

Creating the New Face of Buildertrend

Design Document

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Client: Buildertrend

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Executive Summary

Development Standards & Practices Used

- Write clean, well documented, modular code
- Follow the Buildertrend React migration progress
 - Work with BT dev, product, and QA teams
- Follow Buildertrend frontend design guidelines
- The React pages should be composed of high quality, correct, bug-free code

Summary of Requirements

- The team must adhere to all confidentiality agreements set by our client
- Meet with the client once a week
- Maintain communication with Buildertrend teams
 - Microsoft Teams
 - Pull Request Comments / Suggestions
- Each team member must contribute at least 3 hours of work a week
- Tech discoveries must be done before each page is created
- The team must test original pages and log the results
- Build React common components
- Use the given Buildertrend API

Applicable Courses from Iowa State University Curriculum

- Com S 227: Object-Oriented Programming
 - This course provides students with an introduction to object-oriented programming, including the four pillars of OOP: Encapsulation, abstraction, inheritance, and polymorphism
- Com S 228: Intro to Data Structures
 - This course introduces the importance of data structures in computer programming, covering some of the most widely known and used data structures including linked lists, graphs, trees, and stacks. 228 also focuses on big-Oh notation and sorting algorithms.
- Com S 309: Software Development Practices
 - This course helps students to develop teamwork skills on software projects by giving them a semester-long project to work on. Through this course, students are introduced to the Agile Approach to Software Development and developing an application that can be useful to others.
- S E 319: Construction of User Interfaces

- This course introduces students to different languages and frameworks that can be used for the development of user interfaces. In this course, students learn things such as HTML, JavaScript, Node.js and similar technologies. This course also allows students to learn about the Software Development process through coursework and a small group project in the last month of the course.

New Skills/Knowledge acquired that was not taught in courses

- React Development
- Conversion of legacy code to new platform
- Testing, quality assurance, and documentation of previously written code (tech discoveries)
- Communication with client

Table of Contents

Table of Contents	4
1. Introduction	6
1.1 Acknowledgement	6
1.2 Problem and Project Statement	6
1.3 Operational Environment	7
1.4 Requirements	7
1.5 Intended Users and Uses	7
1.6 Assumptions and Limitations	9
1.7 Expected End Product and Deliverables	10
2. Specifications and Analysis	11
2.1 Proposed Approach	11
2.2 Design Analysis	11
2.3 Development Process	12
2.4 Conceptual Sketch	13
3. Statement of Work	13
3.1 Previous Work And Literature	13
3.2 Technology Considerations	14
3.3 Task Decomposition	14
3.4 Possible Risks And Risk Management	14
3.5 Project Proposed Milestones and Evaluation Criteria	15
3.6 Project Tracking Procedures	15
3.7 Expected Results and Validation	15
4. Project Timeline, Estimated Resources, and Challenges	15
4.1 Project Timeline	15

4.2 Feasibility Assessment	17
4.3 Personnel Effort Requirements	17
4.4 Other Resource Requirements	18
4.5 Financial Requirements	18
5. Testing and Implementation	18
5.1 Interface Specifications	18
5.2 Hardware and software	19
5.3 Functional Testing	19
5.4 Non-Functional Testing	19
5.5 Process	20
5.6 Results	21
6. Closing Material	23
6.1 Conclusion	23
6.2 References	23
6.3 Appendices	23

List of figures/tables/symbols/definitions

Figures

Figure 1. Conceptual sketch of our project	13
Figure 2. Project timeline	15
Figure 3. Flow diagram of the process	21
Figure 4. Current ReachJS version of Data Science Information page	22
Figure 5. Current ReachJS version of Data Science Information page	22

Tables

Table 1. Intended users and uses	7
Table 2. Personnel effort requirements	16

1. Introduction

1.1 Acknowledgement

This project is being sponsored by Buildertrend Solutions. Our team received technical assistance and guidance from Buildertrend's Senior Architect Rick Kalasky, Project Manager Alli Kellner, and Software Developers Daric Teske and Cameron Hessler.

1.2 Problem and Project Statement

General problem statement: Buildertrend is currently in the process of trying to improve the speed and stability of their application website. To do this, Buildertrend is converting their outdated code into something newer, faster, and more efficient through the help of ReactJs. This conversion is taking time though, which is straining Buildertrend's team, seeing as they must currently support two different front-end systems.

General solution approach: Our senior design team will be responsible for building as many of Buildertrend's new website pages as possible. Our team will be given access to the existing Buildertrend pages and will be responsible for reverse engineering them into ReactJs. The pages our team creates for Buildertrend are expected to replace the older pages and will go live on the company's website by the end of the senior design year. While we are only required to convert a minimum of three pages, our senior design team is hoping to accomplish much more than this. Our project will greatly help Buildertrend by speeding up the React Migration the company has been undergoing for about a year now.

1.3 Operational Environment

Buildertrend provides its clients with software meant to simplify and optimize the building experience for homeowners, contractors, and remodelers. The environment in which our pages will be used will primarily be on an online application, accessible

through laptops, desktops, and mobile devices. Due to the nature of most technology applications, our pages must be quick, reliable, stable, and thoroughly tested. We wish to avoid pages that crash or lag often, seeing as we want the users to have a pleasant experience using the Buildertrend application.

1.4 Requirements

1. We will be required to complete tech discoveries for each web page we recreate to capture all of the requirements of the page we are recreating.
2. The recreated web pages must look and function exactly as the original web page.
3. We will be required to complete the project utilizing React Components when dealing with the User Interface recreations.
4. We will be required to implement the solutions utilizing APIs that Buildertrend already has in place at their company.
5. We will be required to keep our code on an internal Buildertrend Git repository
6. We will be required to use Visual Studio and Visual Studio Code as we develop our code.
7. Testing must be done utilizing Storybook and React testing libraries.
8. Some User Interface components must be designed using the Antd library.
9. We will be required to have bi-weekly meetings with the Buildertrend team.
10. We must recreate at least three web pages for Buildertrend.

Note: no other requirements exist.

1.5 Intended Users and Uses

Intended Users	Intended Uses
Homebuilders	<ol style="list-style-type: none"> 1. Everything you need to manage the home building process from start to finish. 2. Turbo charge your efficiency with the Buildertrend platform. 3. Customer management tools that allow you to keep your customers up to date on the project. 4. Project Management tools that allow you to easily view documents, mark up plans, manage scheduling, send estimates

	<p>and more.</p> <p>5. Financial tools that allow you to set budgets, send purchase orders, formalize pricing and manage the lifecycle for your projects.</p>
Remodlers	<ol style="list-style-type: none"> 1. Renovate your business model with a full suite of tools and resources. 2. Connect with your crew, keep your customers happy and grow your business with help from Buildertrend. 3. Customer management tools that allow you to keep your customers up to date on the project. 4. Project Management tools that allow you to easily view documents, mark up plans, manage scheduling, send estimates and more. 5. Financial tools that allow you to set budgets, send purchase orders, formalize pricing and manage the lifecycle for your projects.
Speciality Contractors	<ol style="list-style-type: none"> 1. Solutions that are adaptable, intuitive, and focused on boosting profitability. 2. A single, powerful platform is all you need to expertly manage all aspects of your business. 3. Customer management tools that allow you to keep your customers up to date on the project. 4. Financial tools that allow you to set budgets, send purchase orders, formalize pricing and manage the lifecycle for your projects. 5. Pre-sales process tools that allow you to manage new leads, win more bids and streamline your sales process with tools that belong on a superhero's utility belt.
Commercial Contractors	<ol style="list-style-type: none"> 1. Grow your business with powerful project management tools. 2. Take your business to the next level

	<p>with software that is as ambitious as you are.</p> <p>3. Project Management tools that allow you to easily view documents, mark up plans, manage scheduling, send estimates and more.</p> <p>4. Financial tools that allow you to set budgets, send purchase orders, formalize pricing and manage the lifecycle for your projects.</p> <p>5. Pre-sales process tools that allow you to manage new leads, win more bids and streamline your sales process with tools that belong on a superhero's utility belt.</p>
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Table 1. Intended users and uses

1.6 Assumptions and Limitations

Assumptions:

- Design (color scheme):
 - All web pages will follow the required Buildertrend company color scheme.
- Methodology:
 - The project will be completed using the tools and techniques prescribed by the Buildertrend methodology.
- Technology:
 - The project will use the following technology, tools, and libraries: React, Formik, Storybook, Ant Design, and TypeScript.
- Product environment:
 - All web pages must be accessible through the Buildertrend website and able to be viewed on laptops, desktops, tablets, and mobile devices.
- Product performance:
 - The maximum number of simultaneous users / customers is unknown at this time.
 - The number of users / customers varies greatly depending on the season.
 - For now we will assume a maximum number of simultaneous users to be 100.
 - This is important because we want to ensure that our pages are quick, reliable, and stable.

- If we underestimate the number of simultaneous users then the pages may crash or lag often.
- End product geographical use:
 - The end product will be used all over the world
- Team performance & skill:
 - Each team member is expected to have the necessary technological skills to be able to contribute to the project in a meaningful way.

Limitations:

- Budget & finance:
 - The cost of completing the product shall be no more than \$500, which is the allotment given to us by department for senior design projects.
- Schedule:
 - The project must be completed by the end of the senior design year in December 2020.
- Scope:
 - A minimum of 3 web pages will be converted to React.

1.7 Expected End Product and Deliverables

At the end of our senior design product, we will have recreated at least three web pages for Buildertrend. Each web page should look and function as close to the original web page as possible. All documentation regarding the web pages will be commented within the code. The web pages will be delivered periodically throughout the Spring and Fall 2020 semesters; we do not currently have set deadlines, however, the final products are expected to be deployed in December 2020.

2. Specifications and Analysis

2.1 Proposed Approach

Our planned general approach to this project is to follow Buildertrend's tech discoveries guidelines on existing Buildertrend web pages. Tech discoveries will allow our team to essentially do black-box testing on the existing pages, which will allow us to not only familiarize ourselves with the functionality of the page, but will also allow us to find any existing problems or bugs that have gone unnoticed. Our senior design team will

coordinate with Buildertrend's Code Health team to make sure all of the required APIs for our pages exist and are functioning correctly. From there, our team will reverse engineer the pages using ReactJs and the APIs provided by Buildertrend's team.

Once our newly created ReactJs pages have been pushed to the Buildertrend Bitbucket repo, a React Migration manager will code review our team's work. Once our pages have been thoroughly tested, documented, and reviewed, our newly migrated pages will be deemed "Dev Complete" and will be passed on to a Code Health team member. Should Code Health find any significant problems with our pages, they will be returned to our senior design team to either edit or fix the work. Otherwise, Code Health will essentially finish the page and we will be able to start on our next migration.

2.2 Design Analysis

Although our team had been road blocked for most of the semester, first by non-disclosure agreements and then by our assigned pages being taken by another team, we finally have a start on our project. During our meeting with Buildertrend the week before spring break, Daric informed us that we have our first page: a Data Science Information (DSI) page. Our team members have been working to set up our machines by cloning the Buildertrend Bitbucket repository, installing our Amazon Web Services VM, and familiarizing ourselves with the Buildertrend app. We have begun our tech discovery for the DSI page, which we will continue over the course of the next couple of days. Once the tech discovery is finished, we will create a branch in the repo and begin assigning tasks on our Trello board.

As we move forward, communication and organization are going to be key for our project, especially considering we will be working remotely from now on. It will be important for our team to check in often and frequently, so we can avoid stepping on each others' toes or overwriting each others' code. Our proposed plan of working in one page branch and creating smaller branches off of this one in our repository seems like a strong plan as of now. Daric approved of this idea and it seems this will be the best way to keep our work clean and organized.

Our architecture of our project will be coherent with Buildertrend's architecture that they have in place for all their applications. The React pages that we work on will be created on a premade API that is made for us by Buildertrend. We will stick to what

development practices Buildertrend outlines us to follow. Our expected results will be at a minimum three pages fully converted by the end.

2.3 Development Process

Our team will be using an agile approach. We will be treating our Trello board as our scrum board, which will be updated regularly with tasks and cards that our team needs to complete. Each task will be assigned to a team member, and everyone will be responsible for marking their tasks complete once they are finished.

Our team will also be using Bitbucket to organize our work. Each of our team members will clone a repository Buildertrend created specifically for this React Migration. From there, we will create a branch for each page we are working on, and we will branch off of our page branch for any individual tasks we need to complete. This method will allow us to avoid merging incomplete work into master, which could potentially produce negative side effects for the rest of the repo. Only once our page is fully complete will we submit a pull request, which will need to be approved by Daric. If our work is clean, bug-free, and meets Buildertrend's coding standards, our page branch will be merged into master and our team will be able to move on to the next page.

We are opting for an agile approach due to the flexibility and adaptability this type of development process usually allows. Every page we get will be different, with some much larger and requiring much more work than others. Because of this, our team feels it will be best to do iterative development. After each iteration, our team should have new working code and more progress made than if we tried to do waterfall or TDD.

2.4 Conceptual Sketch

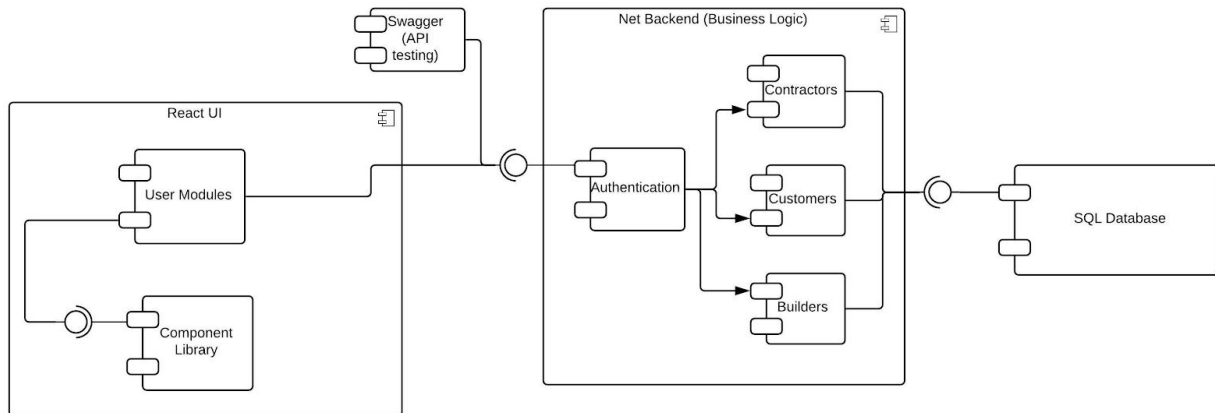


Figure 1. Conceptual sketch of our project

3. Statement of Work

3.1 Previous Work And Literature

The existing work that we will be following will come directly from the Buildertrend application itself. Since we are not actually creating anything new, our work will not be affected or influenced by other products in the market. We have been given existing Buildertrend web pages that we must recreate using ReactJs. The advantage to this is that our team does not have to worry about designing any new pages or building APIs for these pages to use. The layout, design, and API of each page we will be building already exists. This puts less of a burden on our group and reduces the chance of failure in our project. Due to our limited work experience, creating and designing a page from scratch could have been difficult for our group or would have created more obstacles.

The disadvantage of this project is that the design experience we could have gotten had we been assigned to build a page from scratch would have been valuable to each of our team members. In addition, our creativity when working on these pages will be slightly stifled, considering the pages we are building already exist, simply in another coding language. We are not allowed to change much about the pages. We are only supposed to rewrite them using ReactJs.

3.2 Technology Considerations

The biggest advantage to using ReactJs is its speed. React is known for using “components,” which are small fragments of a web page, such as a modal or a nav bar. React will update only those components which have been modified instead of reloading the entire page, which makes React a very quick and efficient language to use for websites. This was the entire motivation behind using ReactJs to replace the current Buildertrend web page code.

3.3 Task Decomposition

- Get web page
 - Complete tech discovery where we analyze the page to see its setup and how it performs.
 - Split up the web page into equal sections for each team member to complete on their own.
 - Each team member will have a branch from our page’s branch in Buildertrend’s repository.
 - We will each be responsible for merging our branch to the page’s main repository once our work is complete.
- Completed web page
 - Once all the tasks are complete for the page branch, our team will submit a pull request to Daric.
 - If there are no problems with our work then Daric will merge the branch into master.

3.4 Possible Risks And Risk Management

Some possible risks for this project involve knowledge of the required coding languages. Failing to know any of the required languages or how to implement something in any of the required languages will hinder our progress. Additionally, if pieces of the code are implemented in inaccurate or nonoptimal ways, this will also slow our progress. To handle these risks, we will continue to learn the required languages. If we do run into any of these issues, we will be sure to reach out to other teammates for help, or ask for assistance from our client.

3.5 Project Proposed Milestones and Evaluation Criteria

Each milestone will be the completion of a page. The pages will be tested while we are coding and after it has been completed; we will run the web page to ensure it is operating in the exact ways the original web page operated. As of right now, we will not be writing any tests for the web pages.

3.6 Project Tracking Procedures

Our team will be tracking our coding progress through a Trello board and tracking how much time each individual has been putting into the project through our bi-weekly reports. Additionally, we will be giving each other and our client updates periodically through our group chat and during our bi-weekly meetings.

3.7 Expected Results and Validation

By December 2020, we are expecting to have recreated three to four web pages for Buildertrend. These web pages should look and behave exactly like the original web pages Buildertrend gives us. We will confirm our results are high level by checking that the user interface and performance of our recreated web pages perform exactly as the original web pages do. We will use our tech discoveries to do this.

4. Project Timeline, Estimated Resources, and Challenges

4.1 Project Timeline

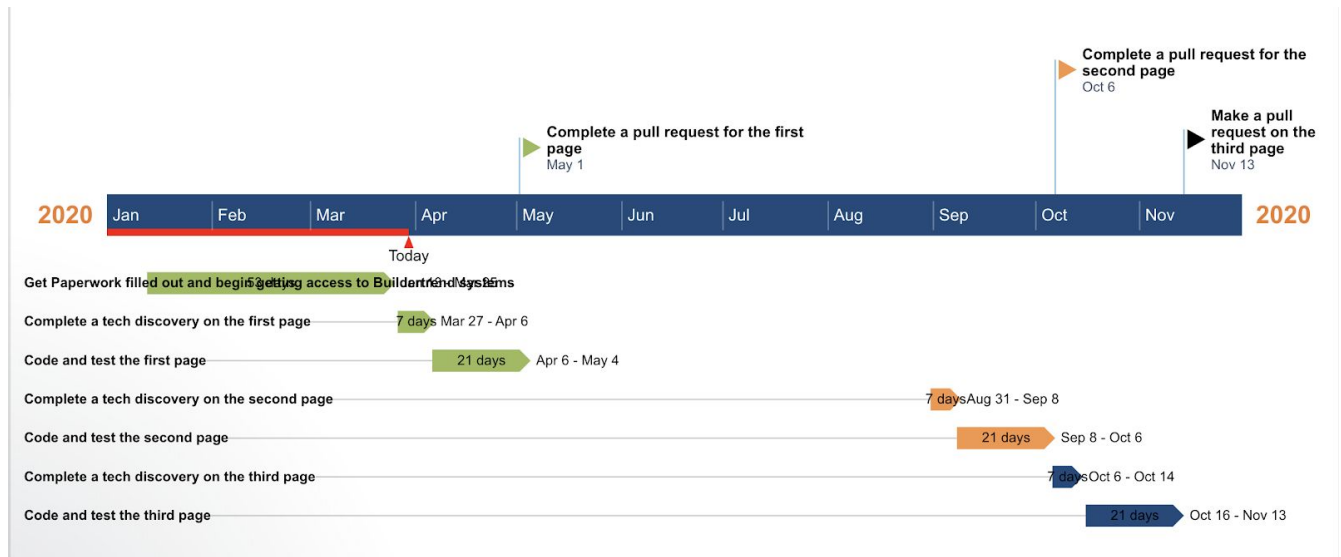


Figure 2. Project timeline

This timeline is not exact, as this project will require us to be very flexible since we are working with a company on multiple pages. Buildertrend expects us to finish at least three web pages, converting them from ASP to React. The Gantt chart above shows the dates the three pages should tentatively be completed. A breakdown of why we chose these dates is below. Since we only have a few weeks left in the semester, we hope to complete one page, but if we do not, we will adjust our schedule to get at least three pages done by the end of the second semester of Senior Design. As shown in the chart, it took quite a long time for us to receive access to the systems from Buildertrend, and we are starting the web page development a little bit later than we would have liked.

Each page will have three steps to complete, ending with a pull request on Git. For each page, we will document the page we are recreating, accounting for all of its features, in a tech discovery. This should take around a week to complete. Then we will work on the page as a team using multiple branches on Git. We will be testing as we go. This should take around three to five weeks to complete. Once we have completed all of our tasks, we will make a final merge and complete a pull request into the pipeline for Buildertrend.

So far, we are on track to complete our first page by the end of this semester, meaning we will be completing the last two pages in the fall. Assuming we begin our work the week after classes start (and accounting for holidays), we should finish our second tech discovery by the third week of classes, and our second page should be complete by the

seventh week. The third page's tech discovery should therefore be completed by the eighth week of classes and the third page should be completed by the twelfth week.

4.2 Feasibility Assessment

With our progression through the semester, our team has been fully integrated into Buildertrend's network and workspace. To most of us who have not worked at Buildertrend before, it will take some time to get adjusted to the development process that they have in place. This ranges from testing, working with new platforms, and documenting tech discoveries. Once our team is adjusted to this new environment, we will be able to deliver at least three fully migrated React pages.

4.3 Personnel Effort Requirements

Task	Time (hours to completion)	Projected Effort (scale of 1 (little effort to) to 5 (most effort))
Research (learning how to use React, Formik, Storybook, Ant Design, and TypeScript)	30 - 50 hours	Avg 3 (depending on the member's familiarity with the tools it may take more or less effort)
Tech Discoveries (need to be very detailed documentation about the interactions, API calls for each page)	10 - 20 hours total per page	Avg 4 (because these task requires a lot of detail it will require more effort)
Development (Programming pages, Git Commits)	20 - 60 hours total per page (depending on how large the page is)	Avg 4 (the team works simultaneously on each page so having each page being worked on by 6 people will be hard)
Testing (testing to see if each page performs the required actions)	3 - 7 hours total per page	Avg 2 (use black box testing)

Table 2. Personal effort requirements

4.4 Other Resource Requirements

Aside from a laptop, there are not any other resources that are required to conduct the project. The project can be completed in its entirety from each group members' laptop.

4.5 Financial Requirements

There are no required financial resources for this project.

5. Testing and Implementation

5.1 Interface Specifications

We are using our tech discovery and Buildertrend's original web page to compare our user interface to the one Buildertrend gave us.

5.2 Hardware and software

Our team utilized only software because everything surrounding our project from our perspective was all virtual.

Google Chrome Developer Tools: This software is utilized when our team is flushing out our tech discoveries. It helps us see all the moving parts of the webpage we are trying to convert. It also helps us see what exact API calls

Postman: Our team used this software when we were testing our code to see if our API calls were successful and returning the correct information we were looking for. It is a good tool to abstractly test specific functionality and communication within an application.

5.3 Functional Testing

We are currently testing the application as we code. We test the code's functionality (according to our tech discovery's specifications) by running the code after each method is complete, using Postman to test our API calls. Additionally, the Buildertrend team is

overlooking our project and ensuring that our tech discoveries fit their expectations. If we implement anything that does not fit Buildertrend's standards, the React Migration team manager will see this in the tech discovery and ask us to change it.

In addition, Storybook is a useful tool that allows us to test and experiment with different component types. Storybook allows components to be developed and tested in isolation, which is incredibly useful when it comes to building up our page. With Storybook, we don't have to worry about deploying our website to be able to see what it will look like. As we work through the components and the front end aspect of our page, all we have to do is hit save and Storybook will automatically re-render our components, allowing us to view the changes we made. We consider this tool a testing tool because it allows us to instantly see the effects of any changes we make to components. Furthermore, we can interact with a component on our page to make sure it functions the way we expected. For example, does this button change color when we click it? Is the value of the drop down stored correctly? Etc.

Outside of this we do not have any formal type of tests such as unit testing, integrity testing, or user study. Most of our testing comes from using Postman to test our API calls. We can determine the anticipated test results for each test case by using the information given to us by Buildertrend. We also test our API results by comparing our results against the API results of the current Buildertrend page. If testing shows that we aren't getting the desired results then we will go back into the code and make the necessary changes and then retest.

5.4 Non-Functional Testing

We test the performance of our code after we complete a significant portion. We test the performance by making sure that when we perform certain actions, such as selecting an option from a drop down menu that the page is responsive to that change in a timely manner.

5.5 Process

The methods indicated in section 2 were provided to us by the client and are something we can neither test nor change. Buildertrend gave us the steps we should take when migrating a page and our job is to follow those steps, which are illustrated below.

Flow diagram of the process:

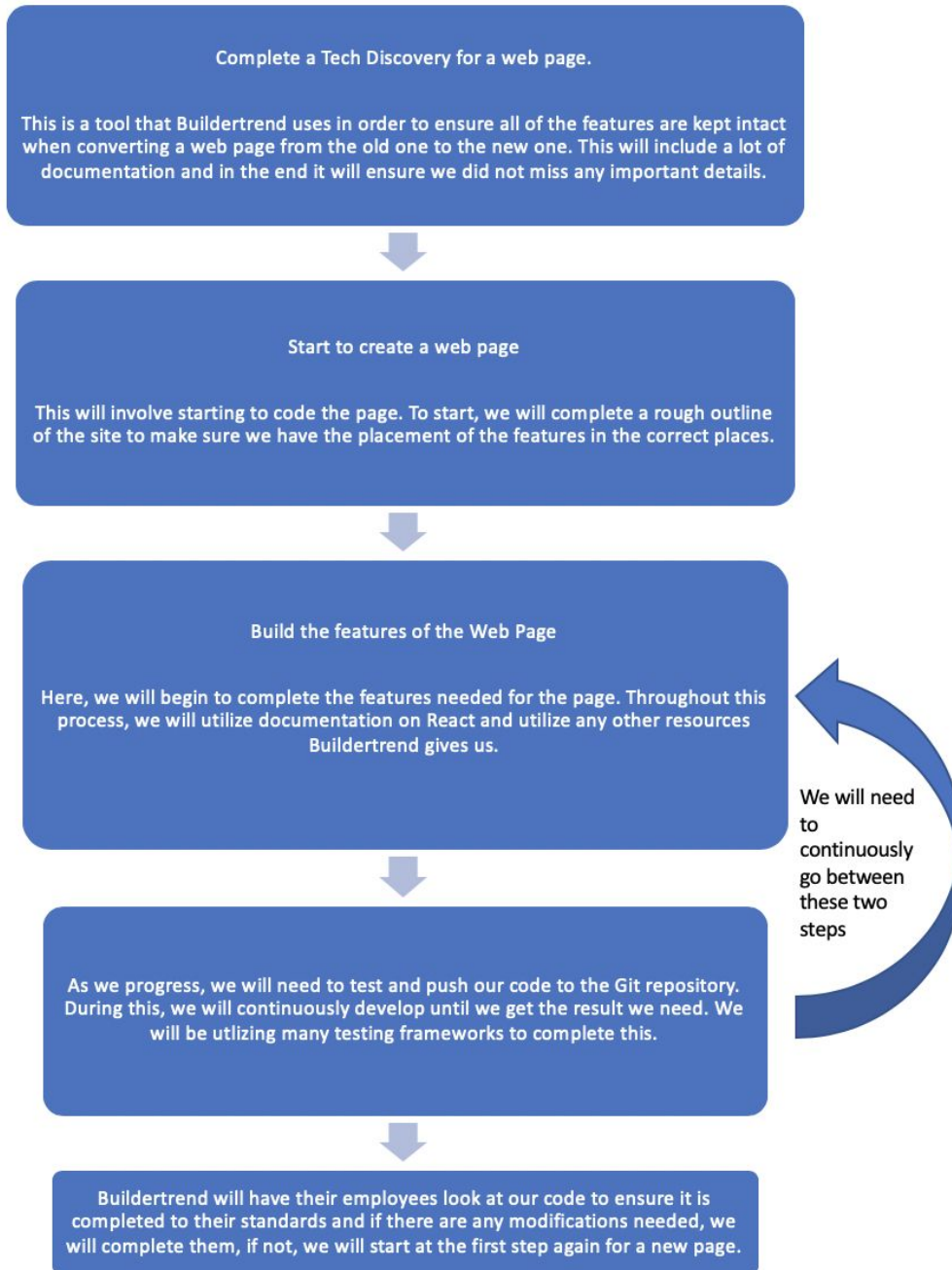


Figure 3. Flow diagram of the process

5.6 Results

Preliminary Results:

Below are images of the current ReactJS version of the data science information page given to us by Buildertrend. As of now the basic physical layout of the page is complete and only a few minor styling changes are needed to the design. We are currently in the process of working on the API's for the page to ensure that it has the same functionality as the current Buildertrend page.

Company Profile Setup

Which category best describes your primary business? *

Residential Homebuilder Residential Remodeler Specialty/Trade Commercial General Contractor

Which of the following best describes your primary type of project? *

Please Select

What is your company's estimated annual revenue? *

Please Select

Figure 4. Current ReachJS version of Data Science Information page

What is your company's estimated annual revenue? *

Please Select

How many full time employees are on your company's payroll? *

5

How many years has your company been in business? *

Less than 1 year
 1-4 years
 5-9 years
 10+ years

Finish

Figure 5. Current ReachJS version of Data Science Information page

Implementation Issues and Challenges:

One of the challenges we are facing currently is the creation of the tile button in the first question of our Data Science Information page. When we first began coding, we realized

there was no Buildertrend common component that could suit the needs of the primary business tiles. We asked if the design had to stay the same—if not, we would be able to use a different component, such as a radio button group—however, the UX team decided they would like to see the page remain mostly the same. Therefore, our group was left with no other choice but to implement a tile component from scratch. When we built this component, we made it specific to this page, but our managers informed us later on that they wanted the component to become a common component for Buildertrend. This meant the component was going to need to be reusable and extendable. Our team will need to go back at some point and refactor our component so that it may be used by other Buildertrend teams down the road.

6. Closing Material

6.1 Conclusion

As the semester is coming to an end, our team has come far and made really good progress. We were given the task to migrate old web pages over to React for Buildertrend by the end of the year. So far we have successfully finished our first tech discovery and have moved on to development. Since we first started the development on our project we are already 80% done with our first page.

Going forward we will keep up the pace and make sure our project is on course for the end of the semester. At the start of the fall semester we will continue with our bi-weekly meetings with Buildertrend to maintain the constant communication and ask for help when necessary. Even though our team is unable to meet in person, we have and will continue to persevere and will get the job done together. This will come to fruition if we stick to what we have been doing and continue making progress on the migration. With everyone dedicated and working together we will end this semester off on a great note and set ourselves up for success going into the fall. The use of our clear cut notes and knowledge of the process will help us get there.

6.2 References

We do not have any references.

6.3 Appendices

We do not have any additional information.