MOMENTUM

1. Motivation

Programmers notoriously terrible at estimating how long their projects will take to complete [1] [2] [3]. This is because developing software is inherently uncertain: it is impossible to anticipate every twist and turn of the design process at the outset. This is only exacerbated by the fact that many programming projects are not completed by a single person, but by teams — if an individual can't predict how long something will take for themselves, what hope does a team have of estimating the completion time for an entire project? Ultimately, this is a problem that can have huge monetary, emotional, and interpersonal costs [4]. The reality is that programmers are usually much too optimistic [1] [2] [3] — they try to fit too many features into a release, and some have to be cut; they think that they can focus effort in one area of a project because it will be quick, but it ends up taking two, three, four times as long as they had thought initially. Having better time estimates lets us choose how we focus our efforts [4] [5].

Despite the strong need for tools that make project estimation easier, existing effort estimation tools are either unintuitive (*cf. section 2.2*), require extensive knowledge of effort estimation processes (*cf. section 2.6*), or both. While learning these processes might be in a software developer's best interest, the reality is that many people (including software developers) are not good at making decisions that will benefit themselves long term [14]. Momentum aims to reduce the entry cost of accurate effort estimation by lowering the amount of time it takes to learn the tool, lowering the monetary cost of entry, and removing the need to have in-depth knowledge of effort estimation processes.

2. Approach

2.1. Goals

We are creating a tool that uses information gathered about a team of developers to predict a project's ship date. We leverage an existing, simple, and accurate software effort estimation strategy called Evidence-Based Scheduling (EBS) (*cf. section 2.6.2*) and are developing a new user interface for EBS that is easier and more accessible than existing solutions. We are developing a new user interface because existing tools for EBS either have poor visualizations of the data they produce, or simply lacks a front-facing app.

Our tool is called Momentum and is an open-source project available at https://github.com/cse403-MOMENTUM/MOMENTUM.

In section 2.2, we address existing GUI tools for software development effort estimation. In section 2.6, we will discuss existing processes for effort estimation.

2.2. UI/UX User Studies: Comparing with Existing GUI Tools

Existing tools related to our project include Manuscript, ProcessPAIR, and Process Dashboard [9][10]. Manuscript is outlined below.

1) Manuscript Overview

Manuscript is a web app for software teams that assists in the processes of project management, issue tracking, and support [8]. A subscription for a team of just five members can cost from $62 to $75 per month. We decided to use this competing tool for our user research rather than other competing tools like ProcessPAIR and Process Dashboard for the following reasons:

1. Manuscript produces estimates for team-wide estimations, which aligns to the goals of our tool.
2. Manuscript uses EBS (*cf. section 2.6.2*), which is the effort estimation model we will use for the development of Momentum. This allows us to consider the effort estimation model a constant when performing usability comparisons between Manuscript and Momentum.
3. Manuscript's audience are software engineers who do not need prior knowledge of the Personal Software Process (PSP) model and processes, which most closely aligns to the audience that we want to build our tool for[6].

2) User Research

Because a large goal of our project is to make an extremely accessible tool, we are substantiating our accessibility decisions based on data collected from user research. Our first phase of this research is to see what users think about our biggest competitor, Manuscript. The second phase of this research is then to test the same users on completing the same tasks on version 1 of Manuscript mockups. This will help us make our tool more user-friendly and achieve our goal while also eliminating our own bias in usability of other projects. At this point, we have completed four informal user tests. The users are detailed below and will be referred to as “User 1”, “User 2”, “User 3”, and “User 4” for the rest of this portion of the report. We plan to perform five user tests on Manuscript as “testing with 5 people lets you find almost as many usability problems as you'd find using many more test participants” [15].

User 1: User 1 is a fourth-year UW student in both the CSE and HCDE departments that has previous user interface and experience development experience through a past internship as well as software development experience on project teams. User 1 has never used Manuscript before the test and has been programming for about six years.

User 2: User 2 is a third-year UW student in the CSE department that has previous software development experience on project teams through a past internship. User 2 has never used Manuscript before the test and has been programming for about four years.

User 3: User 3 is a second-year UW student in the CSE department that has previous software development experience through 7 internships, 6 of which have included working on project teams. User 3 has never used Manuscript before the test and has been programming for about eight years.

User 4: User 4 is a network and securities engineer with 28 years of industry experience. Many of these years were spent on project teams. User 4 has never used Manuscript before the test, but has exposure to estimation algorithms (not EBS) and has been programming for about 32 years.

The chosen tasks are summarized below as well as our intention behind choosing each task.

> Tasks 1-3: These tasks are presented as they represent a direct bridge between Manuscript and Momentum. Both tools should and do offer the ability to create a space to hold related tasks, create and modify tasks, and start, stop, and resolve these tasks. Because these tasks are shared by both Manuscript and our tool, we believe that we can directly measure our success in our usability improvements by comparing user experience in this task across both tools. For all tasks, the users were started on the "Main Iteration Planner" screen of Manuscript and the "Project View" screen of Momentum.
>
> Overarching Questions: In this section, several overarching questions are asked of the user to conclude and summarize the user's experience with the tasks given. We ask these questions to break away from the structure of a task and allow users to voice any other concerns or compliments of the tool after they have finished completing their task. Cross-referencing the responses from this section with the performance of users in each task allows us understand how much ease or complication in each task contributed to the user's overall view of the product.
>
> User 1 and User 2 completed all portions of User Testing on Manuscript before testing Momentum. User 3 and User 4 completed all portions of User Testing on Momentum before testing Manuscript. This was done to lessen any bias that could occur by seeing one tool before another.

Task 1: Creating a new project

In this section, users were given the following scenario: "You are a part of a software project in which you have already broken down the tasks that are assigned to you and your fellow peers. Create a place to store these tasks and fill out any forms to your best ability." The details of each user's interactions for each tool are detailed in the below table.

Manuscript Results:

	User 1	User 2	User 3	User 4
Completed Task as Directed	✗	✗	✓	✗
Finished Task in 60 Seconds	✗	✗	✗	✗

Other Comments: All users except User 3 created a new Case instead of a Milestone or a Project. These users also did not understand how to fill out more than half of the form options in the New Case screen. User 3 took more than 90 seconds to locate the "New Project" button.

Momentum 1.0 Results:

	User 1	User 2	User 3	User 4
Completed Task as Directed	✓	✓	✓	✓
Finished Task in 60 Seconds	✓	✓	✓	✓

Other Comments: All users found the “New Project” button in under 15 seconds.

Task 2: Creating a new task

In this section, users were given the following scenario: “Create a task and assign it to yourself, filling out any forms to your best ability.” The details of each user’s interactions for each tool are detailed in the below table.

Manuscript Results:

	User 1	User 2	User 3	User 4
Completed Task as Directed	✓	✓	✓	✓
Finished Task in 60 Seconds	✗	✗	✗	✗

Other Comments: As in task 1, all users did not understand how to fill out more than half of the form options. All users took longer than 60 seconds to create the case.

Momentum 1.0 Results:

	User 1	User 2	User 3	User 4
Completed Task as Directed	✓	✓	✓	✓
Finished Task in 60 Seconds	✗	✓	✓	✓

Other Comments: User 1 had trouble filling out the “Priority” field in the “New Task” form which caused the user to take longer than 60 seconds to fill out the form. Other users also commented on this aspect of the form, but they still finished in under 60 seconds.

Task 3: Altering created tasks

In this section, users were given the following scenario: “Enter into the task that you have previously created, indicate how you would begin working on the task, stop working on the task, and resolve the task.” The details of each user’s interactions for each tool are detailed in the below table.

Manuscript Results:

	User 1	User 2	User 3	User 4
Completed Task as Directed	✓	✓	✓	✓
Finished Task in 60 Seconds	✗	✗	✓	✓

Other Comments: User 1 and User 2 did not finish within 60 seconds because they could not locate the case that they had previously created because they did not fill out the form option which would choose which milestone that the case would appear in. User 3 and User 4 also could not find their case due to the same reason, but searched for their case by using the chrome “Find” search (Command + ‘F’) and entering their case name. Users commented that they didn’t understand why they needed to exit the “Case View” screen and re-enter it to access the “Stop Work” button after they had pressed the “Start Work” button.

Momentum 1.0 Results:

	User 1	User 2	User 3	User 4
Completed Task as Directed	✓	✓	✓	✓
Finished Task in 60 Seconds	✓	✓	✓	✓

Other Comments: Users didn’t seem to have any trouble with this task. There were no negative comments by users concerning user interface design to share.

Conclusion: Overarching comments

In this section, users were asked questions about their experience using Manuscript. The questions are repeated below as are the answers from each user.

Question 1: Did you have any troubles using [Tool Name]? If so, what were they?

	User 1	User 2	User 3	User 4
Manuscript	Yes	Yes	Yes	Yes
Momentum	Yes	No	No	No

> Manuscript: Users 1, 2, and 3 mainly focused on their troubles with not being able to find the “New Project” button. All users also mentioned their inability to fill out most of the “New Case” form options.
>
> Momentum: User 1 mentioned that they did not understand the “Priority” form option on the “New Case” screen.

Question 2: What did you like about [Tool Name]?

> Manuscript: Users mentioned that they liked some of the “New Case” field options such as “Due Date” and “Priority”, that the Iteration Planner looks and acts like “Trello” (a

web-based project management application), and that it shows complexity well. User 4 did not like anything about Manuscript so no answer was given for this question.

Momentum: All users responded that they liked how clean and intuitive Momentum was to use for the tasks. User 3 responded that the graph showing stats about project tasks could be helpful in a quick glance. Users 1 and 2 mentioned that they liked the progress bar included in the “Cases List View” Screen.

Question 3: What did you dislike about [Tool Name]?

Manuscript: Users repeated mentioned how “complicated” and “cluttered” the tool looked and felt while using it. The lack of explanations or small descriptions was also mentioned more than once. User 1 mentioned that there seemed to be many “unnecessary bits” that were confusing.

Momentum: Users mentioned the confusion around the setup of the “Priority” field of the “New Case” form. User 3 suggested that the colors on the “Project View” screen could be less colorful. Nothing else was mentioned.

Question 4: Would you use [Tool Name] for future projects if you needed to keep track of project-wide estimations?

	User 1	User 2	User 3	User 4
Manuscript	No	No	Maybe	No
Momentum	Yes	Yes	Maybe	Yes

Manuscript: User 3 mentioned that Manuscript would probably work for larger teams with complexity, but not for small teams. User 4 mentioned that “it might take me more time to figure Manuscript out than finishing my project”.

Momentum: User 3 mentioned that Momentum would be good in a small team, but not a large team.

Question 5: Would you recommend Manuscript to others?

	User 1	User 2	User 3	User 4
Manuscript	No	No	Maybe	No
Momentum	Yes	Yes	Yes	Yes

Manuscript: User 3 said that the answer would depend on the use case, but definitely not for new teams.

Momentum: No additional comments provided by users.

Question 6: How would you rate your experience with [Tool Name] with 1 being the lowest and 5 being the highest?

	User 1	User 2	User 3	User 4
Manuscript	1.5	2.0	2.5	2.0
Momentum	4.5	4.0	4.5	4.0

Manuscript and Momentum: No additional comments provided by users.

Concluding Remarks

Overall, users found Manuscript hard to use and were not always sure that they were completing the tasks correctly. They found that many fields and interfaces were not explained well enough for a first time user to fill out. The users would rather use other methods to estimate their projects than to use Manuscript, which leads us to believe that there is room for vast improvement in the usability of a tool that can help with project estimation. We strongly believe that a tool with a seamless user interface is a very novel contribution that drives users to begin using and continue using our tool.

Users found Momentum much easier than Manuscript in the completion of their tasks. Users continually performed better in the same tasks in Momentum than Manuscript. While we believe that our tool has done very well in its comparison to Manuscript through these user tests, we want to take the user feedback for Momentum such as the problems with filling out the "Priority" form option and address them in a new version of our tool. A new version of Momentum is currently completed and awaiting user testing.

2.3. Our Approach

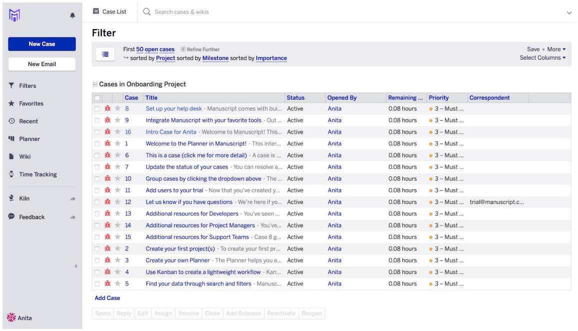
We are designing Momentum to have a better user interface than Manuscript. Our primary goal is to create a new UI that lowers the barrier to entry for using software effort estimation methods. In addition to a small startup cost, our tool has low overhead. Once a project is set up using Momentum, tracking times within the app takes only a few minutes each day.

We also improve the way EBS output is visualized. By leveraging recent research on uncertainty visualization from the UW's Interactive Data Lab, we provide graphs that should allow our users to act on the data they receive better than Manuscript does for its users [11].

From the current existing methods for effort estimation, we've decided on using EBS as the effort estimation model for Momentum. We will explain what the current existing methods for effort estimation are and why we chose to use EBS over the other models in section 2.6

Because EBS emphasizes simplicity, it does not model task dependencies. Since we are not improving upon the EBS model, we also do not support task dependency modelling. We do, however, implement a priority system in Momentum. Users are encouraged to mark tasks that have many dependencies with a higher priority than other tasks to signal that those tasks should be completed first. Priorities do not affect the underlying model of effort estimation.

Below are specific examples of the improvements we have made to the GUI through two versions. We see our direct competitor as Manuscript, so we will compare our GUI mockups with Manuscript to display differences in design ideology.



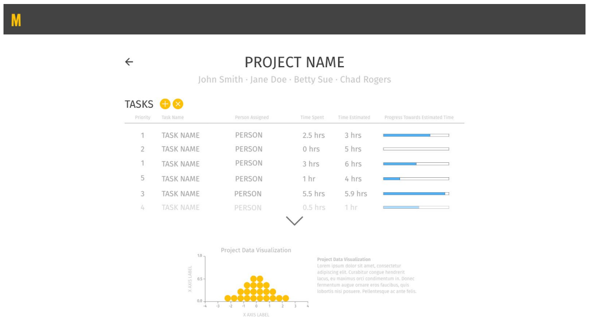
Filter

First 50 open cases ⊞ Refine Further
↪ sorted by Project sorted by Milestone sorted by Importance

⊟ Cases in Onboarding Project

Case	Title	Status	Opened By	Remaining ...	Priority	Correspondent
8	Set up your help desk - Manuscript comes with bui...	Active	Anita	0.08 hours	● 3 – Must ...	
9	Integrate Manuscript with your favorite tools - Out ...	Active	Anita	0.08 hours	● 3 – Must ...	
16	Intro Case for Anita - Welcome to Manuscript! This...	Active	Anita	0.08 hours	● 3 – Must ...	
1	Welcome to the Planner in Manuscript! - This inter...	Active	Anita	0.08 hours	● 3 – Must ...	
6	This is a case (click me for more detail) - A case is ...	Active	Anita	0.08 hours	● 3 – Must ...	
7	Update the status of your cases - You can resolve a...	Active	Anita	0.08 hours	● 3 – Must ...	
10	Group cases by clicking the dropdown above - The ...	Active	Anita	0.08 hours	● 3 – Must ...	
11	Add users to your trial - Now that you've created y...	Active	Anita	0.08 hours	● 3 – Must ...	
12	Let us know if you have questions - We're here if yo...	Active	Anita	0.08 hours	● 3 – Must ...	trial@manuscript.c...
13	Additional resources for Developers - You've seen ...	Active	Anita	0.08 hours	● 3 – Must ...	
14	Additional resources for Project Managers - You've...	Active	Anita	0.08 hours	● 3 – Must ...	
15	Additional resources for Support Teams - Case 8 g...	Active	Anita	0.08 hours	● 3 – Must ...	
2	Create your first project(s) - To create your first pr...	Active	Anita	0.08 hours	● 3 – Must ...	
3	Create your own Planner - The Planner helps you e...	Active	Anita	0.08 hours	● 3 – Must ...	
4	Use Kanban to create a lightweight workflow - Kan...	Active	Anita	0.08 hours	● 3 – Must ...	
5	Find your data through search and filters - Manusc...	Active	Anita	0.08 hours	● 3 – Must ...	

Fig.2.3.1.a.



PROJECT NAME

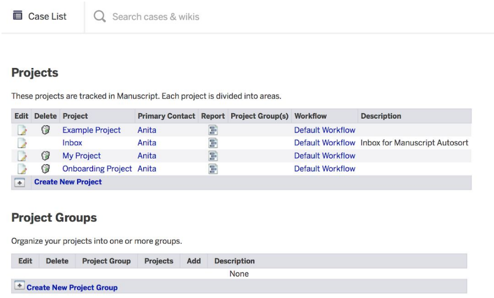
John Smith · Jane Doe · Betty Sue · Chad Rogers

Priority	Task Name	Person Assigned	Time Spent	Time Estimated	Progress Towards Estimated Time
1	TASK NAME	PERSON	2.5 hrs	3 hrs	
2	TASK NAME	PERSON	0 hrs	5 hrs	
1	TASK NAME	PERSON	3 hrs	6 hrs	
5	TASK NAME	PERSON	1 hr	4 hrs	
3	TASK NAME	PERSON	5.5 hrs	5.9 hrs	
4	TASK NAME	PERSON	0.5 hrs	1 hr	

Project Data Visualization
Lorem ipsum dolor sit amet, consectetur adipiscing elit. Curabitur congue hendrerit lacus, eu maximus orci condimentum in. Donec fermentum augue ornare eros faucibus, quis lobortis nisi posuere. Pellentesque ac ante felis.

Fig. 2.3.1.b.

Fig. 2.3.1.a. is the task board for Manuscript while Fig. 2.3.1.b. is the task board for Momentum version 2.0. Momentum's task board is improved in that the interface is significantly simplified as our task board doesn't overwhelm the user with a multitude of non-important features. Momentum's task board has data visualizations easily accessible on the page, which summarize the project's time projections and estimations. It shows tasks ranked by the order that the user chooses (such as ordering by newest tasks first, or ordering by deadlines). The user can also easily see the severity/priority of each task. An additional feature included in Monument is that the user can visually see the progress/time bar of each task.



Projects

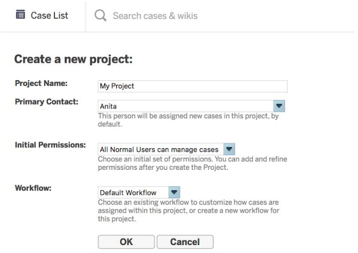
These projects are tracked in Manuscript. Each project is divided into areas.

Edit	Delete	Project	Primary Contact	Report	Project Group(s)	Workflow	Description
		Example Project	Anita			Default Workflow	
		Inbox	Anita			Default Workflow	Inbox for Manuscript Autosort
		My Project	Anita			Default Workflow	
		Onboarding Project	Anita			Default Workflow	

Project Groups

Organize your projects into one or more groups.

Edit	Delete	Project Group	Projects	Add	Description
			None		



Create a new project:

Project Name: My Project

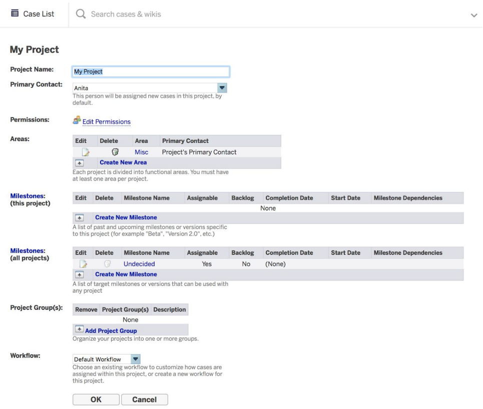
Primary Contact: Anita
This person will be assigned new cases in this project, by default.

Initial Permissions: All Normal Users can manage cases
Choose an initial set of permissions. You can add and refine permissions after you create the Project.

Workflow: Default Workflow
Choose an existing workflow to customize how cases are assigned within this project, or create a new workflow for this project.

Fig. 2.3.2.a.

Fig. 2.3.2.b.



My Project

Project Name: My Project

Primary Contact: Anita
This person will be assigned new cases in this project, by default.

Permissions: Edit Permissions

Areas:

Edit	Delete	Area	Primary Contact
		Misc	Project's Primary Contact
+	Create New Area		

Each project is divided into functional areas. You must have at least one area per project.

Milestones: (this project)

Edit	Delete	Milestone Name	Assignable	Backlog	Completion Date	Start Date	Milestone Dependencies
					None		
+	Create New Milestone						

A list of past and upcoming milestones or versions specific to this project (for example "Beta", "Version 2.0", etc.)

Milestones: (all projects)

Edit	Delete	Milestone Name	Assignable	Backlog	Completion Date	Start Date	Milestone Dependencies
		Undecided	Yes	No	(None)		
+	Create New Milestone						

A list of target milestones or versions that can be used with any project

Project Group(s):

Remove	Project Group(s)	Description
	None	
+ Add Project Group		

Organize your projects into one or more groups.

Workflow: Default Workflow
Choose an existing workflow to customize how cases are assigned within this project, or create a new workflow for this project.

OK Cancel

Fig. 2.3.2.c.

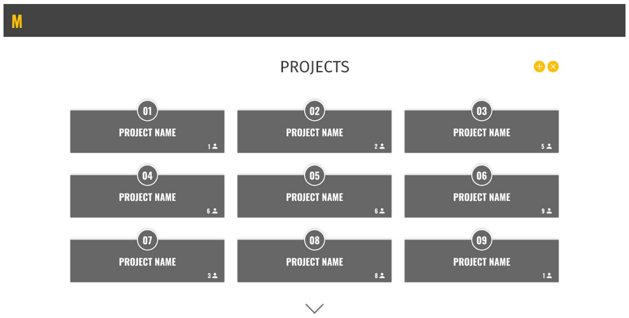
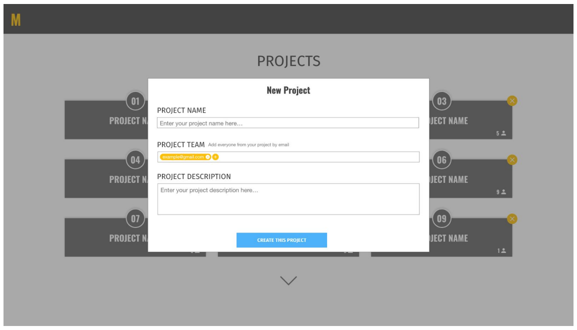


Fig. 2.3.2.d.



New Project

PROJECT NAME
Enter your project name here...

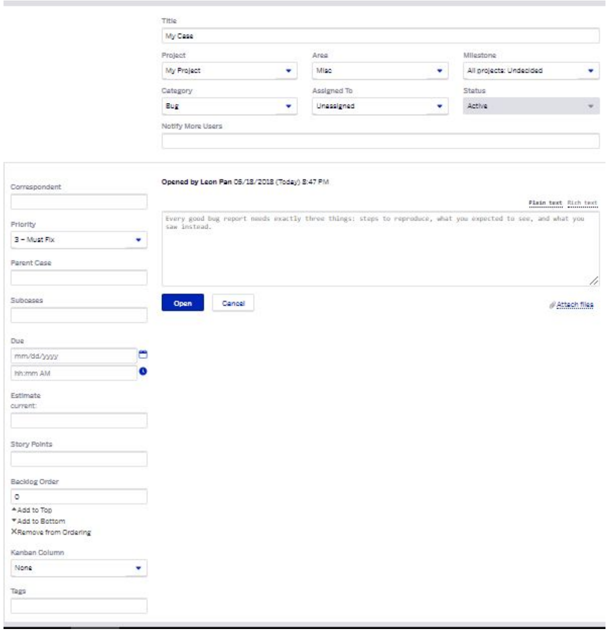
PROJECT TEAM Add everyone from your project by email
example@gmail.com

PROJECT DESCRIPTION
Enter your project description here...

CREATE THIS PROJECT

Fig. 2.3.2.e.

Another example where Manuscript lacks in user friendliness is that the user is required to click on a small link in the navigation menu in order to view their projects, and then require two separate screens (Fig. 2.3.2.b. And Fig. 2.3.2.c.) just to create a new project. Their screens (Fig. 2.3.2.a.) also provide too many options which require reading the manual to discern. For example, there is no clear indication on what the difference of Milestones vs Tasks are. There is also no explanation for the usage and differences of Areas vs Case Groups either. Momentum (Fig. 2.3.2.d.), on the other hand, avoids these confusions as its project page involves only one screen which elegantly displays all the user's projects after logging in, and then allows the user to add information about a new project without being redirected to a new page (Fig 2.3.2.e.).



Title: My Case

Project: My Project

Area: Misc

Milestone: All projects: Undecided

Category: Bug

Assigned To: Unassigned

Status: Active

Notify More Users

Correspondent

Priority: 3 – Must Fix

Parent Case

Subcases

Due: mm/dd/yyyy hh:mm AM

Estimate current:

Story Points

Backlog Order: 0

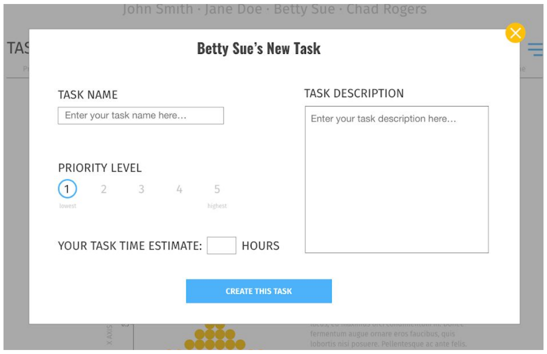
Opened by Leon Pan 05/18/2018 (Today) 8:47 PM

Every good bug report needs exactly three things: steps to reproduce, what you expected to see, and what you saw instead.

Kanban Column: None

Tags

Fig. 2.3.3.a.



Betty Sue’s New Task

TASK NAME: Enter your task name here…

TASK DESCRIPTION: Enter your task description here…

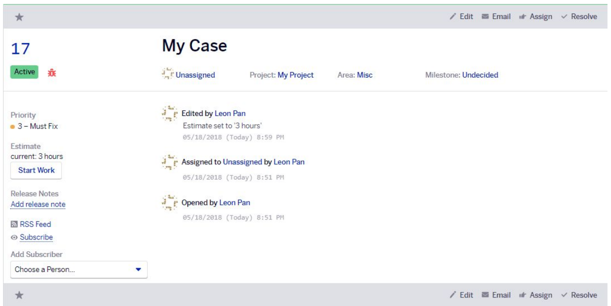
PRIORITY LEVEL: 1 2 3 4 5 (lowest … highest)

YOUR TASK TIME ESTIMATE: □ HOURS

John Smith · Jane Doe · Betty Sue · Chad Rogers
TAS
CREATE THIS TASK
X AXIS
fermentum augue ornare eros faucibus, quis
lobortis nisi posuere. Pellentesque ac ante felis.

Fig. 2.3.3.b.

Fig. 2.3.3.a. is the new case page for Manuscript while Fig. 2.3.3.b. is the new task page for Momentum. Momentum's new task page is also significantly simplified as our task page doesn't overwhelm the user with an abundance of non-important form options. Note that in the Manuscript new case page, most of the form options could be left black, including the estimate. Also, notice that the estimate field is below the button to open/create the case, meaning that the users might not even scroll far enough down to see the field before opening the case. This means the user might not input an estimation which is critical for EBS to calculate a projected ship date. Momentum’s new task page only include the form options that are the most important in terms of knowing what the task is and making the estimate.



17 Active

My Case

Unassigned   Project: My Project   Area: Misc   Milestone: Undecided

Priority: 3 – Must Fix

Estimate current: 3 hours

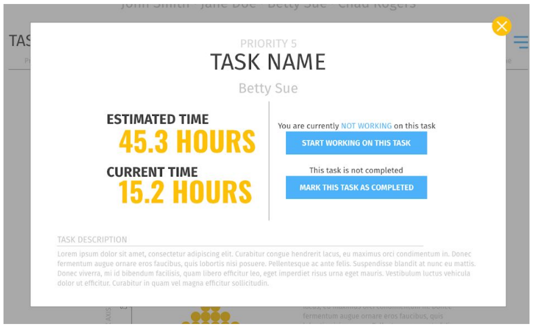
Edited by Leon Pan
Estimate set to '3 hours'
05/18/2018 (Today) 8:59 PM

Assigned to Unassigned by Leon Pan
05/18/2018 (Today) 8:51 PM

Opened by Leon Pan
05/18/2018 (Today) 8:51 PM

Add Subscriber: Choose a Person…

Fig. 2.3.4.a.



PRIORITY 5

TASK NAME

Betty Sue

ESTIMATED TIME 45.3 HOURS

CURRENT TIME 15.2 HOURS

You are currently NOT WORKING on this task

This task is not completed

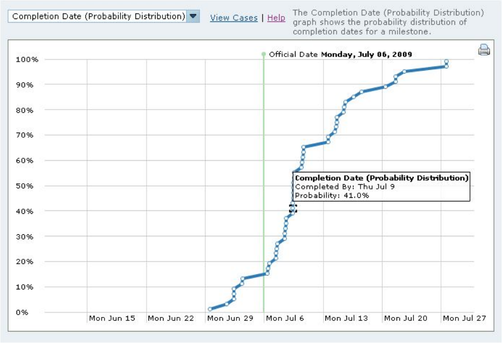
TASK DESCRIPTION

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Curabitur congue hendrerit lacus, eu maximus orci condimentum in. Donec fermentum augue ornare eros faucibus, quis lobortis nisi posuere. Pellentesque ac ante felis. Suspendisse blandit at nunc eu mattis. Donec viverra, mi id bibendum facilisis, quam libero efficitur leo, eget imperdiet risus urna eget mauris. Vestibulum luctus vehicula dolor ut efficitur. Curabitur in quam vel magna efficitur sollicitudin.

TAS
START WORKING ON THIS TASK
MARK THIS TASK AS COMPLETED
fermentum augue ornare eros faucibus, quis

Fig. 2.3.4.b.

Fig. 2.3.4.a. is the case page for Manuscript while Fig. 2.3.4.b. is the task page for Momentum. Notice that in the Manuscript, the time currently spent on the case is not displayed anywhere on the page, so the user can not know how long he/she have been working on the case or compare it with the estimated time. Also note that in Manuscript, when the user click the start work button, he/she cannot stop the task without exiting and reentering the screen. Similarly, once the user clicks the stop work button, he/she cannot stop the task without exiting and reentering the screen. Momentum’s task page provides the user with the information he/she might need to keep track of his/her progress and allows the user to easily manage the task from the task page.



The Completion Date (Probability Distribution) graph shows the probability distribution of completion dates for a milestone.

Completion Date (Probability Distribution)
Completed By: Thu Jul 9
Probability: 41.0%

Fig. 2.3.5.a.

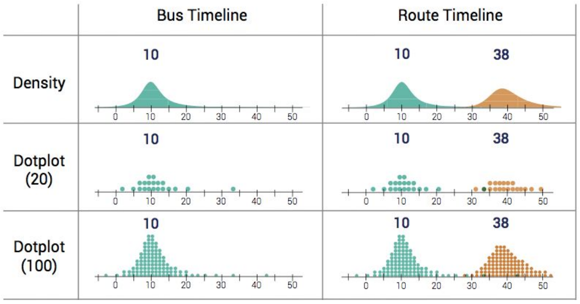


Fig. 2.3.5.b.

Uncertainty visualization in Manuscript vs. Momentum (examples from [11]).

Rather than visualizing ship dates as a line representing the cumulative probability of project completion, we propose visualizing times as a quantile dotplot. Researchers have found [11] that users are able to better interpret the uncertainty of a predicted time when visualized as a quantile dotplot than as a cumulative distribution.

The user manual for our tool may be viewed at this link: https://github.com/cse403-MOMENTUM/MOMENTUM/blob/master/user-manual.md

2.4. GUI Mockup

Our GUI Mockup has progressed through two versions. The first version was based off of comments made about Manuscript during user testing, both concerning what users liked and disliked about the tool. The second version was based off of comments made about the first version of Momentum during user testing. A limited interactive experience with each version is available below:

Version one of Momentum:

https://xd.adobe.com/view/b2653ac4-d8e2-4d64-90e0-d5cb276f5fb3/

Version two of Momentum:

https://xd.adobe.com/view/81870323-070d-4e8a-97b6-b12b52dd486d/

2.5. Architecture

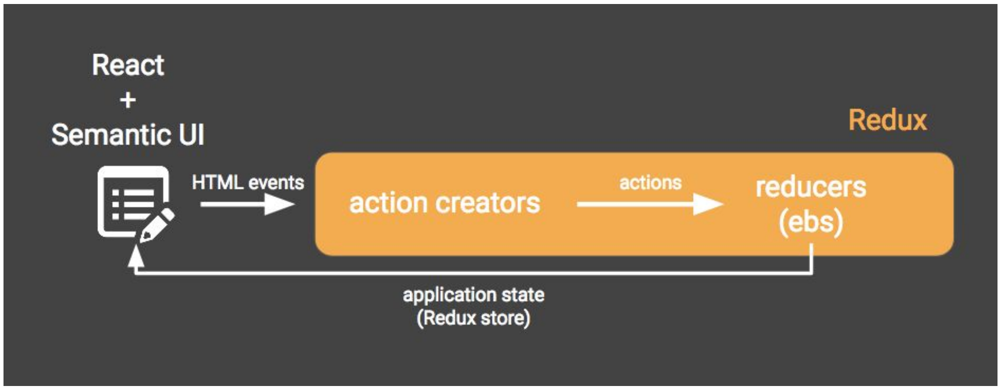


Fig. 2.6.1 Architecture

Our app is divided into a frontend and backend, written almost entirely in Typescript. We use several libraries and tools to manage the complexity of Momentum. For their software engineering benefits we use Typescript (a typed superset of Javascript), Jest (a Javascript testing framework), TSLint (a Typescript linter), and ImmutableJS (a collection of immutable data structures). These allow us to easily write tests, use rich types, and avoid unwanted state mutation. For the frontend we use React for to define the layout of our web pages and SemanticUI to describe how the look and feel of our user interface components. For the backend, we employ Redux, a library for handling application state that works well with React and SemanticUI. EBS is implemented within Redux and forms the core business logic (Fig. 2.6.1).

2.6. EBS

Evidence-Based Scheduling (EBS) is a method and piece of software for effort estimation developed by Joel Spolsky at FogCreek and has been integrated into their product called Manuscript [7]. Like PROBE, EBS first begins with the team of developers breaking down a large software project into smaller subprojects. Individual developers then cut these up into tasks they think they can complete in no more than a day of work. Developers estimate the amount of time each component will take. The EBS software keeps track of how much time the component actually takes and creates a model over time of how good an estimator the developer is. The EBS software then uses this model to predict how long the rest of the project will take and produces a probability distribution for the estimated ship date of the project.

Although there are other estimation models such as PROBE [6] and COCOMO II [12] [13], we decided to use EBS for Momentum rather than other existing models like PROBE and COCOMO II for the following reasons:

1. EBS is much simpler to implement than PROBE and COCOMO II and still provide good estimates for the ship date forecast.
2. PROBE and COCOMO II inherently require more user interactions or a much more complex system.

3. Initial Results

3.1 User Research

An important feature of our tool is to tailor itself to the individual, therefore, it is best to conduct experiments that involve case studies with programmers.

The initial results of our user research includes the complete semi-formally user tests for Manuscript as well as informal user testing that was not recorded on our initial mockups of Momentum. Semi-formal user tests will be conducted on our first mockup shortly and added to the report document.

The user research on Manuscript indicates that there is much room for substantial improvements in user experience, as Manuscript’s average experience score with users was a two out of five with one being the lowest and five being the highest. Most importantly, we see that Manuscript has non-intuitive presentation and access to project, milestone, and case creation buttons as well as broadly confusing form instructions without proper explanations.

Outside of actual usability, users found that the user interface was boring and cluttered.

The user research on Momentum indicates that many of Momentum's user experience problems have been solved. When asked for a experience score, users on average reported a score of four out of five. This is a massive improvement already when we consider that Manuscript received an average of two out of five from the same user group. The users also found Momentum had a more aesthetically pleasing user interface and tasks were completed much faster. On the negative side, users were confused on one form instruction considering the "priority" of the task. This will be fixed in later mockups.

Semi-formal user tests will be conducted on our first Momentum mockup shortly and added to the report document. After each iteration of user tests on the Momentum mockup, the mockup with be tweaked according to user responses and a new round of user testing will begin. We plan to do this cycle at least twice given the amount of time we have to complete our project. We believe this is imperative to the success of our project as our user interface is our novel contribution to EBS. Following this, User research is also very important in evaluating our success in this project as is backs up our claims that Momentum's user interface is more accessible and usable that Manuscript.

3.2 Implementation

For our implementation, we have finished the bulk of our front end interface, including the login, project list, and project details page as well as a rough implementation of EBS. The interface is best visually seen by running the application. The technologies we are working with are mainly React and Redux which are libraries that help create web-applications using JavaScript (see below for more). After much research we have refined the architecture of our files by following this organization, which allows us to effectively organize between presentational code, logical code, and Redux vs React components.

Currently, we are using React as a user-facing, front-end library for creating user interfaces and handling any GUI events. Many of these components are "dumb," in the sense that they only store ephemeral data and handle extremely small computations (e.g. dispatching actions in response to events). Instead of storing and manipulating data themselves, these components send "actions" (*cf. Redux documentation*) to our Redux "backend" in response to events initiated in React components, and then receive an updated state from Redux, after Redux has performed this given action. In other words, Redux is acting as a client-side, serializable database *for a single user*. We plan on implementing multi-user functionality after these single-user components are complete.

3.3 Limitations

Due to time constraints, there are a few objectives that we will not be able to complete. One of the stretch goals that we planned on was to improve upon the EBS estimation model by incorporating elements from other existing effort estimation processes/models such as COCOMO II and PROBE. However, improving on the GUI is taking more time and effort than we initially planned as we need to firmly validate our claims about usability and accessibility across both Manuscript and Momentum. Unfortunately, this means that we will not be able to complete that phase of our project. A part of this reason being that we are all learning new technology in implementing our project.

Manuscript has many functionalities that is not supported by Momentum because: 1. the functionality is not necessary in terms of helping the users estimate the ship date of their project, 2. it is too time consuming to implement within the course of this quarter or 3. we do not have the resources needed to implement the functionalities. In terms of tasks/cases, Manuscript has many data fields such as story points, backlog ordering, and kanban columns that we felt were unnecessary to include. There are also other Manuscript functionalities which are not related to task estimation. These functionalities include snippets, subscriptions, and webhooks. One of the features of Manuscript that we found to be interesting was Manuscript's integration with tools like Slack, GitHub, and Google Docs. Unfortunately, we will not have the time or the resources to add this feature to Momentum.

We will not be able to complete any experiments that involves using Manuscript and Momentum for the entire duration of a project that lasts a significant period of time. Ideally, we would like to distribute the tools so that they could be used for an entire project. This way, we could know if the tools were useful for the entire project or if the tool became an inconvenience for the users.

For the sake of transparency, we would like to point out that Manuscript includes more functions that just uses related to EBS. It also includes several ways to view milestones and tasks such as through an iteration planner and through a kanban board to help track cases in different ways. We understand why this is done as Manuscript is intended to be a heavily-used tool, but we want our tool to be lightweight and have a sole purpose of providing teams with concrete estimations. Thus, we have only compared our tool to Manuscript's EBS functionality.

Another potential limitation due to the time constraint is to conduct studies on Manuscript and our GUI with small teams rather than just individuals. We will prioritize our user studies on individuals, but if we manage to find the time and a willing team to conduct the studies on at the end of the project, we will attempt to do so.

4. Challenges and Risks

4.1. Challenges

A challenge we came across while implementing Momentum was to learn the new programming tools that were used to create Momentum such as Typescript and React/Redux. It took us longer than we've expected to learn the semantic of these tools. This delay was one of the reasons why we had to replan our project.

Using EBS for our own project was also a challenge. We have been applying EBS to our own project by hand during our implementation phase by recording our estimated and actual times taken to complete implementation tasks. Keeping track of the task from each member of the team and making the calculations manually have been a tedious process. We hope that Momentum will prove to be a useful tool that solves this issue, so that future teams would not have this challenge if they choose to use Momentum. The reason we are not using Manuscript is that the trial for testing Manuscript does not last long enough for us to use to track our entire project.

We also came across a few challenges in terms of working as a group. A few times we had trouble scheduling time for meetings where every member of the team was available. For those instances we had a majority of the team meet and later informed the missing members of the contents of the meeting. We believe that working on this project has provided us with valuable experience on how to work on projects as a part of a team.

4.2. Anticipated Risks

There are three large sources of risk in this project that we anticipate could cause us major problems:

1. Creating something too similar to another product.
2. Creating *another tool*. This is an issue that is core to our vision: we want to make something that people would actually use in the software development process. That being said, we don't want our project to be another high-maintenance tool for developers and project managers to have to constantly maintain. This is, in many ways, antithetical to the process proposed in EBS and PROBE: for estimation to work correctly, you often have to manage historical data as well as break down specifications into anticipated tasks — things that are large tasks in and of themselves that may detract from a low-maintenance product.
3. Measuring the success of our product. Since our project focuses heavily on helping teams estimate the time needed for development of a particular software project, observing the actual usage of the deliverables we produce may be difficult (as the nature of this estimation is that it occurs over a longer period of time).

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Appendix

PROPOSED SCHEDULE/UPDATED SCHEDULE

Week	**Milestone**
Week 3	**- Locate case studies for project.** - Gain access to source code for software management tools that employ time prediction. - Continue research on existing time estimation strategies.
Week 4	- MVP (minimum viable product) for new user interface and time estimation backend - Investigate user research and evaluation methods. Conduct user research on competing tools
Week 5	**- MVP for additional workflow enhancements.** - Establish metrics for software success and schedule user research.
Week 6	**- Continue working on MVP's additional workflow enhancements.**
Week 7	**- Complete “draft” of project.** **- Conduct first round of user testing to evaluate the effectiveness of our tool compared to existing solutions.**
Week 8	**- Connect Redux + React** - Project draft refinements based on user testing
Week 9	- Begin project presentation work - Second round of project draft refinements based on user testing
Week 10	**- Finalization of refinements** **- Finalization of project presentation**
Week 11	**- Complete project presentation**

META

A. Hours Spent on Assignment:

```
    Leon Pan: 6 hours
  Haley Ruth: 8 hours
 Anita Leung: 6 hours
Josh Pollock: 6 hours
   Austin Ha: 6 hours
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