

# Pivot

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2015 Master's Project

University of California, Berkeley

School of Information

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Finally, we'd like to thank our friends and family for their influence and support over the past two years.

# Executive Summary

Our Master's Final Project is Pivot. Pivot is a web application that helps career changers explore new opportunities, compare career alternatives, and take next steps to make a career change happen.

We were motivated to build Pivot because workers, especially in younger generations, are changing jobs and careers more frequently than ever. People are increasingly seeking career fulfillment and looking for roles that meet their expectations and values across a wider set of dimensions than just salary.

Our survey of the current information available to career changers highlighted a major need for better tools. There is plenty of excellent data on employment opportunities, but it is either obscured by little-known and hard-to-use government websites, or it is being used by one of many job search sites to match people with specific roles at specific companies. With Pivot, our goal was to build a system that provides unique, helpful, and actionable information at a career level so that career changers can understand the array of options available to them, find careers that build upon their background skills and interests, compare opportunities to see how they fit with their values and goals, and learn about what they can do to take a next step toward success.

In building Pivot, we conducted extensive research with career changers and career specialists to understand what motivates career changes and what information is most important in career-change decision making. We decided to target our project towards early-stage career changers who have less than 10 years of work experience. We employed an iterative design process to target the pain-points that these users feel when evaluating career options online. We collected 35,000 recent online job postings from around the Bay Area, extracted key insights, and combined them with curated government data sets to compile a comprehensive set of data to describe careers. Ultimately, we implemented a prototype web application that lets users explore and compare over 200 different types of in-demand careers in the San Francisco Bay Area.

# 1. Project Overview

## Motivation

Like most of our classmates in the UC Berkeley School of Information, the three of us are career changers. While our individual stories are different, enrolling in the I School was the end result of a long process of introspection and research. Seeking something more from our current jobs, we searched for information about new opportunities that could build upon our strengths and knowledge while providing challenge and room for growth. We talked to colleagues, friends, and family for advice. We tried to understand the landscape of the technology industry and where we might fit in, ultimately deciding that the I School Master's program was the best way to learn more about possible career options and facilitate a successful transition.

Getting a new degree is one of many possible paths to a career change. Regardless of whether you go back to school, navigating a career change is a time-intensive and often frustrating process that requires you to reflect upon your values and goals, assess your strengths and weaknesses, discover new types of positions that might be a good fit, and invest time and often money into acquiring the skills and connections needed to make the transition.

For our Master's Degree Final Project, we wanted to understand more about career changers: who are they, what motivates them, and how do they make decisions? We wanted to survey the landscape of current tools and data sources available to career changers so that we could identify opportunities for fulfilling unmet needs. **Using this information, our ultimate goal was to build a tool to help people explore career opportunities, find careers that are a good match for them, and learn about next steps to make a successful transition.**

## Opportunity

Career changing is happening at a faster rate than ever before. Two-thirds of working Americans consider themselves active job-seekers, and recent research from a major job search engine website shows that the majority of online job browsers are searching for opportunities outside of their current industry of employment. This trend is accelerated within the Millennial Generation, who are continually seeking new opportunities and only intend to stay at a given job for a few years.<sup>1</sup>

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<sup>1</sup> What Job Seekers Want: Occupation Satisfaction and Desirability Report. Indeed.com. March 2014.

Despite these trends, the large market of career changers remains underserved by informational resources. There are currently two main categories of online tools that can be used by career changers for information seeking: (1) government career data sets; and (2) online job search sites.

**Government career data sets.** The largest public data set on career opportunities is the US Department of Labor's [Occupational Information Network \(O\\*Net\)](#). This dataset provides a comprehensive set of information—such as work tasks, skills, abilities, and work environment—for close to 1,000 careers. While the data is frequently updated through surveys with workers, the website is difficult to navigate and is missing information for a number of newly popular careers (for example, data scientist and user experience researcher).

**Online job search sites.** Job search sites like [Indeed.com](#) and [Careerbuilder.com](#) have a huge and rich set of data on job openings around the country and the world. With the right algorithms and organization, this data could have immense value in informing career-changers about what it means to be in a particular career. However, these companies' business models are built around matching people with specific roles at specific companies. As such, they are not incentivized to provide career-level tools that do not tie back to specific job postings.

Given this background, our team saw an opportunity for a product that integrates and processes existing data in new ways to:

- help people explore comprehensive information on what it means to be in a particular career so that they can evaluate how it fits with their goals and values
- help people find new opportunities that take advantage of their existing skills and experience
- suggest next steps for people to make their career change happen

## Solution

Our solution is called Pivot. It is a web application that fuses data mined from internet job postings with data from government sources to provide comprehensive summaries of hundreds of different careers that are in-demand right now in the San Francisco Bay Area.

With Pivot, users can:

- Search for careers by skill, job title, or industry
- View career profiles containing information on typical work activities, commonly used skills, unique characteristics of the work environment, educational requirements, average salaries, and related careers
- Compare two different careers side-by-side to quickly understand commonalities and distinctions

- Get recommendations on next steps to transition to a particular career, such as resume keywords, job titles to search for on online job sites, networking events to attend, and free online courses to take

Pivot distinguishes itself from existing online career service resources in three key ways:

1. **Data.** Pivot is the first product to merge data from current, local job posts with underutilized government data sets. By standardizing these disparate data sets, Pivot's career profiles provide insight into what employers want and what you'd be doing in a new career right now, while also providing access to government data that informs on hard-to-measure career aspects
2. **Design.** The design for Pivot is intentional and curated in order to meet the pain-points that career changers currently experience. For example, Pivot is the only place where you can view a side-by-side comparison of careers that is designed to highlight similarities and differences.
3. **Action.** Pivot bridges the gap between career exploration and making a career change happen by offering concrete suggestions and links for next steps, such as words to use on your resume, job titles to search for on online job sites, online classes to explore, and Meetups to attend for networking and skill-building.

For our Master's Final Project, we developed a functional proof-of-concept of Pivot that is deployed at <http://pivot.meteor.com>.

## Process

The remainder of this report is structured to describe each step of our project process, from ideation to implementation. The **Needs Assessment** section describes our research goals, methods, and findings. The **Iterative Design Process** section walks through the design and user testing process, from wireframing to the final design. The **Data** section describes Pivot's data sources and the process and algorithms for extracting and organizing the information that powers the application. The **Implementation** section presents the technical architecture of the application and explains how the core functionality was built. Finally, the **Conclusions** section synthesizes the links between this project and our I School coursework and discusses next steps for Pivot.

## **2. Needs Assessment**

### **Research Goals**

We conducted generative research in order to assess the needs and motivations of people who want to change careers. We used three methods — interviews, surveys, and participant observation — to gather stories of first-hand experiences with career change.

Our primary needs assessment goals were as follows:

1. Identify our target users.
2. Describe users' understanding of the career change process.
3. Understand user needs, motivations, and attitudes regarding career change.

### **Methods**

#### **Interviews**

We conducted a total of five unstructured interviews, each lasting 45 to 60 minutes. Three of the participants were actively changing careers. One participant works in the career advising space and completed a career change several years ago. The remaining participant encounters career changers in her work managing professional development programs for a large organization.

The interview participants were recruited based on personal and social network connections. One critique of this recruitment approach is that it may cause an in-network selection bias<sup>2</sup>. However, our goal was not to interview a representative sample of career changers, but to gather several cases of people experiencing career change or working with career changers. Each case provides a different lense through which to view and understand career change.

#### **Surveys**

##### **Overview**

We developed and distributed two surveys, one in November and the other in February, to solicit additional career change stories and experiences. The core of each survey was a set of long-response questions based on the following research questions:

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<sup>2</sup> Small, M.L. 2009. "How Many Cases Do I need? On Science and the Logic of Case Selection in Field-Based Research" *Ethnography*. 10(5): 6-38

1. What motivates people to change careers?
2. What challenges are people encountering in the career change process?

Together, we received 40 responses to the surveys. Responses to the open-ended questions were rich and varied, providing insights into career changers' motivations, values, pain points, and behaviors.

### **Defining Career Change**

We intentionally did not explain the term “career change” in the distribution of the surveys or in the survey content because we did not want to assume that other career changers shared our definition. The second survey included a question about defining the term “career change” in order to draw out any shared understandings among respondents. We were surprised to find that the survey responses coalesced around two main ideas:

1. Career change is a change in industry or job role.
2. Career change requires a new skillset.

While advancing in one's career might entail both a new role and skillset (e.g., being promoted to management), survey respondents did not seem to consider career advancement to be a “career change.”

### **Survey Respondents**

Each survey included several short-response questions to gather characteristics of the survey respondents such as career change status and years of work experience before considering a career change. Both surveys were distributed to an I School mailing list and Facebook group, whose members are current students, alumni, faculty, staff and other affiliates of the School of Information. Our team also sent the survey to people in our personal social networks.

Based on the survey distribution list and the responses to some of the short-response questions, we believe the majority of respondents were students and alumni of the I School. Of the 40 survey respondents:

- 27 self-identified as students currently enrolled in a degree program
- 31 responded that they have attained or are working towards a master's degree
- 18 reported to be actively seeking a career change
- 22 reported to have changed careers in the past

While all of the survey respondents had experience with making a career change, none were in the early stage of just considering a career change. In addition, all but 2 of the respondents started considering a career change when they had less than 10 years of work experience.

Survey Question: *How many years of work experience did you have when you started considering a career change?*

Years of Experience	Number of Respondents
0 - 2 years	14
3 - 5 years	11
6 - 10 years	13
11 - 20 years	1
More than 20 years	1

Together with the enthusiastic answers to the long-response questions, we interpreted these responses as confirming the need for career change support among “early-stage” career changers. Before deciding that we would only focus on serving these types of career changers, we decided to talk to more career changers in the mid to late stages of their careers.

## Participant Observation

We participated in a workshop called “Resume Makeovers for Career Transitioning”. More than a dozen Berkeley community members attended the event, which was a round-table session during which we received personal resume advice and tips for situations such as returning to the workforce, switching industries, and transitioning from part-time to full-time work. Attendees covered a wide age-range (30s to 70s), and many shared career change experiences and challenges that differed greatly from those of our interview and survey respondents. For example, some attendees were returning to the workforce after more than a decade of retirement or child-rearing. Others struggled with finding permanent work after a period of unemployment or a string of part-time jobs. More than one mentioned feeling like age discrimination or the decades of varied experience on their resumes made it harder to convince hiring managers that they could be valuable employees.

This foray into participant observation opened our eyes to the fact that people change careers at every age and for many different reasons. The challenges of the mid- and late-stage career changers we met at the workshop differed from our survey respondents in that they faced barriers beyond their control such as attitudes about age, unemployment, and employment gaps. In contrast, the early-stage career changers emphasized the struggle to find meaningful work they enjoy in an organization that provided opportunities for

advancement. After reviewing these differences between career changers, we decided to focus on serving early-stage career changers.

## Findings

### User Profile

This preliminary research helped us identify the following key characteristics, motivations, and pain points of our users:

#### **Target users are considering career change early in their careers**

Our target users are college-educated Millennials with ten or fewer years of work experience. They are thinking about switching careers because they are dissatisfied with something in their current work situations.

#### **Career changers want to do meaningful work**

Many career changers are seeking work that gives them a sense of fulfillment. They often describe this pursuit as looking for careers that are interesting, meaningful, and impactful. However, many express uncertainty about what kinds of work would satisfy these criteria.

#### **Career changers are seeking opportunities for advancement**

Some career changers look for other kinds of jobs because they hit a roadblock in terms of opportunity for growth and advancement.

#### **Career changers want more security and comfort in their new careers**

Other career changers are seeking the kind of security and comfort afforded by things such as better pay and a supportive work environment.

#### **Social networks constrain the career options known to our target users**

Career changers are often only exposed to the careers of people in their immediate social networks. They would have a better understanding of their options if they could discover careers from outside their social networks, and then meet people in those other careers.

#### **Career changers want to rebrand their past experience**

Career changers struggle with re-branding themselves when they first apply to jobs on their new career path. They need help with identifying transferable skills, translating past experience into relevant qualifications, and revising resume and cover letters to get noticed by recruiters and hiring managers.

#### **Career changers want to focus on developing the most valuable new skills**

Career changers are willing to put a lot of effort into learning new skills for their ideal career. However, they need help with figuring out which skills are worth developing. Because skill

development demands ample time and energy, career changers need help identifying the areas where they should apply their effort.

## Personas

We consolidated our user profile into two primary personas to reference throughout the design process.

### **Henry** wants to explore career options to find a better fit

Henry has been in the workforce for a year and a half. He works as a business analyst for a consulting company, but he doesn't enjoy his work. He's turned off by the tedious assignments and stressful atmosphere. He wants to do interesting work in a more positive and energized work environment, but doesn't know what kind of career would be a better fit for him. Henry's immediate goals are to learn about other career options and confirm his interest in another career.

### **Erin** wants to figure out the next steps for switching careers

Erin has nine years of work experience as a graphic designer for various design and advertising agencies. She's feeling overworked and burned-out with the high-pressure environment at her current job. She's also frustrated with her pay and work hours, and thinks she might want to switch to a design role in the tech industry. Her goals are to learn about design careers in the tech industry, identify the skills she can transfer, and figure out what new skills she needs to learn.

More details on the personas are provided in [Appendix B](#).

## Use Cases

To conclude our preliminary research and kick-off the design phase of our project, we defined five key challenge areas for our target users. We then identified possible solutions which could be incorporated into Pivot's features.

Challenges	Solutions
Discovering your career options	Suggest other careers based on your experience, skills, and interests
Deciding which career path to pursue	Easily compare different career paths
Finding out what skills or experience are	List skills and experience you need to

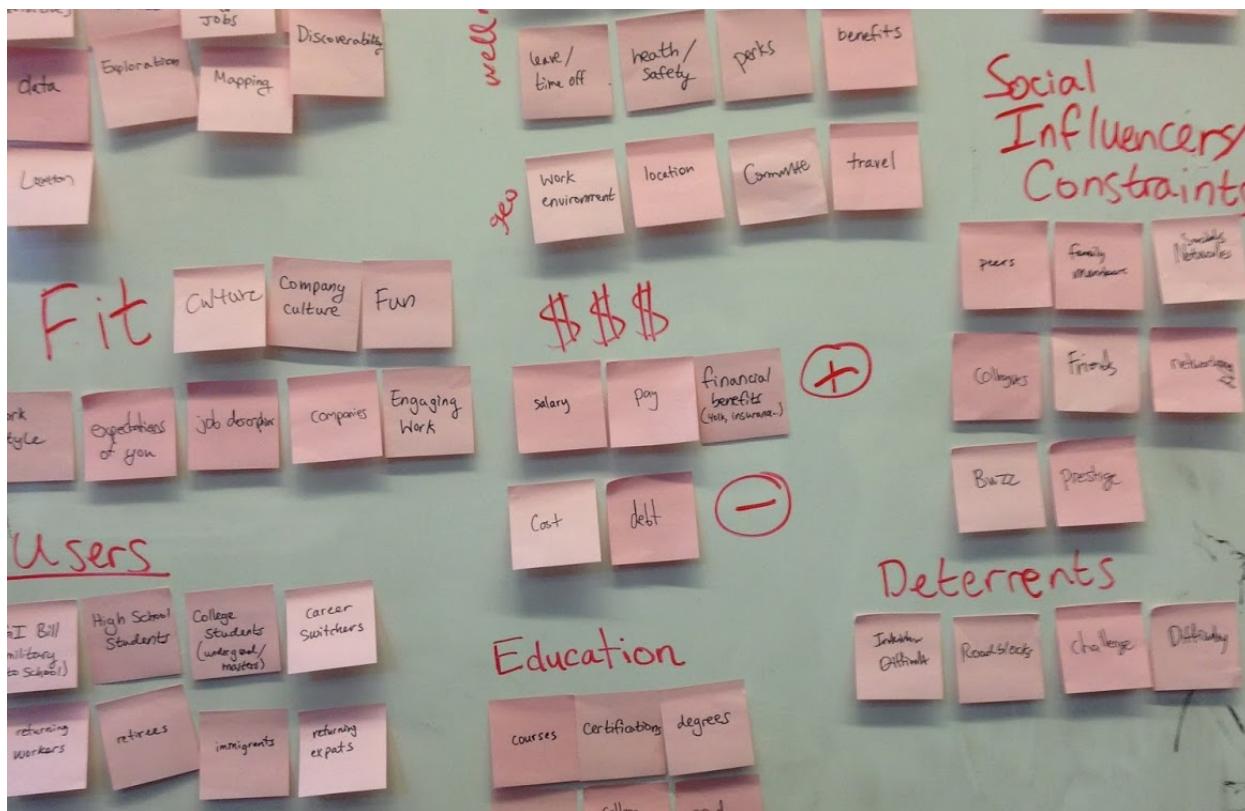
needed in new career path	develop in order to prepare for new career
Rebranding your past experience to be considered for first job in new career	Show the key words and verbs to use when describing your past experience
Building the required skills and experience	Suggest ways to build skills and experience

### 3. Iterative Design Process

#### Ideation

We began the design process by building an affinity diagram of influences on career decisions. The diagram explored potential values, constraints, and relationships that we might explore further during the preliminary research phase. The affinity diagramming process helped our team to develop a shared understanding of the career landscape.

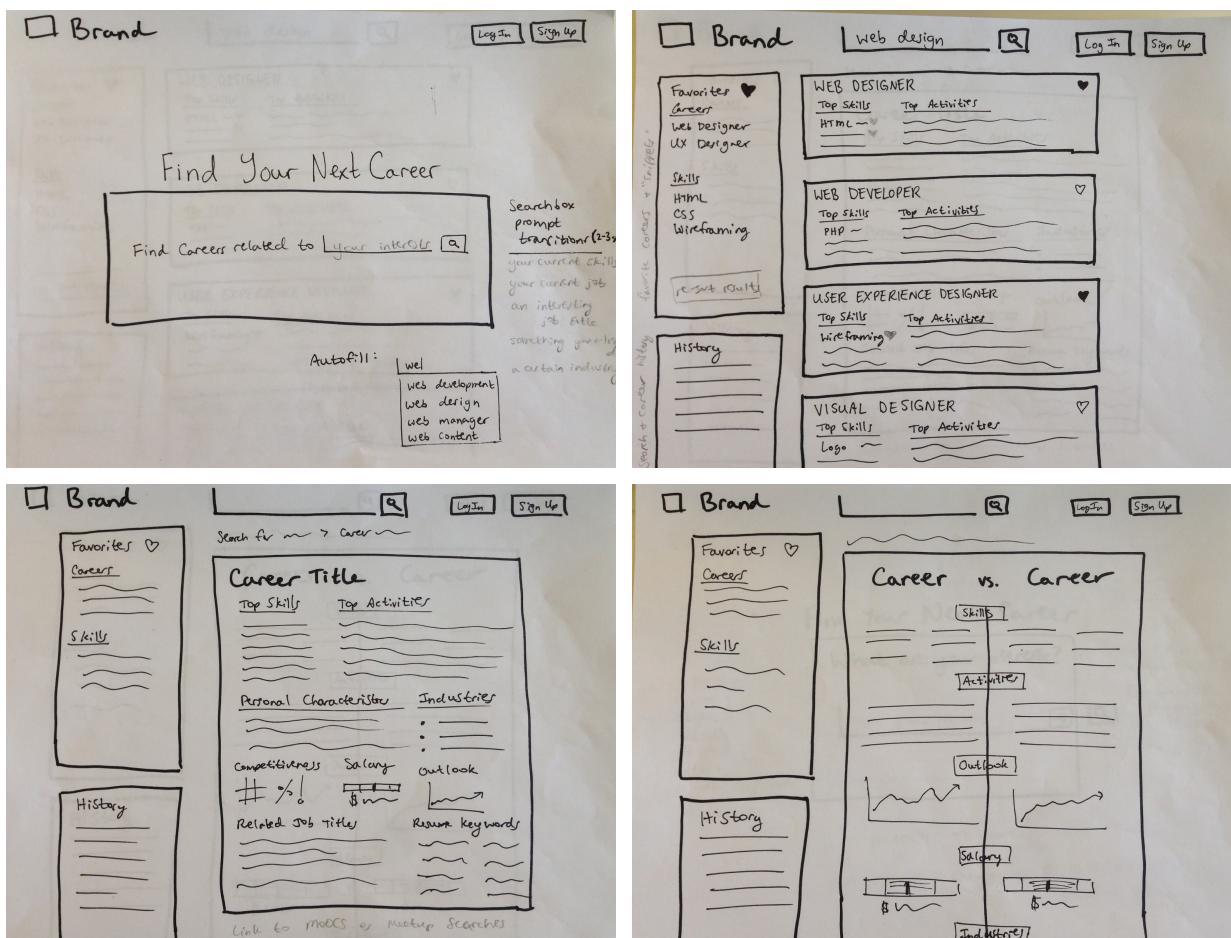
#### Affinity Diagram



# Wireframing

Once we identified the core types of data we would aggregate for this project, we began sketching user interface ideas for the web application. Early sketches included ideas for the home screen, career search results page, career view page, and career comparison page. Sharing these sketches with our team and members of the I School community helped to bring up deeper questions of user experience and functionality. For example, the way we directed users to search the career data on the home screen needed to reflect how we would query the database so that search results matched user expectations and appeared relevant.

## Early sketches of home screen, search results, career profile, and career comparison view



We continued to develop these user interface concepts in low-fidelity “blocking” wireframes. The purpose of these early wireframes was to focus on the basic visual composition and information hierarchy without the distraction of typography and color. We explored the idea of organizing the interface into a main card-like component with a left-hand sidebar. Ultimately, we incorporated this structure into Pivot’s final design. More detail about the wireframing process can be found in [Appendix D](#).

## Low-fidelity “blocking” wireframes of the search results and career profile views

**Search Results - Desktop**

Search Box  
- original search term

Highlight / Refine  
- highlighted attributes  
- button to re-sort results

Search Results  
- career title  
- industry tags  
- top skills  
- work activities

History  
- past searches  
- career profiles viewed  
- past career comparisons

**Career Profile - Desktop**

Career Title

Highlight / Refine  
- highlighted attributes  
- button to re-sort results

Career Profile  
- top skills  
- education  
- industry tags  
- work activities  
- work environment

History  
- past searches  
- career profiles viewed  
- past career comparisons

Next Steps  
- related job titles  
- resume keywords  
- MOOC search  
- Meetup Search

# Participatory Design

At this stage, we decided to engage career changers in the development of Pivot by conducting participatory design sessions. We hoped to incorporate insights from these research sessions into our first interactive prototype. In addition, we wanted to validate the accuracy of our understanding of career changers' needs.

We conducted three one-hour participatory design sessions during which participants were provided with laminated wireframes, laminated cutouts of interface components, and erasable pens in different colors. After being primed to adopt the familiar mindset of a career changer, participants were asked to complete three tasks:

1. Define their search criteria on the home page wireframe
2. Design a career profile page using the provided components and creating new ones
3. Rank the relevance of page elements for different scenarios

The participatory design exercise helped us spot key insights before developing our first interactive prototype.

## **The home page must do more to guide users in forming queries**

All of the participants struggled to define their search criteria because the wireframe did not provide sufficient guidance for forming a query. In addition to clearly describing the kinds of things the user can search for, the home page must provide alternative entry points for those users who don't have a query in mind. For example, the user could click on links that jump directly to popular careers or search keywords. Incorporating an autocomplete feature into the search box could also help users form their query as they start typing.

## **There is ambiguity in the way people talk about careers and jobs**

The design sessions also uncovered some ambiguity about the distinction between "jobs" and "careers". In part because of the way we collected and discussed our data, our team has primarily used the word "job" to refer to an individual job posting, and the word "career" when talking about a higher-level category of jobs. We use these words the same way in the design of Pivot. Despite our efforts to clarify Pivot's use of these words, users in the participatory design sessions and subsequent usability tests continued to bring up questions about the difference between "careers" and "jobs". Further research is needed to develop a vocabulary that we can share with users when discussing Pivot's data.

## **Participants placed highest value on skill and salary data**

Overall, the three research participants prioritized skills and salary data over other kinds of data. Activities and a career description followed closely behind. Interestingly, two of the participants wanted to read stories of real people and projects in the career profile. While we

didn't have access to that kind of data for this version of the project, we believe that including such personal perspective would resonate with users.

More details on the participatory design process are provided in [Appendix C](#).

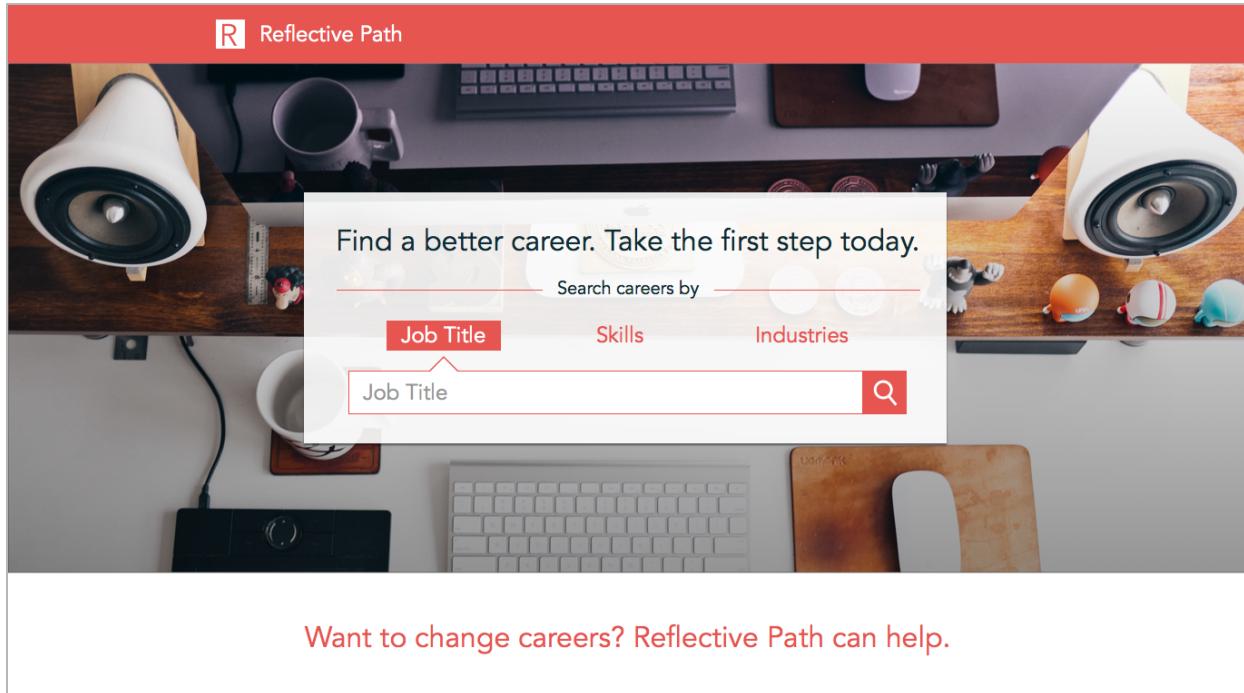
## Interactive Prototype

After completing the participatory design sessions, we used [InVision](#) to connect 25 static screen mockups into an interactive prototype. The prototype included three main pages:

- Home
- Search Results
- Career Profile

We designed a protocol to test 2-3 interactions per page. Since we didn't have time to include a Career Comparison page in the prototype, we planned to ask users about their expectations for such a page.

**Home screen of InVision prototype. “Reflective Path” was the project’s working title.**



In earlier sketches and mockups, we included “Log In” and “Sign Up” buttons because we planned to provide personalization features that would require user accounts. Starting in this version of Pivot, we decided to encourage users to dive in and explore Pivot’s data without making them create an account and provide a lot of information. At this stage of the project, we committed to the idea of making the data easy to access and understand.

More information about the prototype is provided in [Appendix E](#).

## Usability Testing

### Usability Testing of InVision Prototype

We conducted usability tests of the InVision prototype with 6 participants recruited from our networks and the School of Information. Screen and audio recordings were captured for each of the 20-30 minute tests. The tests revealed several insights detailed below.

#### **Many participants first assumed the website would help them search job postings**

The home page messaging and style seemed to imply that the website was a search engine for job postings. Participants did not expect to see career profiles in the search results. The home page and search results need to emphasize that Pivot's value proposition is to offer aggregated career profiles.

#### **Some participants did not discover the content below the fold on the home page**

After the participatory design, we added shortcut links and a product description to the home page to provide more guidance to the users. However, this additional content was hidden below the fold on the home page and many test participants did not discover it.

#### **The “Smart Sort” feature is unfamiliar to users**

This prototype included a “Smart Sort” feature in the sidebar which was meant to help users indicate their preferences and personalize their search results. Most users missed this feature until we asked them to use it.

#### **Career profiles need to convey the relative importance of different skills**

Participants liked seeing the larger list of skills on the career profile, but they wanted to know which skills were more important than others. Using bar charts to represent the relative frequency of each skill for each career may help communicate this information.

#### **Participants wanted to click on skills to reveal additional information**

Participants stated that they wanted to click on skills to access additional information such as a description of the skill or ways to develop the skill.

### Usability Testing of Developed Application

We incorporated the insights from the InVision prototype usability tests into the design and development of the working Pivot application. Once the core features were working, we conducted a final set of six usability tests. We referenced the earlier usability test protocol when conducting these tests with the addition of one task — asking users to try the compare

functionality. The usability test findings and recommendations helped us refine Pivot's features and identify possible next steps for the project.

#### **The successful Venn diagram-like skills section could be used in additional places**

Participants were enthusiastic about the Venn diagram-like format for skills on the compare page. This kind of presentation could be used for tags and work environment.

#### **Users were confused by the word “industries” to describe tags**

Some users were confused by the label “industries” to describe the tag elements because the tag names did not always match their conception of “industry”. Instead, a more general work like “categories” might be clearer.

#### **Users wanted the skills and industries link to provide more information**

Participants repeatedly clicked on skills and industry tags with the expectation that the links would show them more information about what they had clicked on. When the links instead ran a query for careers containing that term, they expressed surprise and disappointment. Users would rather see a definition or description of the term.

#### **Users didn't seem to need or want the personalize feature**

Almost all of the users did not notice the personalize feature without being directed to it. No one was enthusiastic about the feature and how it might work. Based on these responses, we decided not to build this feature.

Usability testing scripts are provided in [Appendix F](#).

## **Final Design**

The results of the final round of usability testing were incorporated into the final design and implementation of Pivot. See [Appendix A](#) for the walk-through of the final design.

## 4. Data

### Overview

Our user research provided insight into the most important pieces of data that a career changer is interested in. From this, we decided to focus our data pipeline on obtaining and organizing the following pieces of information for each career: **top skills**; **sample work activities** (tasks that you would perform in the career); **work context** (information about working conditions and schedule); **sample job titles**; **education requirements**; **salary**; **industries**; **resume words**; and **related careers**.

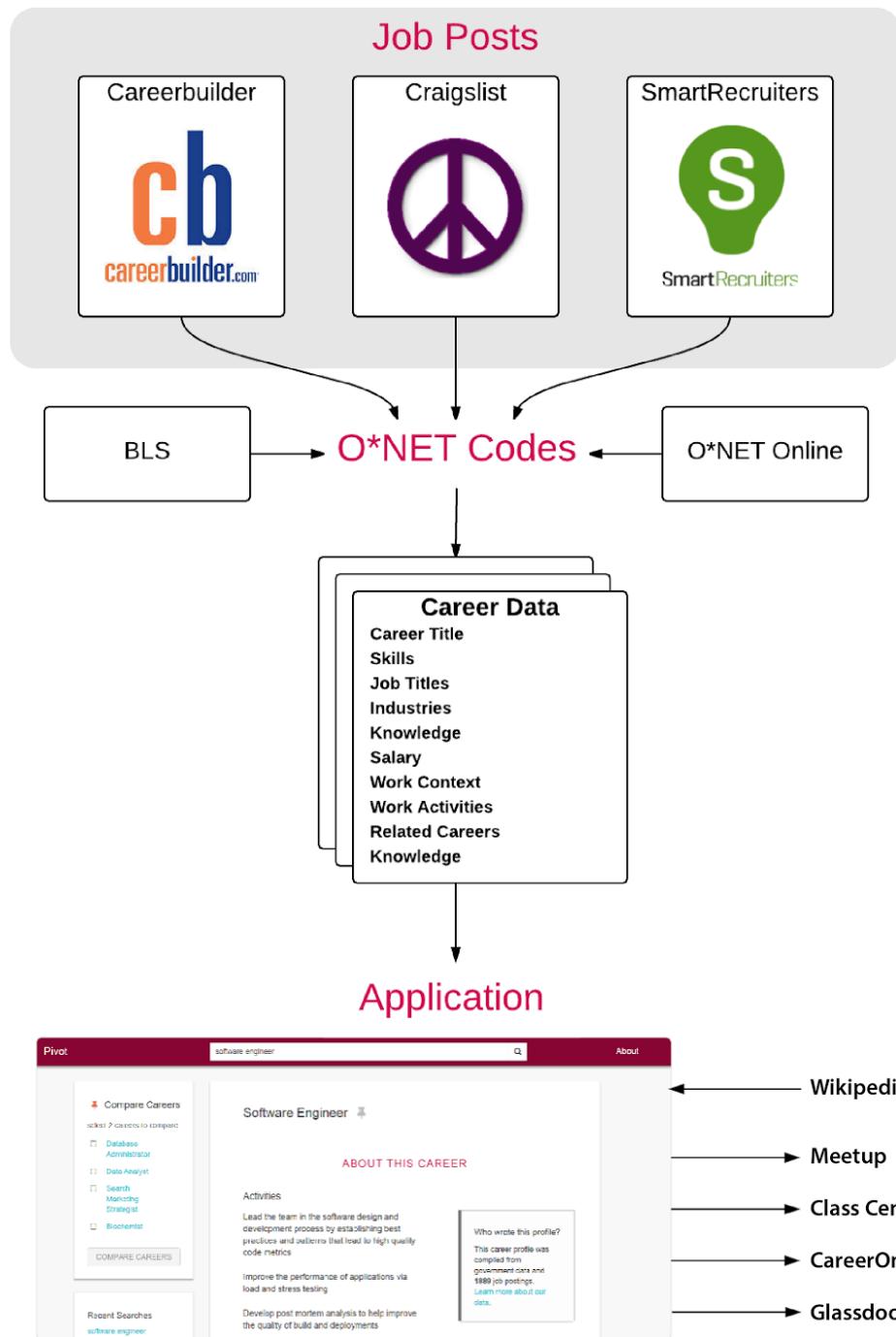
Our overall data strategy was:

1. Collect text and metadata on local, current job postings, and extract information using Natural Language Processing techniques
2. Standardize the data collected from different job posting providers, generating a controlled vocabulary of job titles, skills, and industries
3. Aggregate the *job-level* data obtained from postings to the *career-level* by mapping posting job titles to an O\*NET career title and code
4. Merge the job post data set with the government data sets to produce a broad set of information for each career

A diagram of this data architecture is shown on the following page.

The goals of our data process, particularly with respect to the job postings were to:

- collect a sufficient quantity of job posting data to generate reliable results at the career level
- collect a good representation of different types of jobs that reasonably reflect current career openings in the San Francisco Bay Area
- use automated approaches wherever possible, but use manual review to curate content shown to Pivot users



# Data Sources

We collected data from three sources of online job postings (Careerbuilder.com, SmartRecruiters, and Craigslist) and two government data sources (O\*NET and the Bureau of Labor Statistics).

For the job postings data collection, our preference was to obtain data from APIs rather than through web scraping, in order to receive information in a structured format. While most job search sites have APIs so that other websites can link to their job postings, very few provide the full text of a posting in the API. Ultimately, we found two APIs to support our job posting needs and additionally scraped data from Craigslist to achieve more diversity in our job post data types (SmartRecruiters and Careerbuilder jobs were largely from the Technology, Health Care, and Sales sectors).

Each source is briefly described below.

## Careerbuilder.com

Careerbuilder.com is a job search website. At any given time, it lists over 10,000 open full-time positions in the San Francisco Bay Area. It has a publicly available, free API that can be used to return job search results within a geographic area and return full posting text and metadata for a specific job ID. The API limits each API key to no more than 500 specific job calls per day. We developed automated scripts to run three daily job calls- one for each project team members' API key, ultimately collecting around 30,000 jobs with unique identifiers. Around 30% of these jobs were collected in November 2014, with the remainder collected in February 2015.

Careerbuilder was a very important source of data for this project. It was the only data set that contained structured information on the job posting title and job skills. For many of the jobs, it also included a code for the parent O\*NET career. This greatly aided our process of linking jobs and job titles with parent O\*NET categories.

## SmartRecruiters

SmartRecruiters is a recruiting software product and company. Through an I School classmate, we were able to reach out and get access to their API for jobs within California. We collected all of the California jobs and subset them to cities within the San Francisco Bay Area, ultimately collecting around 9,000 jobs. While we do not know the exact posting dates of these jobs, we were informed that they were all open within the past few years.

The API contained raw job posting text and an industry. It did not contain standardized information on the job title or job skills.

## Craigslist

We scraped Craigslist for job postings within the San Francisco Bay Area, ultimately obtaining around 15,000 postings. While this information was mostly unstructured (the industry was available in a tag), it was beneficial to collect because it brought more diversity to the set of jobs available for analysis, which up until that point had been dominated by sales and technology jobs. All Craigslist data was collected in February 2015.

## O\*NET

O\*NET is funded by the US Federal Government and consists of data collected for 974 different occupations. The data is collected by surveying workers in that occupation. We downloaded the most recent release of O\*NET data text files (O\*NET database version 19), each of which contains a particular type of data (for example, educational requirements) for each career. O\*NET careers are identified by a name (e.g., Computer System Analysts) and a code (e.g., 15-1121.00).

## Bureau of Labor Statistics (BLS)

Bureau of Labor Statistics data was used to obtain career salaries. The BLS data was last updated in May 2014, and contains career-level employment numbers and salary statistics broken down by county.

## Data Processing

We performed extensive data preprocessing on the job postings data. The first task was to extract content from the HTML job descriptions, which was done using Python's *Beautiful Soup* library. The biggest preprocessing effort was in data deduplication. Within each of the three job posting sources, jobs were deduplicated using the unique ID (for SmartRecruiters and Careerbuilder, this unique ID was assigned by the API, while for Craigslist, it was taken as the posting URL). However, we noticed that there were still a number of very similar job descriptions posted for the same role either on the same site or cross-posted on one of the other two sites. Since we did not want results for a particular career to be dominated by repeated postings of the same position, we wanted to get rid of multiple versions of very similar postings. To programmatically identify and remove similar posts from our dataset of 35,000 job postings, we calculated the cosine similarity between each pair of job postings, and removed duplicates that exceeded a similarity threshold that we determined to be appropriate. The features in the cosine similarity calculation were the words from the job posts, normalized using term frequency-inverse document frequency (TF-IDF) weighting to

more heavily weight distinguishing words. This was done using Python's *scikit-learn* and *scipy* packages.

The deduplication process left us with a dataset of approximately 22,000 unique job postings.

## Information Extraction and Standardization

This section details the information extraction and standardization process for all of the different pieces of information displayed for careers in Pivot.

### Job Titles

Job titles were a critical data requirement, as we needed to know the title of a posting in order to map it onto a career and use it in our dataset. Of the three posting datasets, only Careerbuilder directly provided job titles for its posts. Since the same role can have different names across companies and seniority levels, there was much diversity among job title names: out of 10,025 careerbuilder jobs, only 700 job titles were seen more than once.

The two main job title tasks were to extract them from the SmartRecruiters and Craigslist data and to map job titles to career titles for linking with the government career data sets.

#### Job Title Extraction

To extract job titles from the SmartRecruiters and Craigslist posts, we searched the posting text to find matches with one or more titles from the set of CareerBuilder and O\*NET job titles. In cases where there were no matches, we discarded the posting, though future work could investigate using text classification to assign a job title or career title to job posting text. In many cases, there were multiple titles matches for a post. To select a single title, we favored matches found in the name of the posting, as opposed to in the body of the posting, where descriptions often talk about interactions with other positions ("as a software engineer, you will interact with product managers, designers, etc"). If there were multiple title matches, we picked the one that was most common for the corresponding industry.

#### Job Titles to Career Titles

Pivot is a career-focused project, so we had to map the data from each individual job posting to its corresponding parent career. Where possible, we wanted to map postings and job titles to O\*NET codes and career titles, as this would allow us to link the posting data with the government career data. Because the Careerbuilder data included an O\*NET code for most of its posts, and because we extracted titles from the SmartRecruiter and Craigslist data sets using the Careerbuilder titles, we initially thought that we would have all of the

associations that we needed for a one-to-one mapping between a job title and a career title. However, we encountered the following issues during the standardization process:

**Job titles that map to multiple O\*NET career titles.** We had assumed that the a single job title seen in multiple postings in the Careerbuilder data would always map to the same O\*NET code. Unfortunately, this was not always the case. In some instances, the job titles mapped to multiple O\*NET careers that were very similar to one another; in these cases, we assigned that job title to the O\*NET career that it was most frequently matched with in Careerbuilder. In other cases, there was more ambiguity as to which career a particular job title should apply to. An example case was the job title ‘Driver’, which was extracted from a number of the Craigslist ads. Driver can reasonably map to over 10 O\*NET careers, such as taxi driver, heavy truck driver, and delivery driver. We also found that the driver job title was extracted for jobs like Home Health Aides, where driving is a key requirement of the job but not the main function. Another example case was ‘Project Manager’. While the title is less ambiguous than driver, the ‘project manager’ title could reasonably map to multiple O\*NET careers, including Information Technology Project Manager, Construction Manager, and Engineering Manager. For job titles that exhibited these ambiguities, we did a deeper dive into the job posting text to find features to disambiguate between the possible O\*NET careers (for example, ‘project manager’ jobs that mentioned construction-related terms got assigned to the ‘Construction Manager’ O\*NET career).

**Job titles that do not have a corresponding career in O\*NET.** In evaluating the title results, we found a number of examples where current Bay Area job titles had no good mapping to existing O\*NET careers. Many of these instances were for newer careers in high-technology, such as data scientist, product manager, and user experience researcher. We decided to make non-O\*NET career titles for these positions, but this meant that we would not be able to display government data for these careers. This finding illustrates the value of using job posting data to understand career trends, as government data sets quickly become out of date

**Outdated O\*NET codes and titles.** We found that Careerbuilder had been using an outdated O\*NET taxonomy for its mapping, so we had to manually make changes for some careers to properly line them up with the government career data.

In the end of the job title process, we mapped close to 1,000 unique job titles to one of more than 200 career titles. A subset of the final table mapping job posting titles to O\*NET codes and titles to ‘standardized titles’ (the titles we gave to Pivot careers to make them meaningful to users) is shown in [Appendix H](#).

## Skills

Skills are an important aspect of the career-change process, and we wanted them to be a highlight of Pivot. Our process for extracting skills from the job postings was similar to that of extracting titles. Careerbuilder has a skills field in the API, and around half of our Careerbuilder postings explicitly listed skills. To this, we added additional skills obtained in spreadsheet form from O\*NET's [tools and technologies database](#). In total, we had a set of 9,500 unique skills to search for in the job posting data. After the first extraction, we noticed some strange results among our most in-demand skills. Facebook was a top skill result and, while a legitimate tool for a social media consultant, was near the top of our list because of employers listing their facebook page on the posting. Similarly, fax was a top skill due to companies asking candidates to fax their resumes. The skill results were manually reviewed with questionable skills and skill counts removed. We also combined skills that were the same thing with different names (e.g., Microsoft Office, Office Suite, Microsoft Office Suite) into one standardized title (e.g., Microsoft Office).

In the end, we extracted 1,600 unique skills from the job postings. The skills were a major piece of the Pivot search functionality, and were also used in the algorithm for determining related careers.

## Industries

We were able to directly collect industry/category information from each of our three job posting sources. As such, the main work for this data piece was to standardize the industry categories across the three sources. Careerbuilder had 53 unique job categories, Smart Recruiter had 72 unique industries, and Craigslist had 31 unique job tags. To standardize these datasets, we created a crosswalk mapping each of the individual categories/industries/tags to a set of 38 job categories that we were used for search and display in Pivot. A sample of this crosswalk is shown in [Appendix I](#).

## Work Activities

### Extraction

We wanted to extract work activity data from the job postings text, using natural language processing techniques. One common way that work activities are denoted in job descriptions is through sentences that begin with a verb (e.g., "Create mock-ups of new productions"). These activities are often in bulleted lists following the word "Responsibilities". We developed the following automated process, implemented using Python's NLTK package, to extract these activity phrases from each job posting:

1. Tokenize the text into sentences and individual words

2. Train a bigram-based part-of-speech tagger on the Brown Corpus, a computational linguistics training set provided in Python’s NLTK package
3. Apply the part-of-speech tagger to each job description
4. Extract various phrases that have part-of-speech patterns indicative of work activities (for example, starting verb followed by a comma, followed by a verb, followed by a conjunction followed by a verb followed by a noun to capture phrases like ‘designs, programs, and tests software)

Our initial results showed that the trained part-of-speech tagger failed to correctly tag the first word of work activities as verbs, probably because sentences beginning with verbs are infrequent in the Brown Corpus training set. These verbs were instead being tagged as nouns, and thus were not being extracted as work activities. We developed an automated approach to address this mistagging. For each first word in a sentence that was not tagged as a verb (for example, “design”, tagged as a noun), we looked it up in [Wordnet](#), which is a “lexical database for the English language” that, among other things, lists possible “senses” and parts of speech that a word can have. If the word had more verb senses than noun senses, we retagged it as a verb, making it possible for the sentences to be extracted as a work activity. This step greatly improved the quantity and quality of extracted work activities.

### **Aggregation**

We wanted to report, for each career, a set of frequent work activities to help users understand what it would be like to be in that career. However, we found that determining “frequent” work activities from our large and diverse corpus of job data was a challenging problem. Examining frequency counts of the extracted work activities showed that very few were ever repeated verbatim in other postings. For a given career and a large set of unique extracted work activities, we had to decide what we wanted to display on our website. We were concerned that a fully automated approach would lead to low-quality activities being prominently displayed on the Pivot Career Profiles. As such we used a blended approach of automation and curation.

For each career, we clustered the work activities into ten groups, using k-means clustering with the work activity words (normalized using term frequency-inverse document frequency) as the feature set. For each of the ten clusters, we selected the five work activities closest to the cluster centroid and wrote them to a CSV file. In most cases, the clustering proved a useful way to identify similar themes in the activities (for example, one cluster was about the types of other roles that you would interact with, one cluster was about a specific technique you’d need to know, and another was about a specific company). From the subset of 50 activities for each career, we manually selected work activity sentences to showcase in Pivot, employing some light editing to improve grammar, standardize the verb tense, and remove specific company names.

## Resume Words

With the resume words feature, we wanted to give users a sense of the common vocabulary used in a career, so that they could tailor resumes accordingly. We selected resume words from the set of extracted work activities for each career. From each work activity, we extracted all of the verbs, nouns, and adjectives, using Python NLTK WordNet's morphy function to lemmatize each word (i.e., counting "design" and "designing" as the same verb). From the set of all verbs, nouns, and adjectives found in the work activities for a career, we selected the top 10 from each category to display in Pivot. After noticing that many of the verbs were too generic to be interesting or useful, we removed these "weak verbs" from the candidate set (such as "work", "assist", and "help").

## Work Context

Work context data was obtained from O\*NET. For each career, the O\*NET work context data provides a number between 1 and 5 for each of 57 categories that represents the extent to which that context applies to that career. Example work contexts include "public speaking", "exposed to radiation", "spend time sitting", and "impact of decisions on coworkers or company results". For each of the careers in Pivot, we chose to display all of the work contexts with a value greater than or equal to 4, in order of importance, breaking ties by favoring those values that have a greater distance from the mean of that context across careers. For display on the website, the values are mapped to text phrases (for example, "daily public speaking", "decisions have a very important impact on coworkers and company", "weekly meetings", etc.). Each career also has information on the schedule (regular, irregular, or seasonal; less than 40 hours a week, 40 hours a week, and more than 40 hours a week), and this is displayed in Pivot for each career.

## Education

Educational requirement data was obtained from O\*NET. The O\*NET education data provides information on the minimum educational requirements for each career. O\*NET has 12 categories of education, ranging from "Less than a High School Diploma" to "Post-Doctoral Training". For Pivot, we mapped these to 8 categories. Each category is given a percentage, which represents the percentage of survey respondents who chose that category as the minimum required education for that career.

## Knowledge

Knowledge data was obtained from O\*NET. For each career, the O\*NET knowledge data contains numbers between 1 and 5 measuring the extent to which the career uses each of

33 knowledge areas (e.g. “Food Production”, “Biology”, and “Psychology”). In Pivot, the knowledge data is used to improve the searching algorithm, but it is not displayed on the website.

## Salary

Career-level salary data was obtained from the Bureau of Labor Statistics. The BLS data was obtained in a spreadsheet containing the number of employees and average salary of each career broken down by county. We calculated Bay Area average salaries and California average salaries by taking weighted averages of the average salaries.

## Related Careers

We wanted to highlight three “related careers” on each Pivot career profile, to help users better explore careers that they might be interested in. Since we wanted a fixed number of related careers, we attempted k-nearest-neighbors clustering with a variety of different features sets primarily generated from the skills data (for example, the proportion of jobs in a career requiring a skill), and incorporating other data sets to try to improve results (such as educational requirements, industry, and knowledge). The clustering approaches performed unsatisfactorily for about half of the careers. Ultimately, a simpler approach provided much better related career recommendations. For each career, we found the top 15 skills and top 2 industries. Then, between each pair of careers, we calculated the total number of shared top skills and industries. The three careers with the most shared skills and industries were the related careers.

## 5. Implementation

### Technical Infrastructure

Pivot is a web application built in JavaScript, powered by Meteor combined with AngularJS. Meteor is a full stack JavaScript web application development framework that runs on top of Node.js and MongoDB, providing modern web functionalities such as database-to-DOM data synchronization, reusable web components, HTML5 routing, and thousands of available packages for clean integrations with external libraries and resources.

AngularJS is a front-end framework that provides a powerful templating engine by separating presentation, data, and logic components with a model-view-controller (MVC) architecture. Angular also features two-way data binding between DOM elements and business logic, which integrates cleanly with Meteor Mongo database publications and subscriptions to provide rich, reactive interactions for the user.

We used several other convenience libraries in the implementation of Pivot. Most notably, the user interface is built on top of Bootstrap 3.0, a framework that provides HTML and CSS-based templates for responsive interface layouts and common interface components such as typography, buttons, and navigation. In both our server and client-side code, we also relied heavily on LoDash, a JavaScript utility library for performant and concisely-written data manipulation.

### Database Architecture

Job-level data is processed into the NoSQL Mongo database instance on the server side of the application if the database is found to be empty. It is grouped by standardized career title and each career “document” is inserted into the Careers “collection”, which is the most important processed data resource for the application. Additional career-level data is then also incorporated, keyed on the standardized title or O\*NET ID fields. Using the publish/subscribe model, the server publishes only small subsets of this collection to any template at any given time. For example, when a user inputs a query, the server filters the data to only the subset that matches that query, identifies any computed data as needed, and sends the minimum amount of data necessary for the client to display the elements it needs access to. This architecture results in fast, reactive interactions for the user and offers flexibility in the types of data features we are able to implement.

# Application Features

## Search

The primary way for users to navigate to career profiles in Pivot is through search. Users can enter queries on either the home search page or in the navigation bar search box. In order to help users arrive at queries that are most likely to return results in our system, we include typeahead functionality, using the Angular implementation of Twitter's *typeahead.js* package. When a user starts typing, the application reactively suggests search terms from a set of 2,500 keywords, taken from the set of skills, industries, knowledge areas, job titles, and career titles in our final dataset. Instead of matching to any portion of a term in our data, we customized the typeahead behavior to display suggestions that match the start of our set of terms, showing the top 6-8 matches in alphabetical order. We found this display model to be consistent with the typeahead behavior of modern search engines, such as Google search and Glassdoor.com job search. Users are also allowed to submit queries that don't exactly match a typeahead suggestion.

Once a query is submitted, it is compared against the following text fields: **career title, job title, skills, industries, knowledge, and work activities**. A subset of careers where the user query matches our regular expression patterns for one or more of these fields is returned. From here, a relevance score is computed for each career based on the user's query. This relevance score is comprised of the sum of weighted sub-scores for matches to each of the data fields that were used to filter the set of career results. Careers where the query is in the standardized career title are given the highest weight. Job title, skill, and industry matches are normalized for each career by the number of jobs aggregated into that career profile, which results in an intuitive value representing the percentage of job postings that contained the search term for that data field. In order to avoid artificially over-ranking careers that were composed from few job postings, job-level subscores are also weighted by a proportion of the number of postings aggregated for each career to the number of job postings included in our entire dataset.

Finally, we use *localStorage*, the modern browser web storage protocol, in order to cache each user's three latest unique search queries locally in the client. The use of web storage allows Pivot to help the user return to recent results without the need to create a user account or use the browser back functionality excessively. A tradeoff for this design decision is that it does not work for users who prefer to have browser cookies disabled. In future iterations of this application, we would provide logic in our code to have alternative options for these users. For example, we could use temporary database collections or require user accounts for those who prefer not to enable cookies in their browser.

Like recent searches, the three most recently viewed unique career profiles are also displayed in the sidebar. Recently Viewed Careers are tracked and synchronized across browser tabs for each user through *localStorage* as well.

## Pinning

A career title can be “pinned” to the sidebar from the Results list, Recently Viewed Careers list, or Career Profile page. Pinning a career is akin to “starring” or “favoriting” an item to return to later, an interaction paradigm that is familiar to our users. Pins are updated reactively in all views and tracked in *localStorage*.

## Viewing full career profiles

When a user clicks on a career title, they go to the aggregate career profile view for that career. This view contains job posting data that is summarized into the following sections for each career profile:

- work activities
- skills
- industry categories
- related careers
- sample job titles
- resume keywords

If the career maps to an O\*NET career ID, the following sections are also displayed:

- education and work context data from O\*NET
- average salary values for California and the San Francisco Bay area (US Bureau of Labor Statistics, joined on O\*NET ID)

To make salary and education values easier to grasp at a glance, we show this information in bar chart form.

In addition, career profiles feature dynamically constructed links to external resources intended to allow users to easily take action toward pursuing a career change. The following actions are facilitated:

- **Search for real jobs.** We use the career title to construct a link to a query for current job openings posted to Glassdoor.com, a job search engine.
- **Connect with other people.** We use the career title to construct a link to query Meetup.com, which is a social networking portal that facilitates offline group

meetings. When the user clicks on the Meetup.com link, they are directed to the Meetup website that runs a query searching for relevant groups to join within a 50 mile radius of San Francisco. An expert interview we conducted with a career advising professional early in our project formation process highlighted the importance of interpersonal connections and support in making a successful career transition for many people. Though the core functionality of Pivot is focused on integrating disparate informational data sources into one place at a useful level of aggregation, this particular feature represents a layer of social network integration that we are interested in expanding in subsequent versions of the application.

- **Find a free online class** to build in-demand skills. We use the top skill on each career profile to construct a query that looks up related free online courses on class-central.com, an aggregator for Massively Open Online Courses (MOOCs).
- **See more detailed salary estimates** for this career in geographic areas in the United States. Geographic location, and how jobs may differ between locations, is important to many people. Though the scope of this project did not allow us to expose geographic variation for job posting data across the country, salary data (which can vary widely) was readily available through the Bureau of Labor Statistics Occupational Statistics program. For careers that are mapped to O\*NET IDs, we construct a query link that takes users to a tool where they can see salary distributions for that career in other areas, by state or zip code. The default view we route to is for California as an aggregate.

## Comparing Careers

The Compare Careers view is a core, differentiating feature of our application. It is accessed by choosing any two pinned careers from the persistent sidebar. When weighing career options, no other tools we have found allow for pairwise computed comparisons across the factors that matter most to career-changers. In this view, users can see activities, skills, categories, work context, average salary, and education values. The skills, categories, and work context data is presented in a Venn diagram-like format, with shared items in the middle and items unique to each career on either side. If both careers being compared have associated O\*NET codes, then the charts for salary and education data are merged onto one axis for easier comparison. If one of the careers does not include O\*NET data, then a gray box is displayed in place of where the data would be, with an explanation of why there is no data there.

## Wikipedia Integration

Throughout our application, skills and categories are displayed as interactive elements. During user testing, nearly all of our users expected that clicking on these elements would result in some kind of informational view that would provide a short explanation or definition

of the item they clicked on. To address this expectation, we use the Wikipedia API to query skills and industry elements. The title and introduction section from the matching Wikipedia article (if available) is passed into a modal window that appears over the current view. We chose this interaction model to show users the definitions they are seeking in context rather than routing to a new screen or external site. The modal is easy to dismiss and contains enough content to give the user a sense of what the skill or category they are wondering about represents. A handful of common skills with known routing issues in the context of our application were hard coded to route to the more appropriate article. For example, the default article for “Python” is about the snake, rather than the programming language.

## **6. Conclusions**

### **Synthesis with coursework**

There was not a single I School class that we took during our two-year Master's program that did not influence our project in some way. We would like to particularly highlight how the following classes gave us the knowledge, tools, and inspiration to make Pivot.

#### **Data Mining and Analytics**

The I School's Data Mining and Analytics class was where the idea for Pivot first took shape. In searching for an interesting data set to use for the course's final project, we found the O\*NET dataset, and began brainstorming and implementing analytics that could take better advantage of this rich dataset.

#### **Information Organization & Retrieval**

Much of the challenge of the Pivot project was standardizing and organizing information from disparate data sources. We extensively used principles taught in the I School's Information Organization and Retrieval Course, such as crosswalks and controlled vocabularies, to integrate our datasets and present them to the user in a standardized and interpretable way.

#### **Information Visualization and Presentation**

We used the visualization principles and toolsets taught in the I School's Information Visualization and Presentation course in developing designs to compare career features. We also used the Information Visualization and Presentation homework assignments and final project to perform a visual exploration of our large job and career data sets, which helped us to better understand and make use of our data.

#### **Interface Aesthetics**

The I School's Interface Aesthetics class taught us visual design principles and a vocabulary for discussing user interface ideas. The coursework provided an opportunity to iterate on Pivot's visual design and gather critical feedback.

## Natural Language Processing

Much of the information extraction that we did in this project applied techniques learned in the I School's Natural Language Processing (NLP) class. In our NLP final project, we demonstrated the potential of using NLP techniques to extract work activities and work environment information from real job postings. Our findings from this project and feedback from Professor Marti Hearst informed our data processing strategy for Pivot.

## Needs & Usability Assessment

In the I School's Needs & Usability Assessment class, we learned and applied the following concepts for Pivot user research: competitive analysis, user testing, participatory design, test protocols, qualitative analysis tools, and survey design. This class gave us an opportunity to get users involved in the design process, understand the competitive landscape more broadly, and validate our initial concepts for Pivot.

## Qualitative Research Methods

We used the qualitative research methods taught in this class to learn about the motivations and experiences of people making career changes. The Qualitative Research Methods class introduced us to participant recruitment, qualitative interview techniques, qualitative data analysis, and ethical considerations for user research.

## User-Interface Design & Development

The User-Interface Design and Development course provided an introduction and hands-on application of the ideation and iterative design process.

## Next Steps

Pivot illustrates how rich career data and good design can provide career-changers with the information and confidence they need to make a change. We consider the application to be a prototype, and have pinpointed the following improvements as good next steps.

### Acquire more job posting data

After deduplication, information extraction, and data cleaning, the careers currently in Pivot are based on an aggregation of approximately 17,000 job postings. While some career titles

(such as software engineer) have hundreds of postings, others only have a handful. We have the highest numbers of job postings for jobs in technology and sales. While this is in part a function of the current Bay Area economy, it is also likely influenced by our selection of data sources. In future iterations, it would be beneficial to partner with a wider set of online job search providers to gather a greater number and variety of job postings.

## **Use content written by current career professionals**

Our user testing showed that people enjoyed reading the current content on Pivot, but thought that the experience would be enhanced if the product featured first-hand accounts, written by professionals, about what it is like to work in that career. A related idea would be to provide access to sample resumes from professionals in the career, so that Pivot users could understand the various paths taken by career professionals and get ideas for better tailoring their resumes for a career switch.

## **Allow users to create Pivot profiles**

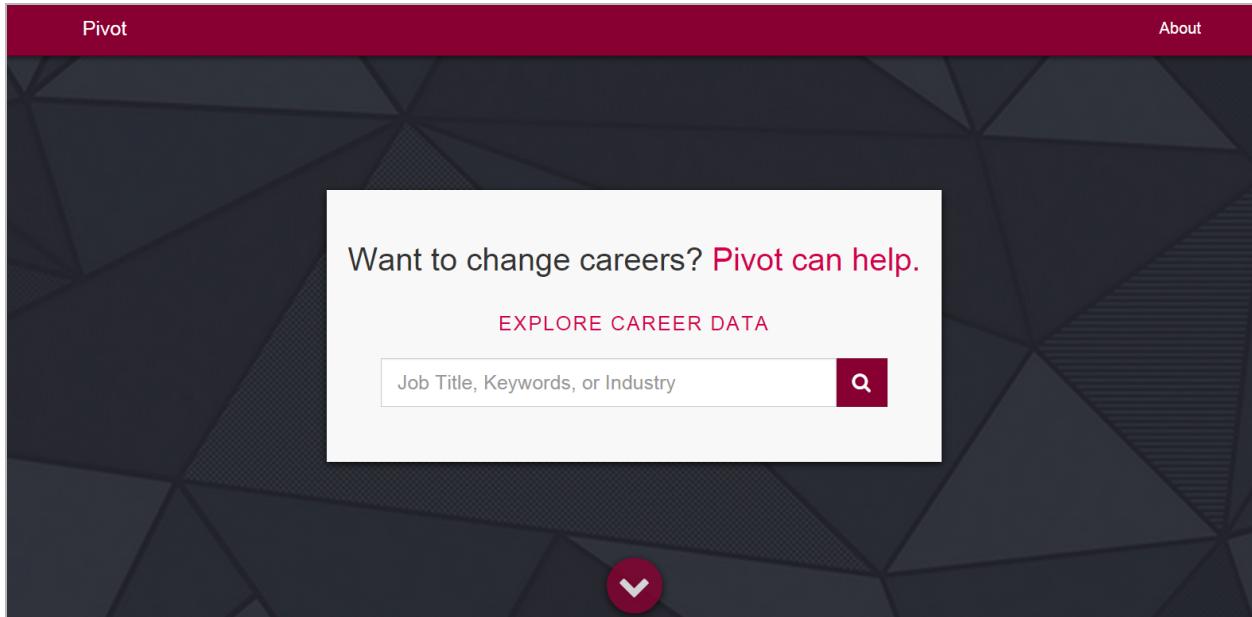
This report discussed our reasons for not implementing user profiles in Pivot. If we were to continue the project, we would like to make user profiles an optional part of the Pivot experience. In user testing, people expressed an interest in being able to save information about their current skills and work experience, and have that factor into the career recommendation process. Creating user profiles would also be a first step towards ensuring that Pivot is an application that users keep coming back to as they navigate their career change.

## **Provide a space for networking and mentorship opportunities**

Networking is a critical (and often feared) part of the career change process. In the current version of Pivot, we took a first step to meet this need by suggesting local Meetups as a way for career changes to make connections. We think that Pivot could become a place that more directly facilitates networking opportunities for career changers. One way to create a social dimension to Pivot would be to enable connections between people interested in transitioning to the same career. Another way would be to coordinate mentoring partnerships between professionals in a career and people who want to switch to that career.

## Appendix A: Pivot Walk-through

The Pivot homepage features a search box prompting users to look up job titles, keywords, or industries they might be interested in.



Scrolling to the bottom of the homepage provides information and popular search terms.

A screenshot of the Pivot homepage showing the bottom section after scrolling. The page has a light grey background. At the top, there's a red header bar with the word "Pivot" on the left and "About" on the right. Below the header are three columns of text: "Find Other Careers", "Compare Your Options", and "Take the Next Step". Each column contains a brief description. Below these columns is a section titled "Not sure what you're looking for?" followed by three tables of popular search terms. The first table, "Jump to Popular Careers", lists Accountant, Software Engineer, Sales Representative, Registered Nurse, and Product Manager. The second table, "Search Careers by Top Skills", lists marketing, programming, design, customer service, and project management. The third table, "Search Careers by Top Categories", lists Information Technology, Consulting, Health Care, Sales, and Nonprofit.

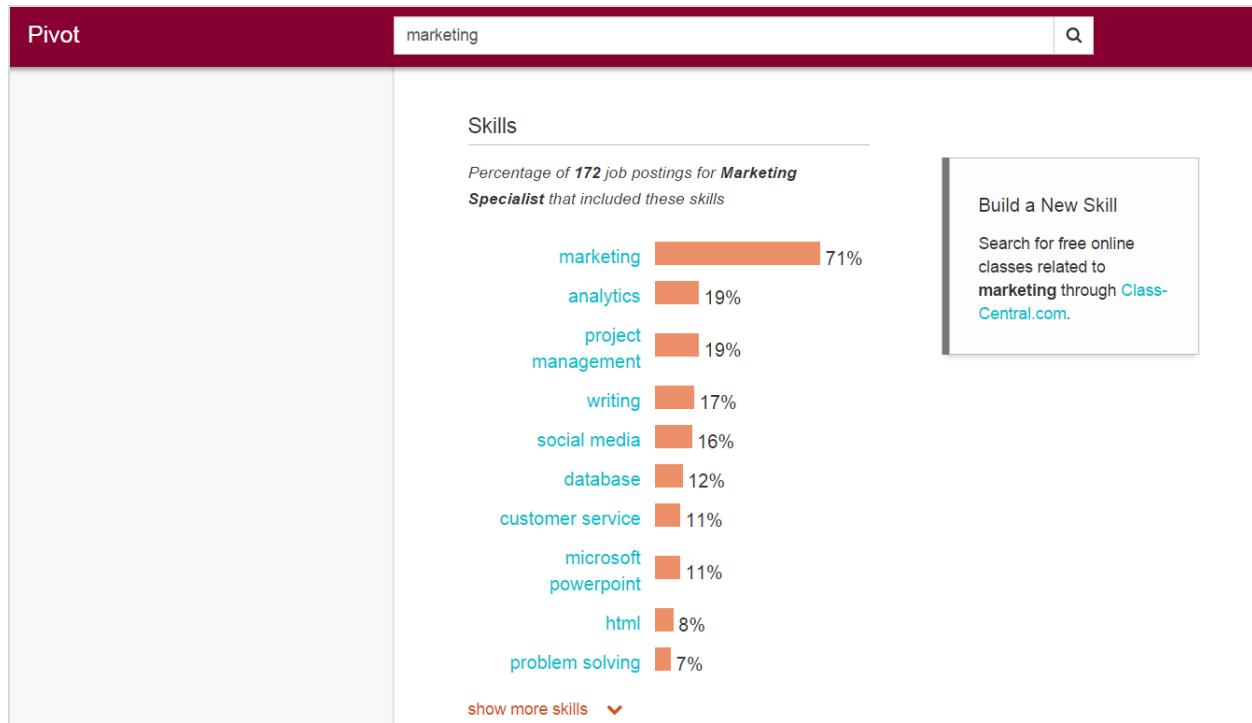
The search page (here, we've searched for "marketing") returns at-a-glance summary information for relevant careers. Users can click on a career to get more detail, click on a skill or industry to get its definition from Wikipedia, or can pin a career to enable career comparison.

This screenshot shows the Pivot search interface. At the top, there's a navigation bar with 'Pivot' on the left, a search input field containing 'marketing', a magnifying glass icon, and 'About' on the right. Below the search bar, a sidebar on the left contains sections for 'Recent Searches' (listing 'marketing') and 'Recently Viewed Careers' (listing 'Marketing Specialist'). The main content area on the right is titled 'Career profiles related to marketing' and shows 10 of 130 profiles. Each profile card includes the job title, a list of 'Top Skills' (e.g., 'marketing', 'business development', 'social media', 'analytics' for Marketing Manager), and 'Top Categories' (e.g., Marketing, Information Technology, Business/Management, Sales, Business Development). There are also cards for 'Marketing Specialist' and 'Search Marketing Strategist', each with their own skill and category lists. A 'Copy Writer' card is partially visible at the bottom.

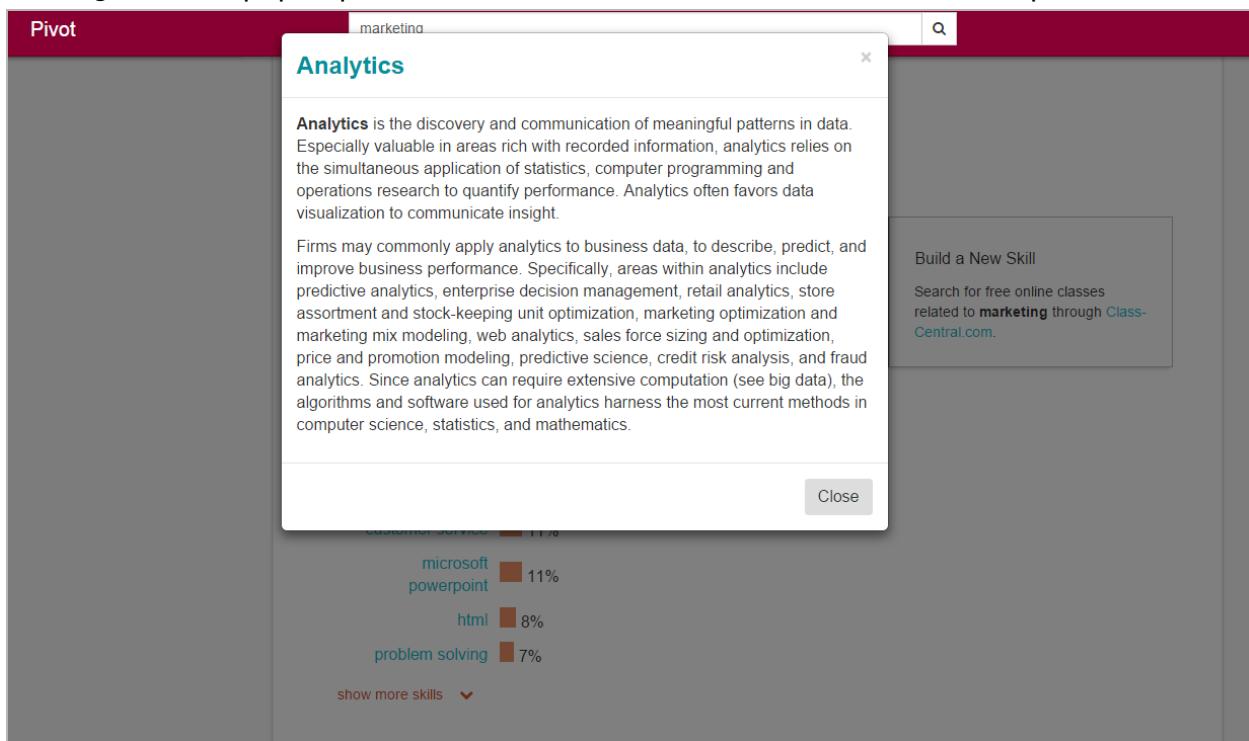
Clicking on a job title takes the user to the Career Profile page. The top part of the page features work activities, and a link to learn more about the data.

This screenshot shows the detailed career profile for 'Marketing Specialist'. The top navigation bar is identical to the search results page. The sidebar on the left remains the same. The main content area is titled 'Marketing Specialist' and includes a red pinned icon. Below the title is a section titled 'ABOUT THIS CAREER'. Under 'Activities', there are four bullet points: 'Produce and analyze daily, weekly, monthly campaign reports measuring performance and effectiveness of online partnerships', 'Measure the effectiveness of email, direct mail, and other direct marketing channels', 'Build, manage, and improve CRM-based analytics and key performance indicators that help drive trial, activation, engagement, monetization and evangelization', and 'Identify, collect, and synthesize research on market structure, market participants, and competitive performance'. A link 'show all activities ▾' is at the bottom of this list. To the right of the activities is a sidebar with the heading 'Who wrote this profile?'. It states: 'This career profile was compiled from government data and 172 job postings.' and includes a link 'Learn more about our data.'

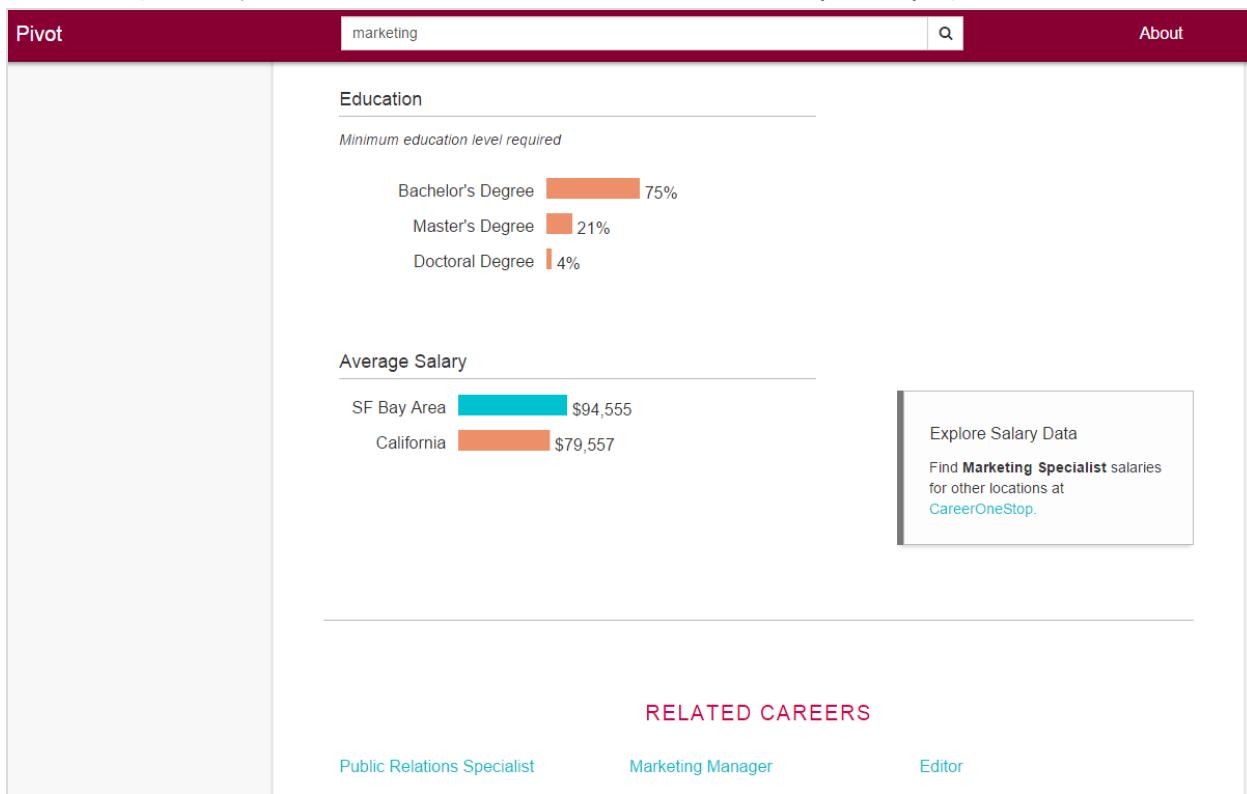
Further down the profile page, top skills are displayed in a bar chart. To the right, a link takes users to a MOOC search site ([classcentral.com](http://classcentral.com)) for a list of classes related to the career's top skill.



Clicking on a skill pops-up a modal with the definition obtained from the Wikipedia API



Below the skills, the career profile page features bar charts showing education requirements and average salary, then contains links to visit related career profile pages.



The Get Hired section at the bottom of each career profile links to Glassdoor searches for possible job titles in the career, links to a search of Meetup.com for events related to the career, and provides lists of top verb, noun, and adjective keywords to use in resumes.

The screenshot shows a website interface for the career 'marketing'. At the top, there's a navigation bar with 'Pivot' on the left, a search bar containing 'marketing' in the middle, a magnifying glass icon, and 'About' on the right. Below the navigation is a large white area with a dark grey header bar containing the word 'GET HIRED' in white capital letters. This section includes three columns of sample job titles: 'producer', 'marketing analyst', 'analytics consultant' in the first column; 'marketing coordinator', 'marketing assistant', 'research analyst' in the second column; and 'marketing specialist', 'marketing associate', 'marketing consultant' in the third column. Below this is another section titled 'Meet Cool People' with a sub-instruction to join a Meetup group. The final section is 'Resume Keywords' which lists top verbs, nouns, and adjectives drawn from 172 job postings for Marketing Specialist.

Verbs	Nouns	Adjectives
market	team	internal
create	project	local
manage	data	regulatory
develop	business	new
Maintain	content	complex
Coordinate	production	commercial
ensure	Market	various
lead	customer	analytic
build	Campaign	predictive
drive	Email	quarterly

Once a user has pinned at least two careers, it becomes possible to use the Compare Careers functionality on the top-left of the screen

The screenshot shows the Pivot interface. At the top, there's a navigation bar with 'Pivot' on the left, a search bar containing 'marketing', and a magnifying glass icon on the right. Below the search bar is a link to 'About'. On the left side, there's a sidebar with a 'Compare Careers' section. It says 'select 2 careers to compare' and lists 'Marketing Specialist' and 'Search Marketing Strategist' with checked checkboxes. Below this is a large orange button labeled 'COMPARE CAREERS'. In the main content area, the search term 'marketing' is entered in the search bar. The results show a card for 'Search Marketing Strategist' with a red pin icon. The card includes the title, a section for 'ABOUT THIS CAREER', and a 'Activities' section with several bullet points. To the right of the main content, there's a sidebar with a box titled 'Who wrote this profile?' which states: 'This career profile was compiled from government data and 7 job postings.' and a link 'Learn more about our data.'

The Compare Careers page presents similar information as the career profile, but shows it in such a way that users can quickly analyze the similarities and differences between two careers.

This screenshot shows the 'Compare Careers' page. The top navigation bar is identical to the previous one. The main content area is titled 'Compare Careers' and compares 'Marketing Specialist' and 'Search Marketing Strategist'. Each career has its own section with a title, a 'Activities' section with bullet points, and a 'Skills' section with a grid of shared and unique skills. The 'Activities' sections for both careers are identical to the ones shown in the career profile screenshot above. The 'Skills' section shows the following data:

Marketing Specialist	Both Careers	Search Marketing Strategist
writing	marketing	google analytics
social media	analytics	sql
database	project management	user experience
microsoft powerpoint	problem solving	search engine marketing

## Appendix B: Personas



### Henry Liu

Henry graduated from the University of Southern California with a degree in business almost 2 years ago. Since then, he's been living in Los Angeles and working as a Business Analyst for Deloitte Consulting. He applied for the consulting job during his senior year in college because many of his friends were applying to similar jobs.

**Age**  
24

**Occupation**  
Business Analyst

**Work Experience**  
1.5 years

**Smartphone**  
Samsung Galaxy S5

**Laptop**  
MacBook Air

**Tech Familiarity**  
Medium

It hasn't taken him long to realize that he really doesn't enjoy this kind of work. He is turned off by the tedious assignments, stressful atmosphere, and big egos in the office. He's starting to think that he needs to get a different kind of job — the sooner, the better. While Henry has some work experience and a clear idea of what he dislikes about his current job, he doesn't know what types of jobs might be a better fit for him.

A few of Henry's college friends moved to San Francisco to work in technology companies, so he's wondering if there might be something for him in the Bay Area tech industry. However, he really has no clue about what kinds of roles there are. He's open to the idea of taking classes online or going back to school for a master's degree, but doesn't have enough savings to live on or pay for school.

image: randomuser.me



### Henry Liu

*I picked the wrong career.  
What would be a better fit for me?*

**Age**  
24

**Occupation**  
Business Analyst

**Work Experience**  
1.5 years

**Smartphone**  
Samsung Galaxy S5

**Laptop**  
MacBook Air

**Tech Familiarity**  
Medium

#### Current Problems

- Feels trapped in a job he doesn't like
- Overly relies on his college social circle to learn about other career options

#### Desires

- Wants to do interesting work in a more positive and energetic work environment

#### Immediate Goals

- Learn about other career options
- Confirm his interest in another career
- Figure out whether he should go back to school

#### Values

- Doing interesting and challenging work every day
- Working with people he actually wants to be around
- Continuing to make the kind of income that supports his lifestyle preferences for travel and eating out

image: randomuser.me



## Erin Foster

Erin is a graphic designer at an advertising agency. She got into this line of work because she loves design, but now she's frustrated with the pay and the stress of working in a high-pressure environment where she has to get things right the first time. She's done agency work her whole career and is starting to feel jaded.

**Age**  
31

**Occupation**  
Graphic Designer

**Work Experience**  
9 years

**Smartphone**  
iPhone 6

**Laptop**  
MacBook Pro

**Tech Familiarity**  
High

She's been reading a lot about changes in the tech industry, especially how some companies are really starting to value designers and iterative design processes. It sounds like user experience design is the kind of work she would enjoy doing. However, she's not sure how to transition from graphic design to UX design.

Erin is trying to figure out what skills she needs to build before she applies for a UX position. She's also wondering how to revise her resume and portfolio website to make herself seem well-suited for a UX role. Erin doesn't want to go back to school, but she might be willing to take a class or two part-time.

image: randomuser.me



## Erin Foster

*The grass looks greener on that side. How do I get over there?*

**Age**  
31

**Occupation**  
Graphic Designer

**Work Experience**  
9 years

**Smartphone**  
iPhone 6

**Laptop**  
MacBook Pro

**Tech Familiarity**  
High

**Favorite Website**  
Dribbble

**Favorite Brand**  
Apple

**Living Situation**  
Has a rent-controlled 1-bedroom apt. with her long-time boyfriend Matt

**Finances**  
Modest savings, but but some stress due to high cost of living in her area

### Current Problems

- Feels overworked and burned-out
- Losing interest in the kind of work she's doing
- Pay seems low compared to other types of designers

### Desires

- Wants to work in a field and organization that places a higher value on her expertise
- Wants to do work she thinks is meaningful and important
- Wants to continue learning and growing professionally

### Immediate Goals

- Learn about specific careers she has in mind
- Confirm her interest in another career
- Identify transferable skills and skills she needs to build
- Translate her past experience into qualifications

### Values

- Work-life balance
- Professional development
- Continuing to earn an income during her career transition
- Staying in her neighborhood
- Her short commute on public transit

image: randomuser.me

# Appendix C: Participant Design Materials

## Orientation script

### **Moderator:**

- *Informally introduce team: Cameron, Karl, Victoria*
- *Informally provide context:*
  - *This is a class project for Info 214;*
  - *Our client is Reflective Paths, a group of iSchool students designing a web application that will support people who are changing careers;*
  - *Participatory design is an observational research method that brings users into the creative process. We provide users with materials for them to express their ideal solutions to assigned tasks.*
  - *We would like to take pictures and notes during the task to help us keep a record of the session for analysis.*
- *Informally cue start time.*
- *Formally read orientation script.*

### **Observers:**

- *Load online screener onto a new window.*
- *Ensure all materials are in place.*
- *Find good vantage points.*
- *Prepare note-taking materials.*

Start Time: \_\_\_\_\_

Thanks for agreeing to participate in our research study. Please take your time reading through this participant consent form before signing. Let me know if you have any questions.  
[Moderator- give user a pen and form to sign. Collect form.]

Thank you.

During the rest of the session, I'll be working from a script to ensure that my instructions to everyone who participates in the study are the same.

Our goal for this participatory design session is to learn how people gather and interpret information about their careers. Today you'll be working with a paper prototype of Reflective Path, an app designed to help career changers with comparing their career options and discovering the next steps for making a change.

During the session, I will ask you to use the paper prototype to do a variety of things, observe you while you do them, and ask questions along the way. Please try to think out loud while you're working. Just tell me whatever is going through your mind. We'll be taking notes and recording key segments of the session.

Please keep in mind that we're not testing you in this participatory design exercise. There is no wrong answer. Your participation will help us understand the mental models and expectations of our users, and will ultimately help us design a better tool for career changers.

Here's how the session will work:

- We will review your responses to our preliminary questionnaire.
- Then we will go through a series of tasks using these materials here.
- After each task, we'll ask a couple of questions about your experience doing the task.
- At the end of the session, we'll wrap up for a few final questions.

The whole session will take about 45 minutes.

Do you have any questions before we begin?

## Task scenarios

### **Moderator (lead):**

- Lead task completion session.
- If participant is not currently changing careers (according to our definition), provide him/her with the optional scenario. This ensures participant is mentally primed to complete tasks.

### **Observer:**

- Take detailed field notes: focus on qualitative preference data, not performance.
- Take photos upon completion of each task. See below for cues.
- Note areas of concern to be explored during the debrief session.

### **Materials:**

- 3 fine point expo markers (black, blue, red)
- 2 wireframes (home screen and job profile)
- 36 filled wireframe components
- blank wireframe components
- reward: cookies
- camera (phone)
- audio recorder (phone)
- 1 open laptop (mock-up display)

### **Priming Scenario:**

1. Personal scenario  
*[Moderator- Clearly restate the career change being made by the user.]*
2. Generic scenario (if personal is not available)  
Business analyst at consulting firm, you've been here for three years. You're frustrated with the stressful atmosphere, work environment, and traveling and looking for a new career.

### **Tasks:**

1. Review responses to preliminary questionnaire. Administer it if not already completed. The first thing we're going to do is [review the questionnaire you took / have you complete this brief questionnaire].
2. Define your search criteria.  
You are looking at a wireframe of the home page of Reflective Path. Thinking about yourself in the role of a someone who is thinking about changing careers, what would you want to search for when you see this screen? Please feel free to use this [blue] pen to write on the wireframe. You can write a search term or draw any other ideas on the page.  
*[Observer- Take a picture of completed artifact.]*
  - a. Walk us through your design.

3. Learn about new opportunities.

Imagine that while using Reflective Path, you arrived at a profile of a career that you find interesting.

For this task, we would like you to use this empty wireframe and these components to design a full career profile. You may write on the wireframe and use whichever existing components you choose. If anything is missing, create it using the blank cards.

Please start by writing in the name of a career you might like.

Take as much time as you need and let me know when you're done.

*[Observer- Take a picture of completed artifact.]*

- a. Walk us through your design.
- b. Why did you chose these components and not those remaining on the table?
- c. Fill in the components that you picked with the text you'd expect to see.  
*[Observer- Take a picture of completed artifact.]*
- d. What's supposed to happen when you click on these components? Or are they static?

4. Prioritize information.

What are the top 6 things you'd like to include in a **side-by-side** job comparison?

Mark those things with the **[pink]** pen.

*[Observer- Take a picture of completed artifact.]*

What are the top 3 things you'd like to include in a **quick snapshot** of the career.

Mark those things with the **[orange]** pen.

*[Observer- Take a picture of completed artifact.]*

5. What next steps would you take on this this page to help your career transition?

Please feel free to rearrange the existing components, or create new components using a blank card.

*[Observer- Take a picture of completed artifact.]*

## Debrief

### **Moderator:**

- You've completed the final task. We have a few last things we want to ask about. But first, we'll take a brief 5-minute break to review our notes. In the meantime, please help yourself to the refreshments.
- Prep final questions during break.

### **Observer (lead):**

- Review high-level questions during break.
- Prep specific question during break.
- Load photos of final products onto laptop.
- Open following images: mock-up and artifacts.
- Lead debrief session.

### **Open-ended questions:**

*Wrap up the interview by asking the participant about the observation experience from his or her perspective.*

- How did that go?
- Was there anything about the tasks that made you [the participant] anxious?
- Is there anything you [the participant] would like to do differently?
- Are there things that I could do differently?

### **Specific questions:**

*Use field notes to identify and explore areas of concern.*

*Show participant images of his/her completed designs to jog his/her memory.*

### **Mock-up feedback:**

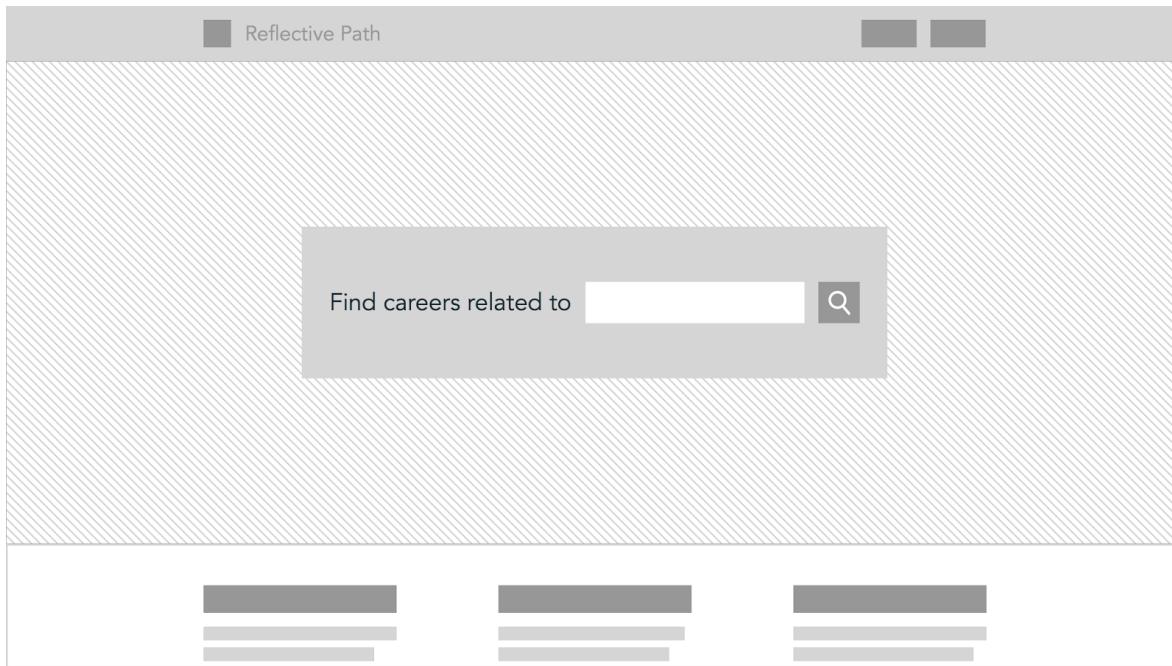
*Show participant the mock-up up on laptop screen. Ask for feedback on design ideas in development.*

- We'd like to show you a mockup of one of the design ideas for Reflective Path.
- What do you think about this design?
- Are any of the labels unclear?
- Do you have questions about the functionality of the components?

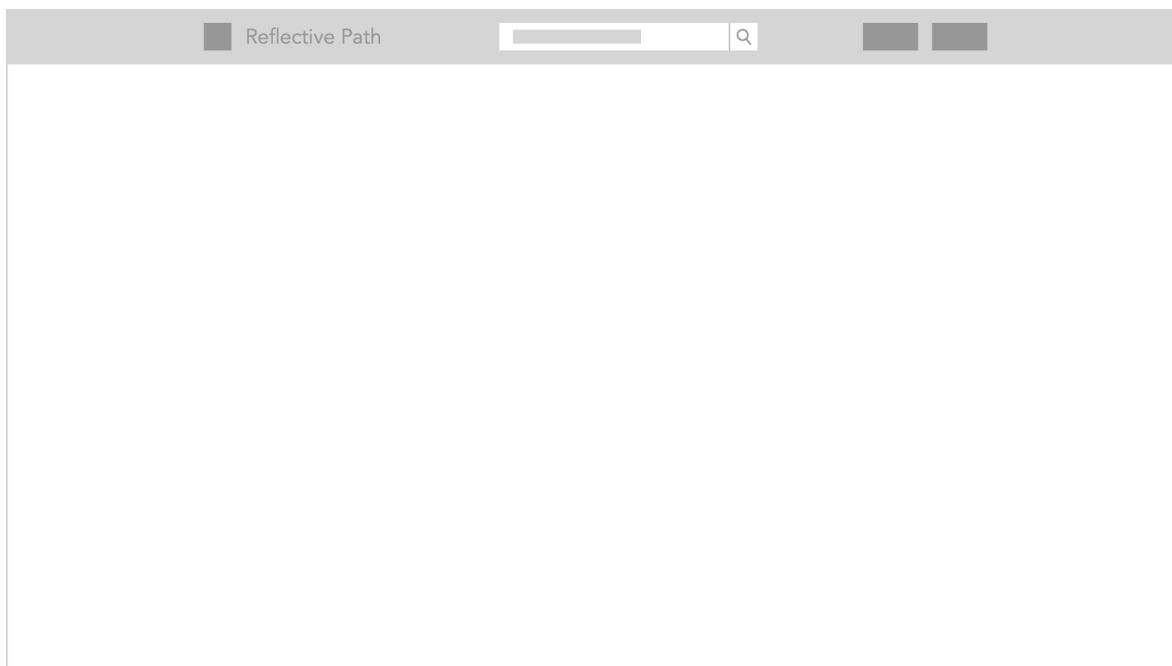
**We have no further questions at this time. Do you have any final questions or comments for us?**

# Appendix D: Design Materials: Wireframes & Components

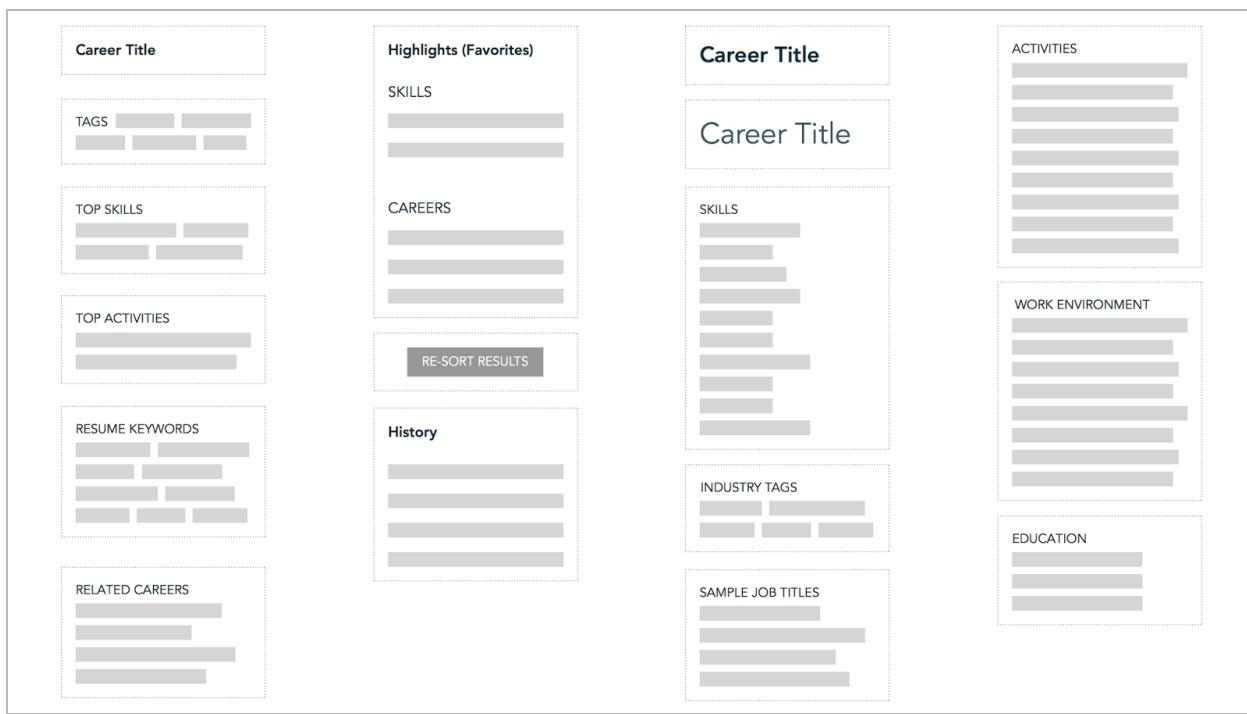
Home wireframe



Blank wireframe

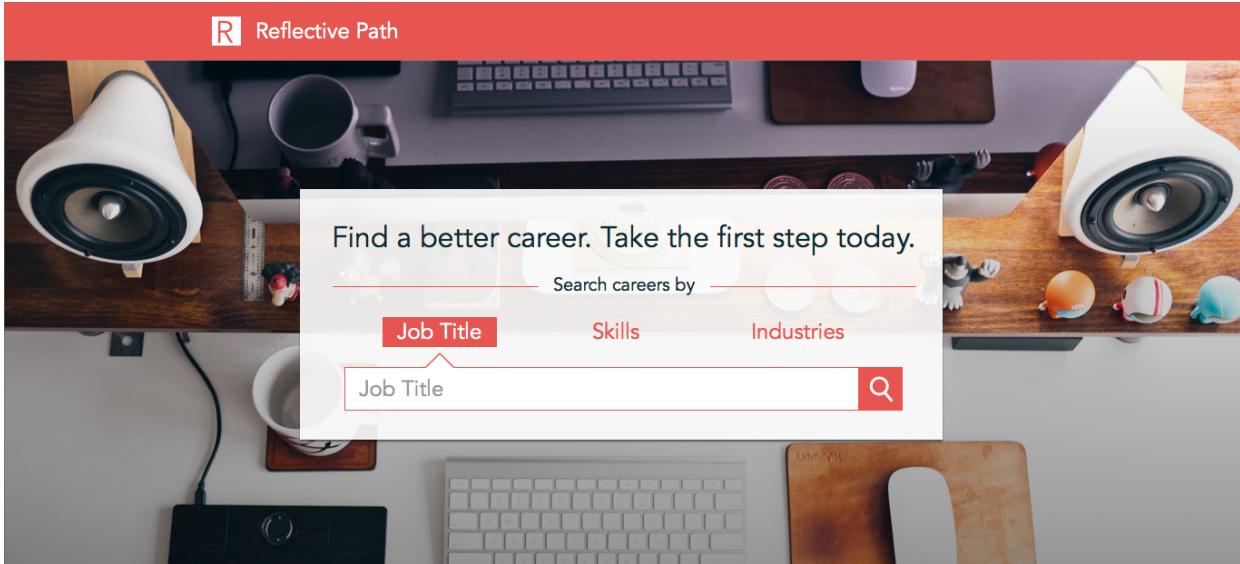


## Wireframe components



# Appendix E: InVision Prototype

## Home page



Want to change careers? Reflective Path can help.

<b>Find Other Careers</b>  Whether you have a new career in mind or not, Reflective Path helps you search hundreds of career profiles to find a better career path for you.	<b>Understand Your Options</b>  Our career profiles are based on data aggregated from thousands of job postings. Explore the data to get a deeper understanding of your options.	<b>Take The Next Step</b>  Learn more about different careers by meeting people and taking classes. We'll suggest Meetups in your area and free online classes!
---	--	---

### See Popular Careers

- web developer
- business analyst
- sales representative
- accountant
- driver

### Search Trending Skills

- analytics
- programming
- communication
- customer service
- management

### Search Top Industries

- technology
- finance
- health care
- tourism
- nonprofit

## Search results page

The screenshot shows a search results page for the term "web developer". The interface includes a navigation bar with the Reflective Path logo and a search input field. On the left, there's a sidebar with "Smart Sort" options, a skill filter for "html5", and sections for "I'm Interested (0)" and "I'm NOT Interested (0)". Below that is a "Compare Careers" section with a "COMPARE" button. The main content area lists careers related to "web developer", showing four entries: "Web Developer", "Software Developer", "User Interface Designer", and "User Experience Designer", each with a brief description of skills and activities.

R Reflective Path

web developer

Smart Sort clear

Are you interested in careers that involve:

html5

no yes

I'm Interested (0)

I'm NOT Interested (0)

Compare Careers

Pinned

Find a career you like?  
Click on its to save it.

Recently Viewed

Browse career profiles and they'll be shown here.

COMPARE

Careers related to **web developer**

showing 10 of 18 careers

**Web Developer**

technology software design

**SKILLS**  
html5, css3, javascript, php, mobile apps, wordpress, ecommerce, visual design, content management

**ACTIVITIES**

- Design, build, or maintain web sites
- Maintain understanding of current web technologies
- Write, design, or edit web page content
- Evaluate code to ensure that it is valid

**Software Developer**

software engineering technology

**SKILLS**  
java, back-end development, ajax, object oriented programming, ruby, php, javascript, git, mysql, database management

**ACTIVITIES**

- Analyze user needs and software requirements
- Design, develop, and modify software systems
- Coordinate software system installation
- Develop and direct software system testing

**User Interface Designer**

design technology

**SKILLS**  
adobe illustrator, adobe photoshop, html, css, branding, visual design, style guide, icons, typography

**ACTIVITIES**

- Design elegant, simple user interface elements
- Create icons, visual elements, and style guides
- Collaborate with marketing to design emails
- Create online presentations and reports

**User Experience Designer**

design research technology software

**SKILLS**  
prototyping, interaction design

**ACTIVITIES**

- Define user experience requirements

## Career page

R Reflective Path

[back to results](#)

**Related Careers**

- Software Engineer
- Web Administrator
- QA Engineer
- User Interface Designer
- UX Designer

**Compare Careers**

Pinned

- Web Developer
- Software Developer
- Quality Assurance

Recently Viewed

- Web Developer

**COMPARE**

### Web Developer

---

**TOP SKILLS**

- html5
- css3
- javascript
- php
- programming
- visual design
- mobile apps
- wordpress
- content management
- ecommerce

**ACTIVITIES**

- Design, build, or maintain web sites
- Maintain understanding of current web technologies
- Write, design, or edit web page content
- Evaluate code to ensure that it is valid

**WORK ENVIRONMENT**

- face-to-face discussions every day
- some freedom to make decisions
- some freedom to determine tasks
- moderately competitive

 technology  software  design

**EDUCATION**

 57% of positions require a Bachelor's Degree

**AVERAGE SALARY**

San Francisco Bay Area	\$91,560	
California	\$79,520	

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**Learn Something New**

Find free online classes through [Class-Central.com](#)

<b>Web Development</b> via Udacity	<b>Intro to HTML and CSS</b> via Udacity
<b>Mobile Web Development</b> via Udacity	<b>Software as a Service</b> UC Berkeley via Coursera

---

**Meet Cool People**

Find interesting Meetup Groups through [Meetup.com](#)

<b>East Bay Python Web Development</b>	<b>Learn Web Development and Paired Programming</b>
<b>Responsive Web Design SF</b>	<b>Girl Develop It San Francisco</b>

---

**Get Hired**

<b>JOB TITLES</b>	<b>RESUME VERBS</b>	<b>COMPANIES HIRING</b>
Senior Web Developer Web Developer / Designer Web Application Developer Front-End Developer Full-Stack Web Developer	develop, create, design, coordinate, provide, manage, build, review, test, ensure, improve, lead, maintain, analyze, refine	Planet Labs SolarCity Moovbe BayOne Solutions Johnson Service Group

# Appendix F: Usability Testing Protocol

## Introduction

- Instructions
  - Thanks for agreeing to participate in our research study.
  - Today you'll be working with a prototype of Reflective Path, an app designed to help career changers with comparing their career options and discovering the next steps for making a change. Our goal for today's activity is to test the usability of various features of the web application.
  - During the session, I will ask you to use the paper prototype to do a variety of things, observe you while you do them, and ask questions along the way. Please try to think out loud while you're working. Just tell me whatever is going through your mind.
  - With your permission, I will be recording the screen and audio of the session to aid in our analysis. [Ask to sign consent form]
- Questions
  - Do you have any questions for me before we begin?

## Task 1: Homepage Overview

- Research Questions
  - *Is the homepage communicating what reflective path does?*
- Instructions
  - This is the homepage of Reflective Path. Please walk through this homepage and tell me what you see.
  - What do you think Reflective Path does?

## Task 2: Homepage Search

- Research Question
  - *Is the homepage search providing enough guidance for what to do?*
- Instructions
  - What actions do you think you can take on this page?
  - Let's say you are someone who is considering a career change to web development. Show me how you would go about getting more information on making a change to a career as a web developer?
  - Before clicking on anything, please tell me what you expect to happen.

## Task 3: View Search Results

- Research Question
  - Do people understand what is in the search results?
- Instructions
  - Here are search results for “web developer.” Please walk me through the page and describe what you see.

## Task 4: Smart Sort

- Research Questions
  - Do people understand how Smart Sort works?
  - Do they think it is helpful?
  - Would they prefer a different sort or filter function?
- Instructions
  - Take look at the Smart Sort feature in the left column.
  - How do you think it works?
  - Use the Smart Sort feature to sort your results until the top 3 results are Web Developer, Software Developer, and Quality Assurance.
  - What changed on the screen as you used the feature?
  - How did that interaction compare to what you expected?

## Task 5: Pinning Results

- Research Question
  - Does pinning results make sense to people?
- Instructions
  - Pin the top 3 results in order from top to bottom.
  - How did that compare to what you expected?
  - How do you think you might use that feature?

## Task 6: Clicking on Career Profile

- Research Question
  - What do people notice and like in the profile?
  - How do they interpret the “Get Hired” section?
- Instructions
  - What do you think will happen when you click on the top result?
  - Go ahead and click on Web Developer. Walk through the page and describe what you see.
  - What do you think about the information in the “Get Hired” section?

## Task 7: Career Profile Interaction

- Research Question
  - Where do they want to drill deeper?
- Instructions
  - What interactions do you think are possible on this page?
  - Show me where you would click to learn more information about this career?
  - If hovering over a link:
    - What do you think would happen if you clicked there?
    - [Encourage to click]
    - What do you see now?
    - How does that compare to your expectation?

## Task 8: Compare Feature

- Research Question
  - How do people interpret the compare function?
  - Would they want to use it?
- Instructions
  - Take a look at the compare box in the sidebar.
  - What do you think this is for?
  - Click on the top two pinned items in order.
  - What do you expect to see when you click “Compare”?

## Participant Debrief

- You've completed the final task. We just have a few final questions for you.
  - How did that go?
  - Was there anything about the tasks that made you feel confused or anxious?
  - Think about the process of making a career change, are there any parts of this site that you think you wouldn't find elsewhere?
  - Why wouldn't you use this tool to support your career change?
  - Why would you use it?
  - Do you have any final thoughts or comments on this prototype?
  - Do you have any final questions for me?

## Appendix G: User Research Consent Form

### Nondisclosure agreement and recording consent form

Thank you for participating in our user research for the class *Needs and Usability Assessment*. Please be aware that information will be disclosed to you that Reflective Path does not wish to be disclosed outside of the project. Please do not reveal information that you may learn while participating in the research.

In addition, we will be recording your session to allow those Reflective Path team members who cannot be present to observe your session and benefit from your feedback. Please read the statements below and sign where indicated. Thank you.

I agree that I will disclose no information to any person, firm, or corporation about the product research conducted by Reflective Path, or about the specifications, drawings, models or operations of any machine or devices encountered.

I understand that photographs, screen recordings, and/or audio recordings will be made of my session. I grant Reflective Path permission to use these recordings for the purposes mentioned above, and waive my right to review or inspect the recordings prior to their dissemination and distribution.

---

Name (Please Print)

---

Signature

---

Date

## Appendix H: Sample mapping of job and career titles

onet_title	career_title	job_title
Accountants	Accountant	accountant
Accountants	Accountant	accounting analyst
Accountants	Accountant	accounting manager
Accountants	Accountant	analyst financial
Accountants	Accountant	reporting analyst
Accountants	Accountant	revenue analyst
Accountants	Accountant	senior accountant
Accountants	Accountant	tax analyst
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	Administrative Assistant	administrative assistant
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	Administrative Assistant	administrative support
Executive Secretaries and Executive Administrative Assistants	Administrative Assistant	executive assistant
Executive Secretaries and Executive Administrative Assistants	Administrative Assistant	executive coordinator
Executive Secretaries and Executive Administrative Assistants	Administrative Assistant	executive personal assistant to ceo
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	Administrative Assistant	front office coordinator
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	Administrative Assistant	office assistant
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	Administrative Assistant	office coordinator
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	Administrative Assistant	operations assistant
General and Operations Managers	Operations Manager	business office manager
General and Operations Managers	Operations Manager	facilities coordinator
General and Operations Managers	Operations Manager	facilities manager
General and Operations Managers	Operations Manager	facility manager
Education Administrators, Preschool and Childcare Center/Program	Child Care Administrator	center director
Advertising Sales Agents	Advertising Sales Agent	advertising sales executive
Architectural Drafters	Architectural Drafter	drafter
Art Directors	Art Director	art director
Electrical and Electronic Equipment Assemblers	Assembler	assembler
Auditors	Auditor	assurance associate
Auditors	Auditor	assurance senior
Auditors	Auditor	audit manager
Auditors	Auditor	auditor
Automotive Specialty Technicians	Automotive Technician	auto body technician
Automotive Specialty Technicians	Automotive Technician	automotive technician
Automotive Specialty Technicians	Automotive Technician	truck technician
Bartenders	Bartender	bartender

# Appendix I: Sample of crosswalk for industry standardization

final_category	careerbuilder	smartrecruiter	craigslist
Food/Travel/Entertainment	Grocery	Food And Beverages	food/beverage/hospitality
Food/Travel/Entertainment	Restaurant - Food Service	Restaurants	
Food/Travel/Entertainment	Hospitality - Hotel	Hospitality	
Food/Travel/Entertainment		Leisure and Travel	
Food/Travel/Entertainment		Food Production	
Food/Travel/Entertainment		Entertainment	
Food/Travel/Entertainment		Music	
Food/Travel/Entertainment		Events Services	
Health Care	Health Care	Hospital And Health Care	healthcare
Health Care	Nurse	Medical Practice	
Health Care		Mental Health Care	
Skilled Trades	Skilled Labor - Trades	Arts And Crafts	skilled trades/artisan
Administrative	Admin - Clerical		admin/office
Construction/Labor	Installation - Maint - Repair	Building Materials	general labor
Construction/Labor	Construction	Construction	
Construction/Labor	General Labor		
Sales	Sales		sales
Customer Service	Customer Service	Consumer Services	customer service
Nonprofit	Nonprofit - Social Services	Non-Profit Organization Management	nonprofit
Transportation	Transportation		transportation
Transportation		Aviation And Aerospace	
Transportation		Transportation/Trucking/Railroad	
Accounting/Banking/Finance	Finance	Financial Services	accounting/finance
Accounting/Banking/Finance	Accounting	Accounting	
Accounting/Banking/Finance	Banking	Banking	
Accounting/Banking/Finance		Venture Capital	
Accounting/Banking/Finance		Investment Banking/Venture	
Education	Education	Higher Education	education/teaching
Education		Primary/Secondary Education	
Education		Education Management	
Retail	Retail	Retail	retail/wholesale
Information Technology	Information Technology	Computer Software	software/qa/dba/etc
Information Technology	QA - Quality Control	Semiconductors	technical support
Information Technology		Computer Hardware	systems/networking