interdependencies are shown with links between hexagons. Goals for the week are shown with a crown icon and can be set by the user in the "My Goals" page (Fig. 3D). Users can toggle between this hexagon overview and a more traditional list view of the same tasks, which is ordered by RFP phase.

For additional details per task, the user can click on a hexagon to see the task's title and due date (Fig. 3A). By double-tapping the hexagon, users are brought to a detailed version of the task in the list view (Fig. 3B). Here is made available information on task priority, due date, assigner, assignee, a detailed description, and previous users who have completed similar tasks, in case one needs advice.

Promote achievement. Another major focus of the design is to encourage and promote personal achievement, which is implemented through goal setting. At the beginning of each week, users can set goals for tasks they want to complete within the upcoming week, to be displayed in the My Goals page (Fig. 3D). Tasks are introduced on a "Not Started" page (not pictured) and once the task is underway, users can drag it to the bottom of that screen, and it will appear in the "In Progress" screen (Fig. 3E). As users complete tasks, they drag them downward on the "In Progress" screen, from barely started, to halfway there, and then almost done. Once they are done with the task, they drag it down to "Complete Task" and the task will move to the "Completed" page (not pictured). This intuitive gesture of dragging helps users feel in control of their project. When the user completes a goal, they will receive confetti and congratulations on a bee-themed page. On Friday, the user can reflect and determine if they met their goals and how to improve for the following week. The "Not Started," "In Progress," and "Completed" pages are viewable by swiping left and right.

High customizability. Another goal is to afford high customizability since every project is slightly different. As such, the user can filter within the mass data display by using the filter icon in the top left corner of the screen for the due date, RFP phase, owner of the task, task priority, and goals (Fig. 3C). Users can save specific filtered options to create custom pages, which they can swipe to access, in case they find themselves using the same few filter options often and want to create preset pages to easily navigate.

Gamification. Lastly, the concept of gamification makes the app fun and engaging. Workers in the acquisition space want more joy in their work and this app is meant to keep workers motivated and excited for their projects. A bee-themed design is incorporated in this design to represent workers coming together to achieve a common goal. The bee theme is incorporated throughout the app, especially in showing each worker's "hive" (Fig. 3F) where the user can manage each of their projects. Users can also view others' hives if they want inspiration or advice on how to complete a task from a more experienced user.

C. Concept Selection

The boat design (Fig. 1B) represented the timeline aspect of the government contracting process well, and it was easy to see one's overall progress in each of the three RFP phases by seeing how close each boat was to its end goal. Blockers and setbacks were represented effectively through obstacles in the boats' paths. However, it was more difficult to see individual tasks in terms of how they were prioritized and to whom they were assigned. This made it difficult to understand the individual steps to be taken in completing their project.

In the kitchen design (Fig. 1C), it was more difficult to see the overall project progress because the user could only view one RFP phase at a time and had to swipe to view the others. It was also more difficult to view as a timeline with an end goal. However, it was easier to view the progress and ownership of individual tasks. It also incorporated a help feature where a user could look at previous "recipes" for advice on a task.

The final honeycomb design (Fig. 3) incorporates both high- and low-level views of the entire project and each task. By utilizing a mass data display, users can see in a glance the timeline and progress of their project. The filter feature allows the user to display as many tasks as they desire. This design utilizes the bee-themed gamification to keep users engaged and motivated while incorporating the rest of the functional and information requirements. For these reasons, the honeycomb design was selected as the final design.

IV. METHODS: USABILITY EVALUATION

To evaluate the design's intuitiveness and ease of use, as well as its coverage of domain requirements, the team conducted usability testing with actively employed acquisition personnel. The personnel were individually guided through a presentation that navigated through each screen of the design and were notified of which gestures the app was responsive (tap, tap and hold, swipe). On each screen, the usability evaluator was given at least one scenario where they would be told to utilize a particular app feature, navigate to or from the screen displayed, or interpret the layout and visual indicators in the design. The user evaluator would then verbally walkthrough their understanding of the given screen and how they would attempt to handle the given scenario. Afterward, the evaluator would be asked for general feedback on the displayed screen before proceeding to the next screen and scenario.
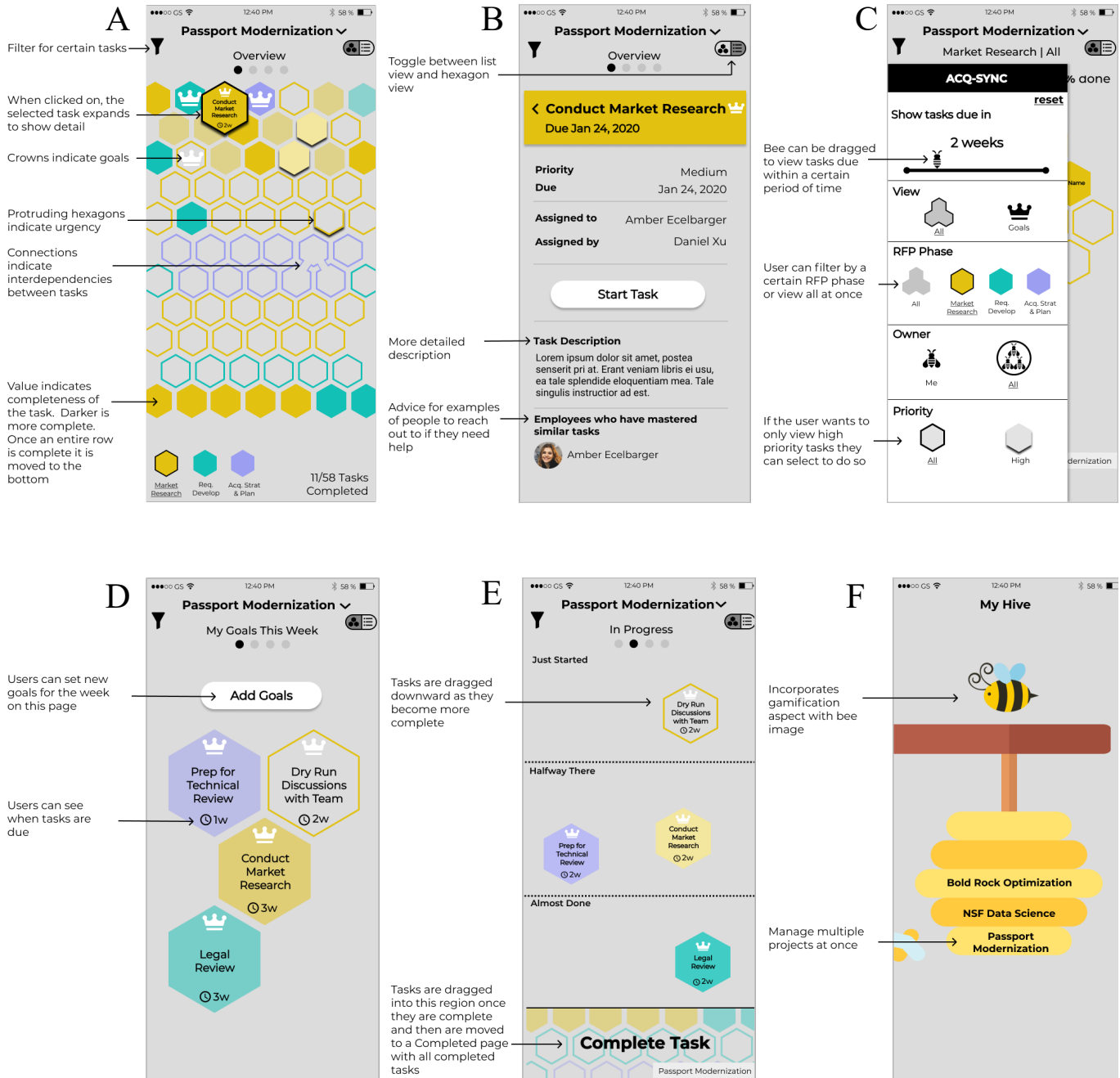
Fig. 3. Selected Screens from the Final User Interface Design. **Panel A)** shows a high-level overview page with all tasks ordered by due date from top to bottom for a project in Passport Modernization. Currently, the "Conduct Market Research" task is selected and expanded. The user can see it is part of market research by its hue, that it is close to being complete by its value/brightness, that it is a goal due to the crown icon, and that it is due in 2 weeks. Many other indicators are used including symbols, depth, and connections to indicate goals, urgency, and interdependencies. When the user clicks on "Conduct Market Research" again, they are brought to Panel B. **Panel B)** shows a low-level task description with more detail on a selected task. This task is now shown in a list view in order to detail information including the owner, priority level, and previous employees to reach out to if they need assistance in completing the task. **Panel C)** shows a filter page that can be accessed by clicking on the filter icon in the top left corner of the overview screen in Panel A. Users can filter by due date, RFP phase, owner, and priority level. Here, the user has chosen to view only tasks in Market Research with all priority levels. **Panel D)** shows the goals page that is seen when the user filters by goals set. Four goals have been added for this week: "Prep for Technical Review", "Dry Run Discussions with Team", "Conduct Marker Research", and "Legal Review". Users can add other goals to this list using the "Add Goals" button. At the end of the week, users can reflect on which goals they have completed and which to set for next week. **Panel E)** shows tasks that are In Progress and allows users to self-report progress on a task by dragging a task downward toward the Complete Task section as they work on it. This page which is accessed by swiping to the right from the Panel A. **Panel F)** shows the user's "Hive" which will appear when the app is first opened. Here, users can view all projects they are working on simultaneously. Currently, the user is working on the Passport Modernization project as seen in the top of the previous pages. Once the user is within a certain project, they can navigate to other projects by clicking the dropdown on Panel A next to the project title rather than navigating back to the Hive page.

A. Use Case 1: Understanding Project Status

User evaluators were first presented with the home "My Hive" screen (Fig. 3F). The use case scenario required the user to select the "Passport Modernization" process given the known gestures to which the app responds.

B. Use Case 2: Task Progress and Completion

The next screens presented to the user evaluators were the two variations of the "Project Overview." First, the user was asked to identify the major indicators they noticed on the main "Project Overview" screen (Fig. 3A). The user was then asked to navigate to the list view of the "Project Overview" screen. Lastly, from this screen, the usability tester was asked a series of questions regarding how to navigate and utilize the filter feature for both the "Project Overview" screens (Fig. 3C).

C. Use Case 3: Goal Setting

User evaluators were presented with a scenario where a goal was to be set for a given task. They were asked to navigate to the "My Goals" screen from the "Project Overview" screen. From there, the user was asked how they would go about navigating the "My Goals" screen to set the goal for the selected task (Fig. 3D).

V. RESULTS

Of the three personnel who participated in the usability evaluation, only the second user was unable to complete the guided testing of all 20 screens in the 20 minutes designated for each tester. User 3 was able to work through the usability testing with the most ease. User 3 was able to answer 12 of the total 17 usability testing questions correctly. Although User 2 was unable to complete the usability testing fully in the allotted time, their accuracy rate with regards to the questions asked to each usability testing was higher than that of User 1.

The qualitative feedback that each user evaluator provided varied between the individuals. Nonetheless, all three did share certain requests and sentiments. Among those was the request to change the color scheme for the app. In the version tested during usability evaluation, a shade of red was used to signify a particular task or goal was under the Acquisition Strategy and Planning phase. All three users suggested that red usually indicates an error or an urgent matter needing attention. The usage of red shades was misleading to them, and they believed they could unintentionally pay more mind to Acquisition Strategy and Planning items than others. This would likely increase the potential for users to fail to notice an urgent or upcoming task under a different RPF phase.

The evaluators had varied reactions to the "Project Overview" screen (Fig. 3A). Two users expressed they were, to some extent, overwhelmed by this main "Project Overview" screen. After navigating to the list view orientation of this screen, these two testers indicated their ability to understand the purpose, options, and information included in the main screen was greatly supplemented by seeing the list view. All three users suggested we make the list view screen the default for "Project Overview" upon first usage of the app.

VI. DISCUSSION

This effort designed a non-traditional scheduling application tailored to account for the complexities inherent in the government acquisition process. This design differs greatly from current project management offerings on the market as it focused on often-overlooked functional requirements: a task management system, gamified environment, and goal setting capabilities. The design accounts for these requirements as it provides the following: a visual overview of tasks with customizable scheduling, an engaging environment with displays of task and project status, and a way to promote and recognize achievement through goal setting.

What truly distinguished this design from others, is its mass data display element where users can visually track the progress and timeline of their projects. Data displays have becoming increasingly important in a variety of technical fields including personal computing, financial services and medical applications [4]. Mass data displays, which allow users to maintain an overview of the behaviors and state of a given process while limiting mental exertion, have been used previously in the context of power plants [5]. An experiment to identify the effectiveness of these displays in a coal-fired power plant found that the mass data display allowed test users to recognize plant abnormalities up to 20 times faster than traditional display techniques.

Given the level of success mass data displays have seen in other fields, we sought to test their effectiveness in the realm of government contracting by creating a visual display where the progress of numerous tasks in the multiyear process can be seen at a glance. The success seen in usability testing validated use of this display and may ultimately transform how users manage the complexities and intricacies of the acquisition process.

REFERENCES

[1] D. Fox and J. C Morris, "The role of accountability in federal acquisition: A search for context," Journal of Public Procurement, Vol. 15 No. 4, pp. 514–536, March 2015.

[2] S. M. Maser and F. Thompson, "Dispelling Fear and Loathing in Government Acquisition: A Proposal for Cultivational Governance in DOD Source Selections," Journal of Public Procurement, Vol. 13 No. 3, pp. 289–314, March 2013.

[3] "Contract Management Software for Government Contractors | Costpoint," unpublished.

[4] G. A. Jamieson, S. A. Guerlain, and P. T. Bullemer, "Multivariable Process Trend Display and Methods Regarding Same," U. S. Patent and Trademark Office, June 2003.

[5] C. Beuthel, B. Boussoffara, P. Elzer, K. Zinger, and A. Tiben, "Advantages of Mass Data Displays in Process S&C," ScienceDirect, Vol. 28 No. 15, pp. 383-388, June 1995.