FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

CV 2.0 - Global Resume

Vereinfachung und Visualisierung von Lebensläufen

DIPLOMARBEIT

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Wien, 15. August 2017

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Simplifying and Visualising Resumes

DIPLOMA THESIS

submitted in partial fulfillment of the requirements for the degree of

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in

Media Informatics

by

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to the Faculty of Informatics

at the TU Wien

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Erklärung zur Verfassung der Arbeit

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Wien, 15. August 2017

Sanja Bonic

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Last but not least, I'd like to express my gratitude to the numerous people I met through the W3C and through the internet for their criticism, feedback, and input. Thank you - be excellent to each other!

Kurzfassung

Diese Arbeit hat als zentralen Fokus die Erstellung von Lebensläufen, die Fragestellung wie diese in den Bewerbungsprozess integriert sind und wie visualisierte Lebensläufe in den heutigen Tagesablauf von PersonalberaterInnen und Bewerbungen hineinpassen. Von Seiten der BewerberInnen gibt es einen klaren Trend zu visualisierten Lebensläufen in Form von Infographics während auf Seiten der PersonalberaterInnen verstärkt Bewerbungs- und Talentmanagementsoftware eingesetzt wird, die automatisiert Informationen aus Lebensläufen und sozialen Medien extrahiert, um weniger Zeit und somit Geld mit individualisierten Lebensläufen zu verschwenden.

Anstatt diese zwei Seiten im Bewerbungsprozess als Gegensätze zu sehen, versucht diese Forschungsarbeit sie zu vereinen und ein System zu kreieren, das beide anspricht. Die Herausforderung besteht darin, einen Weg zu finden, Lebensläufe auf eine neue und innovative Weise so zu gestalten, dass sowohl PersonalberaterInnen als auch BewerberInnen davon profitieren. Eine neue globale Spezifikation, die innerhalb einer Community Gruppe am World Wide Web Consortium erstellt wurde sowie eine rudimentäre Implementation, die als mögliches Sprungbrett zur Implementierung dieser Spezifikation dient, werden im Rahmen dieser Diplomarbeit vorgestellt. Die Forschungsarbeit rund um das Themengebiet musste aus drei verschiedenen Blickwinkeln betrachtet werden: State of the Art in der Forschung bezüglich Recruitment und Lebensläufen, State of the Art in der Industrie und bereits existierende Standards für Lebensläufe. Die Frage, ob diese bereits existierenden Standards für die nächste Generation von Lebensläufen, die wir vorstellen, passend ist, wird ebenso erläutert.

Es werden die grundlegenden Punkte für die nächste Generation von Lebensläufen, den sogenannten CV 2.0, aufgelistet sowie Möglichkeiten, eine höhere Akzeptanz und Adoption dieses CV 2.0 zu erreichen.

Abstract

This work has as its main focus the creation of resumes, how they are integrated into the hiring process, and how visual resumes play into the current world of recruitment and applications. On the side of applicants, there is a trend to create visualised resumes in the form of infographics whereas the recruiting side employs more and more automation technology that extracts the information contained in regular resumes and on social media sites in order to have to spend less time and therefore money on individualised resumes.

Instead of viewing both these sides as opposites, this research tries to unify them and design a system that appeases both. The challenge is to find a way to create and use a new and innovative form of resume that benefits both recruiters and applicants. A new global specification created within a Community Group at the World Wide Web Consortium as well as a rudimentary implementation that can evolve into a rich ecosystem using that specification are introduced. Research for the topic had to be conducted from three different angles: the state of the art in research regarding recruitment and resumes, the state of the art in the industry, and currently existing resume standards, including the question whether they are suitable for the next-generation resume we are proposing.

We are defining the core points of this next-generation resume that we labelled CV 2.0 and are proposing ways to reach a greater adoption of this resume in the future.

Contents

CHAPTER 1

Introduction

Resumes or Curricula Vitae (CVs) are a person's representation of themselves, including personal details that they wish to disclose, their professional experience, education, skills, and other information they add to the document. The majority of resumes adheres to current standards and most bigger companies use recruiting tools to filter out applicants. In order to do this, companies either use automated software (e.g., CVlizer [CVl17] which is explained in chapter 2.2) that pulls information from an uploaded CV or they make the applicants fill out an additional form where, effectively, the data have to be input twice - once in the applicant's original CV and once via the company's own form. For people who are applying for several jobs at a time this quickly becomes a redundant task they have to go through when applying for jobs which has sparked the creation of numerous memes.

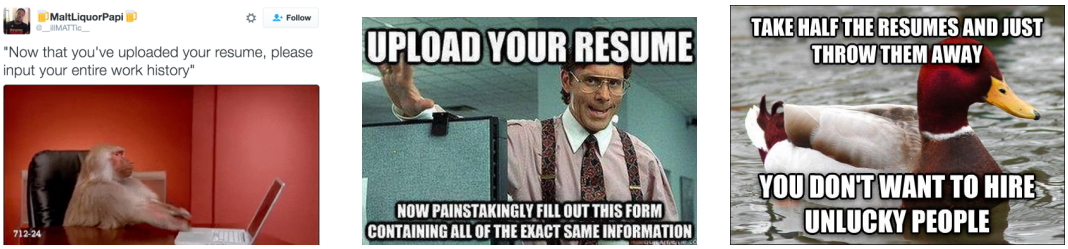


Figure 1.1: Three of the various memes that were created due to redundancy in the application process. [ivT15, soc14, wvR14].

The creativity born from frustration can be seen in figure 1.1 which introduces three memes from different sources where the first and second meme are mainly mocking the fact that an applicant has to input their details multiple times, and the third meme is targeted at the arbitrariness of recruiters' choices.

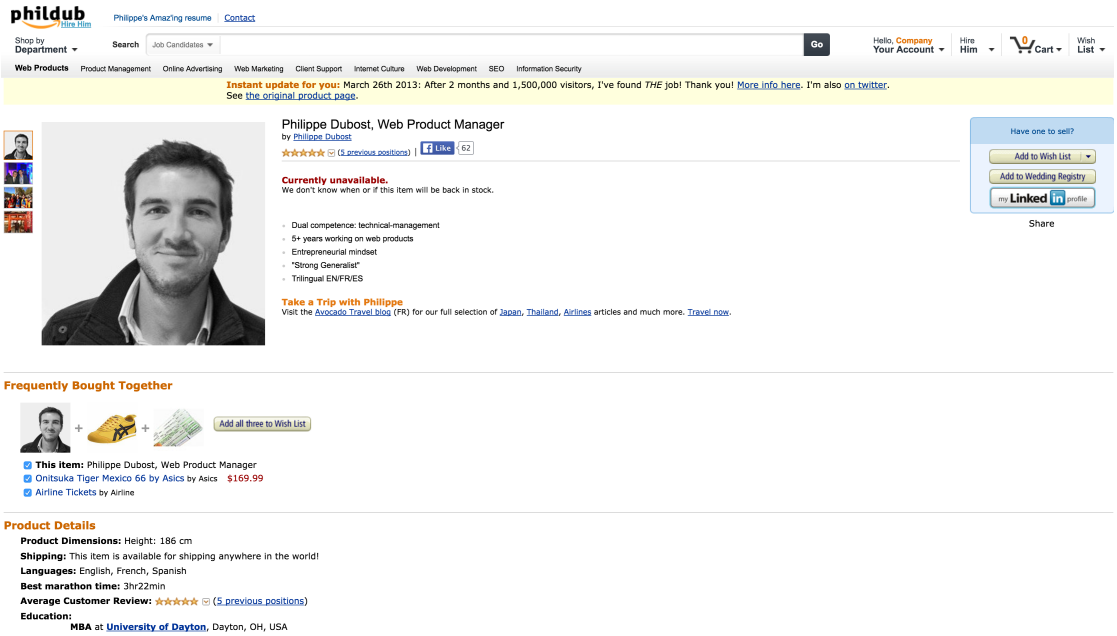


Figure 1.2: Fake Amazon product page as resume by Philippe Dubost. [Dub14].

In addition to traditional resumes, people come up with many creative ideas in order to stand out from other applicants. From websites that are made to look like a company's website with the applicant's own information up to infographic resumes, pamphlets, videos, posters, handouts to big street advertisements and consumer goods packaging style resumes [Pos14].

Philippe Dubost created the Amazon-style resume featured in figure 1.2, which, according to his website, enabled him to get the job he wanted. On his resume, Dubost uses all the original Amazon website style elements including their phrasing. Another famous resume style that has been copied several times throughout the years is the resume bar. It is essentially a chocolate bar wrapped in foil and a paper that, instead of the usual packaging, shows a candidate's resume using standard packaging phrasing to elicit even more curiosity. The typical ingredients section of a food packaging becomes the headline for a person's skills and instead of a brand there is the applicant's name. For an example, see figure 1.3. This style of resumes, while interesting, may also come across as playful, which for some jobs is neither required nor desired.

There are many reports of people having tried the resume bar as their resume of choice, among others [evR13, Mas16]. Both claim to have achieved the expected result of being hired. The Amazon-style website and the resume bar are good examples that demonstrate the range of variations in resume styles and delivery. Nonetheless, these are very special resumes that do not fit a large user base and do not work on a bigger scale due to the novelty wearing off if everyone applies the same way. There are many options for improvement in the resume sector, though. The frustrations of having to fill out the same

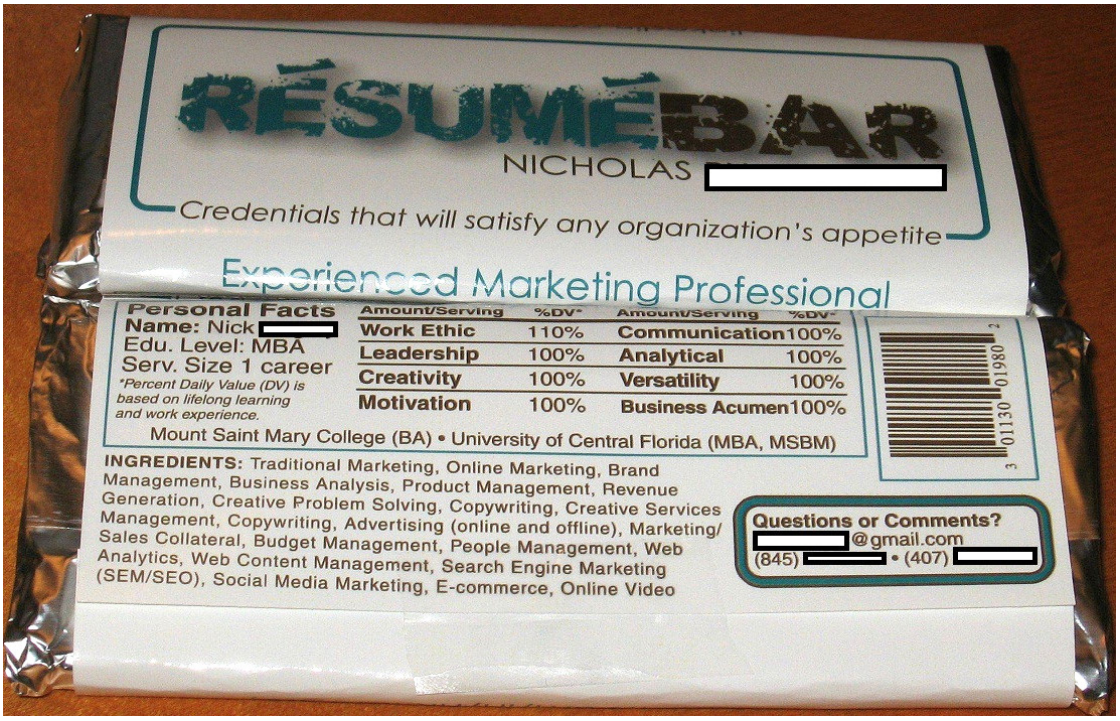


Figure 1.3: Chocolate resume bar. [evR13].

information in several places, even when applying for the same company, are obvious. Even when merely changing personal details, reformatting the entire resume or parts of it are common due to the nature of most resumes being written in a visual text editor with little control over where things are placed and misplaced. Some tech-savvier users write their resumes in LaTeX, HTML, or another format. However, unless the format is able to produce several output files that can be sent to recruiters, often more than one file needs to be edited with the same data. This leads to several versions of one resume, which all have to be edited redundantly, if other formats are needed. One company might accept only Microsoft Word documents (*DOCX*) while the other wants Portable Document Format (*PDF*) only. Some recruiters might want the resume to look a certain way, but the applicant wants their resume to look differently when applying elsewhere. Therefore, the problems we want to solve are:

- **redundancy** in the resume creation process
- **file formats** (usually single file and style output)
- **visual representation of information** (look and feel of resumes in general)

Redundancy is a main point of frustration in the resume creation process, as demonstrated by figure 1.1. **File formats** are usually predetermined by the text editor used

and cannot be converted into other formats and styles easily. Likewise, the **visual representation** of information depends on the applicant's taste and software of choice.

Research for the CV 2.0 started as a state of the art paper in 2014 about visualising resumes where a few months were spent on finding out more about the current state of infographic/visual resumes; what they are, how they are used, who uses them, how they are received, and whether there is a research area around them. In the year following the state of the art paper, a concept for standardised visual resumes and the idea for this thesis, including the actual development parts as part of a complete system, were created. The reasoning behind each decision and the solution to each of the aforementioned problems will be explained in the individual chapters of this thesis.

The focus of this thesis is the **CV 2.0** - a global resume with a W3C Community Group specification and one example system implementing the building blocks for this type of resume. At the center of interest is the creation of infographic resumes, i.e. a collection of diagrams, charts, and other graphical elements containing and/or representing information. The process involved in the creation of such a CV enables us to **automatically create resumes in several formats with several styles while only having to input information once**. In a nutshell, this solves all of the three problems mentioned: redundancy, single file and style output as well as the visual representation of information. This also introduces the topic of accessibility. Resumes are usually not accessible - neither the generation for the applicant nor the sifting through for the recruiter. A CV 2.0 solves this problem elegantly on both sides: applicants can fill out an accessible form while recruiters can choose output format and style to fit their needs.

1.1 Hypotheses

CVs need a decentralised and transparent way to be both created and viewed in order to evolve with minimal frustration for the people involved in the resume process. With this hypothesis as main focus, there are several sub-hypotheses that are addressed throughout this thesis:

- It is important to offer people a way to express creativity while keeping a certain standard so the editing frustration that applicants are usually facing does not transfer into viewing frustration for recruiters.
- Any solution for this problem cannot be closed source or in any way blocking for the stakeholders involved in its evolution (applicants, recruiters, developers).
- Any solution has to be flexible enough to adapt to changing patterns in the hiring process and cater to special needs, such as from people with disabilities.

1.2 Thesis Structure

Chapter 2 takes a look at the state of the art of resumes and analyses existing approaches to solve the problems of redundancy, file formats, and visual representation. The chapter is divided into several largely independent sections because there are numerous papers that deal with the topic of resumes and the application process as well as visualisations of various types of information whereas the state of the art in non-academic areas mostly covers the aspect of making money in solving the aforementioned problems of redundancy, file formats, visual representation, and/or a combination thereof, mostly tied in with a talent sourcing and filtering tool. **Chapter 3** explains the concepts and methods used as well as the reasoning behind them. Following those, **chapters 4** and **5** describe the two parts of a complete system that solves the redundancy, single file and style output as well as the look and feel factor of resumes throughout the application process, starting with resume creation and ending with employers. An example and evaluation of the approach as suggested in this thesis are described in chapter 6. **Chapter 7** then summarises the contents of this thesis, gives an insight into its limitations, and explores some options for future work based on the CV 2.0.

CHAPTER 2

State of the Art

Throughout the years many technologies have emerged that tried to structure and design resumes in the most appealing way. Depending on the software, that meant either appealing to applicants or recruiters. In this chapter, we will break down the topic of visualised resumes into four parts - the state of the art in research, industry, existing resume standards, and closely related work.

There are several fields where existent and upcoming technologies and standards would help with processing the information we face on a daily basis. Yet, we are still using standards that have been established decades ago and since have been only slightly changed. Resumes are one of these fields where change is difficult to set in motion. One reason for that is that many people are involved. Every company has employees which are mostly hired by the Human Resources department, external recruiters, or each department's team itself. An applicant generally does not know where his application will land and by whom it will be processed. They cannot predict if it will be an advanced computer user, what their knowledge of visual representations of data is, or simply their willingness to accept and forward something out of the ordinary. Changes in this area are subtle and the transition period lasts years. Over the course of the past fifteen to twenty years, we went through several steps regarding the sending of resumes. The first step went from handwritten and then typed postal applications to e-mail. E-mail attachments were often in a text format which later changed to PDF files, when printing to PDF became more common and easily usable in most word processing applications. PDF also ensured that an applicant's resume would look the same on the receiving end. As an additional bonus, security issues that were quite common with DOC(X) files due to macros and extensions were of no more concern either. Simultaneously to the rise of PDF resumes came forms which are, as discussed in chapter 1, a cause of frustration since each company that relies on forms, usually still wants an extra resume and additionally requires applicants to fill out all previous work experiences and other data which are already described in the resume. This process is usually intended to

facilitate automated filtering of candidates. With the Web 2.0 and the omnipresence of social media, resumes are sometimes hosted solely on network sites like LinkedIn or StackOverflow for developers, as can be seen in figure 2.1. If a candidate wants to print their resume as PDF, they can effortlessly export their data.

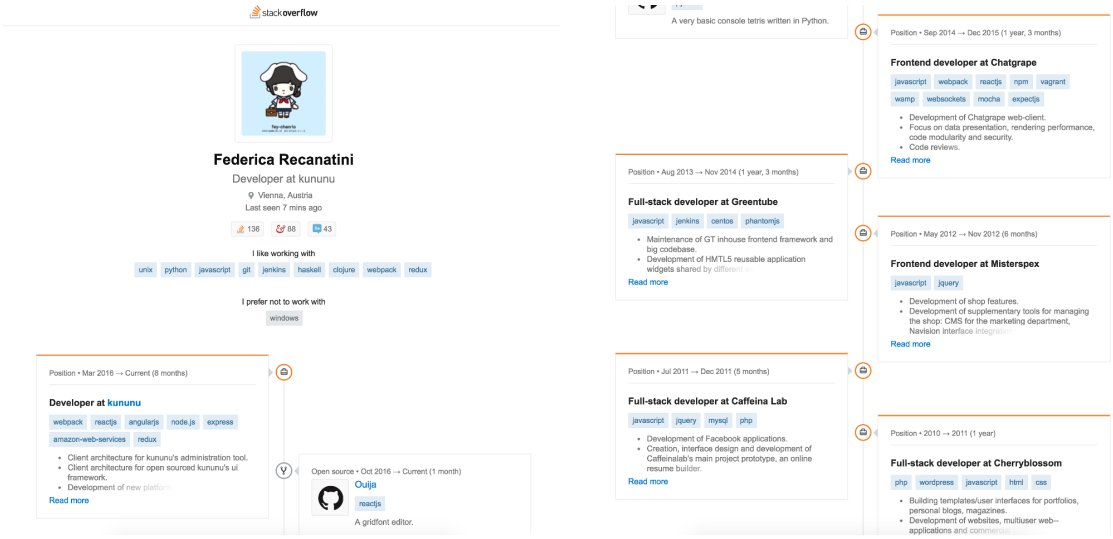


Figure 2.1: Resume of a front-end developer, hosted on StackOverflow. [Rec16].

The above excursion into how resumes were sent and the transition to being mostly electronic nowadays, paves the way to visual resumes.

Resumes cover concurrent and sequential data for which the field of information visualisation gives us many possibilities of exploring the data in various ways. If they decide to personalise their resume with graphics, the applicants usually create colourful and creative resumes, although some decide for few and/or dark colours.

By definition, a resume should sum up a person's life within very few pages. Academic resumes (publications and education make up a major portion of this type of resume) naturally vary from a designer's resume (portfolio pieces are key) which of course also has different needs and requirements than the resume of a non-artistic or non-academic person (a mix of work experience, education, and certificates matter most in this type of resume). The challenge with visualising a resume is that it does not cover only time-oriented data but also skill levels and other interests or achievements that need to be incorporated and presented. With only text, it is by its nature difficult to convey one's interests, special skills, or talents because the applicant can manipulate the hiring process only by highlighting text or using bad practice elements such as WordArt. A visualised resume can draw the attention of the employer and can even be tailored directly to the job, raising the chances of success and giving an indication of the applicant's motivation.

2.1 State of the Art in Research

In academia, there are various aspects of the application and hiring process that are of interest to researchers of different fields. Most notably, social sciences are interested in what draws the attention of recruiters, what is important during the application process, and what role personal and subconscious preferences play in regard to hiring a candidate. Additionally, in computer science, there are numerous papers dealing with visualisations and evaluations thereof. These visualisations, although not specifically designed for resumes, are useful to depict information such as skills and timelines.

Much of the current research about the recruitment process, i.e. five years or younger, is focused on social media, recommender systems, and machine learning models on extracting relevant information for certain recruitment tools or ideas, but little about resumes themselves. Due to my own previous work experience in the specialised field of IT recruitment as well as my current full-time position where I also actively select and interview people, I can safely state that resumes have become a secondary thing to look at once medium to senior level jobs are reached. At present, highly qualified people as well as executives in IT are mostly actively sourced via social networks and local events. In the field of IT, only entry-level jobs still require a resume for selection. Resumes are looked at as a side dish, but are not really the main course. This is evident from the current state of research as mentioned above as well as from personal anecdotes and large samples of observations of how recruiters work in 2017. Resumes are not disappearing, though. They are transforming. This thesis aims at showing ways of going into the future more organised and less divided by proposing a system that is free and open for everyone to use. But first, we take a look at existing research and related work.

2.1.1 Research Regarding the Recruitment Process

While there are thousands of articles, books, presentations, and videos on how to create and impress with resumes, there is proportionately little new research regarding the recruitment process, specifically the part of resumes. The success of a resume is determined by advancing to the next round in the recruiting process which usually is a follow-up interview. Sometimes, the resume step is skipped altogether, for example when the recruiting process starts with the applicant getting through to the employer via a connection. In this case, a resume is either not needed, not looked at, or handed in later as a formality.

I have not found any scientific research with proper methodology that directly examines the effectiveness of graphical resumes in a hiring process. Much of the literature about traditional textual resumes is more than 15 years old where it was seen as too creative and perceived negatively if the colour of the paper was something else than what as is explained in depth by [ATØL10]. This study conducted in 2010 had 90 participants equally distributed between male and female as well as professionals from recruitment agencies and non-professionals (students). Twelve applications were distributed in three variations - a traditional resume on white paper, a traditional resume on coloured paper

(light colours), and a creative resume using different shapes on white paper - along with a job description. As has become apparent, being a professional or non-professional had no signficant effect on the rejection or approval rate. The study shows that the rejection rate for creative resumes is at 41.67% compared to 26.11% for formal, traditional applications. Therefore, they concluded that acceptance for creative resumes is mostly based on cultural context and individual preferences. For our research, this means that we have won no further insight other than a confirmation that well-known and accepted standard are needed if we want infographic resumes to be established. The authors advise still going for the creative approach if the applicant's chances are relatively low from the start because it might give them an initial boost if the employer is not too conservative. Considering the study is already seven years old, the results might already look a bit different now, but the concluding advice is certainly still applicable.

A paper from the Rehabilitation Psychology journal in 2010 ([WBH10]) examines the effects of visual formatting in the hiring process for blind job applicants. The study with 249 HR (Human Resource) managers clearly shows that even when people knew that the applicant was blind, the resume formatting still played a significant role in the managers' evaluation, even though the general attitude towards people with visual disabilities was very positive:

> "These ambivalent findings parallel those found for other stigmatized groups such as women: Although those in power may readily give praise to members of the disadvantaged groups, allocation of valued resources often does not accompany positive feedback (Biernat & Vescio, 2002; Vescio, Gervais, Snyder, & Hoover, 2005). One of the strengths of the current study is that we investigated both ratings of personal characteristics (praise) and direct ratings of hireability (allocation of resources)." Quote 2.1.1, [WBH10, p.69].

Quote 2.1.1 is the stepping stone for the topics of accessibility and diversity covered by the CV 2.0 which will be explained in the designated chapter 4. Even when the personal attitude is declared as positive, there empirically is a certain bias against women and minorities which can be solved in two ways, ideally combined. In the initial selection process the proper technology can hide race, gender, disabilities, and other potential triggers for personal bias. After the selection process, individuals who hold interviews need to be actively and repeatedly trained in order to remove any existing obvious or latent bias against the candidates.

Other than demonstrating the aforementioned discrepancies within the hiring process, the paper by [WBH10] also explains that resumes receive more positive attention if their content is chronological rather than functional, which is an indicator for the potential success of infographic resumes, if they are designed correctly. The visual formatting in the study by [WBH10] refers to black font on white paper made visually appealing through indentation and font variation as opposed to an exclusively functional resume listing the contents via paragraphs and bullet points but without font variation or indentation.

The papers referenced by [ATØL10] and [WBH10] are either from a time (1990s and earlier) where the usage of technology varied drastically from our usage today or they have nothing to do with the recruitment process and resumes as such.

2.1.2 Research Regarding Visualisations

Any research results regarding visualisations cannot be directly translated into their effectiveness for resumes but some knowledge can still be deduced, such as general readability or user experience.

As for the effect of infographics without resume context, a very recent study by [HRC15] from the year 2015 with over 1000 participants concluded that the subjective evaluation of a resume is based on various components - not only the actual form of visualisation and design used, but also the participants' demographic. The latter is not surprising either, considering the results from the studies by [ATØL10] and [WBH10] were also able to correlate personal preferences with the evaluation of different resume formats as well as candidates.

By numbers, the study by [HRC15] definitely delivers a big sample on the dos and don'ts of infographics. 1,278 participants rated 330 infographics which resulted in a sample of approximately 83,000 ratings including demographic information as well as visual style for each rating. The rating was to be given after 500ms of being shown the infographic for the first time, building upon previous research by references mentioned in the study which indicates that infographics that have been found visually appealing also resulted in higher willingness to process and remember the information presented in the infographic as well as the visual style itself. The research by [HRC15] aimed at answering questions such as how quickly these impressions that were researched in their references form, whether demographics are important, and which factors make up an appealing infographic.

It has been found that while participants' ratings of subjective visual appeal are consistent, the majority of infographics leads to controversial ratings in regards to good design and therefore visual appeal. Also, it seems that neutral viewpoints on visual appeal rarely exist - infographics were either very appealing or strongly disliked. This result is mirrored in the comparatively small survey I conducted as described in chapter 3.

Demographic factors play a significant role in the impression an infographic makes, according to [HRC15]. One striking insight which is important for the CV 2.0 is only mentioned on the side in their study, namely that participants' occupation did not significantly affect their perceived visual appeal for an infographic, leading to the authors of the study disregarding "occupation as a factor in the analysis" ([HRC15, p. 1188]). If we combine the three main takeaways from our state of the art research regarding recruiting and visualisations so far, we have the following results:

- visual appeal is consistent, but highly subjective and dependent on demographics and personal preference

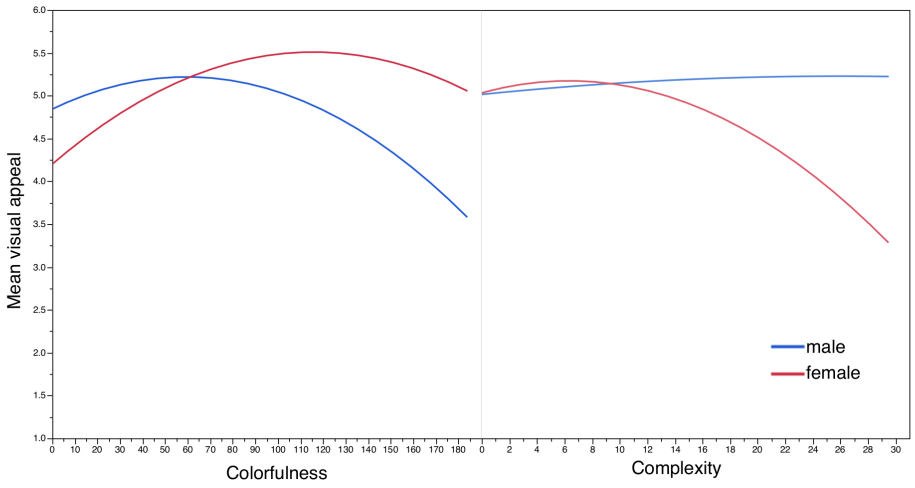


Figure 2.2: Infographic ratings in a study of 1,278 participants. Curves show male and female ratings with regards to colourfulness (left) and complexity (right). [HRC15, p. 1189].

- visual appeal tends to be a strong response, either positively or negatively towards the perceived aesthetic value of an infographic
- a person's occupation has no significant effect on their visual preferences

We have by now established that the appeal of infographics and visual formatting are a highly subjective topic, depending on various factors in a person's demographic as well as personal preferences and previous experience. As far as demographics go, there have been some valuable insights in [HRC15]. Most notably - albeit not surprisingly - gender does affect the visual appeal of an infographic as far as colourfulness and complexity go. Colourfulness and saturation were an evidently female preference overall whereas colourless infographics or those which did not have many colours were rated higher by males.

The results in figure 2.2 imply that colourful and less complex infographics are more appealing to people identifying as female while the opposite would be true of people identifying as male. The definition of colourfulness in this study encompasses the number of images as well as saturation of colours used in the visuals while complexity is a computed value which is based on the ratio of text to image areas and colour combinations used. From the 1,278 participants in this study, 77.5% identified as female. According to what [HRC15] describe, there is no indicator that the study results are skewed due to some mistake in the experiment setup since it was an online experiment with the infographics being carefully selected to first not be widely known already and second to not show any content that can be deemed questionable, such as political topics or

pornography. Therefore, these study results that focus solely on what makes infographics aesthetical, are also able to produce an interesting discussion for gender studies. We are only marginally concerned with gender in our research because the only possible option where it would matter is in future suggested designs for recruiters and applicants alike, i.e. the default template they see if they do not want to choose one themselves.

Moving on to the topic of visualisation methods, we find descriptions and evaluations of various methods for visualising specific types of data, as presented in [AMST11]. We differentiate data into these categories:

- numerical (data that are best represented through numbers, either continuous or discrete)
- categorical (data that can be categorised as belonging to specific groups)
- ordinal (data that are best represented in a specific order)

Data within a resume are naturally more complex than just single data points that need to be combined into a visualisation. An infographic usually contains several data points summed up in order to tell a story and disseminate information. Resume data are a combination of numerical, categorical, and ordinal data. Visualising time-oriented data, which is probably closest to describing the information from the education and work experience sectors of a resume, is a topic well-described in [AMST11] and also discussed in papers by [AMM+08, WSMY09]. None of these sources specifically talk about resumes but they are worth mentioning and [AMM+08] has some insights that are valuable for our own research. More specifically, they state that when generating a visual representation of time-oriented data, it is imperative to define what sort of characteristics the data have. Therefore, they have defined the most relevant attributes for visualising these data as follows [AMM+08]:

- linear time vs. cyclic time
- time points vs. time intervals (also called temporal primitives)
- ordered time vs. branching time vs. time with multiple perspectives

Linear time is used to describe data which cover information from a start point up to any potential future whereas cyclic time is used to describe many natural events, such as the rising of the tide. High tide will always follow and precede low tide. Discrete time points and time intervals function like mathematical discrete numbers and intervals. Time points are a discrete, abstract number in time and a time interval has both start and end point as well as a duration. Sequential events are defined as ordered time whereas branching time covers alternate, exclusive options happening at the same time. Time

with multiple perspectives describes several points of view of observed data, much like several film cameras at different angles recording the same scene.

The data presented in resumes has the characteristics of linear time, time intervals, and ordered time. Determining these characteristics ensures that the visualisation techniques chosen in order to match them will avoid "inexpressive or ineffective visual representations" [AMM+08], therefore making information processing more precise and easier to achieve.

Another approach for depicting time lines is that from [PMR+96]. They have used several timelines to incorporate different cases of criminal youth records for each juvenile. Those *LifeLines* could be a way of depicting professional experience or education in a resume, although it might take up too much space on the page and is therefore not as useful for our research unless we change it a bit so that we have only two timelines, one for professional experience and one for education, similar to the first chart in 3.2, although the feedback from our survey mentioned in chapter 3 suggests that it is not quite easy to process quickly. Other things that are better expressed as time points/intervals, such as time spent in foreign countries or special certificates, would add an additional cognitive load on the timelines that would make processing quickly even more challenging and quick processing is the key to successful resumes in the eyes of a recruiter.

Albeit the research presented in [WSMY09] is interesting and features a time-oriented interface design that reacts to people's immediate needs at a certain time, for example when waiting, watching TV, or relaxing, it is not applicable for resume design and its implications. Another paper which seemed to be a good candidate for our own research is [BCL14]. We had to omit it, though, as it has a focus that is too specific and, unfortunately, does not align with our research. They have analysed people's activities in distributed teams and developed a visualisation that made it easier to see who has done what in which amount of time. It might be worth exploring again when we do further research on our topic and for more interactive resumes such as websites where people could showcase their part of work in a team they worked with. For the basic resume it is not useful, though, same as the *PlanningLines* mentioned in [AMTB05] which are very useful for medical treatment planning but can barely be applied for resumes. The *PlanningLines*' strength is to cover events of uncertainty whereas a CV has clearly defined content that needs some other visualisation techniques for non-time-oriented data as well. Another paper that covers the visualisation of time-oriented data is [AMM+07]. Again, there is the problem of it not being applicable for our research as it uses visualisation methods that need training to understand and cannot be incorporated into a resume that needs to be understandable at first glance.

Categorical and ordinal data such as skills and languages are very trivial visualisations in comparison and can be easily solved via bar charts and bubble charts. There are undeniedly more ways to visualise categorical and ordinal data, though. The point of a resume is for the reader to grasp the contained information quickly, so more complex ways to treat simple data are only useful as means of artistic expression rather than information processing.

As mentioned at the beginning of this chapter, proper research about visual resumes needs to cover many fields at once - apart from psychology and the various aspects of the recruiting process, a look needs to be taken at visualisations, specifically in the field of computer science. In addition, we can find some information in the Semantic Web research field and understand how to better visualise our data, if we look at a resume as an ontology. Essentially, an applicant who designes their own infographic is creating their own ontology mapping and we need standards to make sense of those for the general public that is not used to visualisation techniques other than those already widely known and accepted. [KHL+07] have defined six categories of visualisation techniques in the ontologies they have used for their study, which are:

1. indented list
2. node-link and tree
3. zoomable
4. space-filling
5. focus and context or distortion
6. 3D information landscapes

Indented lists as well as node-links and trees are the core of most visualisation techniques, yet we have not seen many graphs used to visualise the data in a resume. The evaluation of usage and acceptance of graphs for these kind of data are likely a good jumping point for further research. [BS14] clearly state that information processing with a graph is faster than in a list if the convex hull is small enough. They have used an eye tracking monitor to gather 500MB of gaze data from over 30 participants. Their results were that indented lists are faster when the participants are presented with tasks of finding or completing something that is missing. The accuracy for both graphs and lists was equally high, but working with the lists was obviously faster. They are not sure, though, if this is an inherent feature of lists or if we as a society are just well-trained to use hierarchical lists since we use them every day in books, magazines, and even our file explorer in any operating system. This result potentially confirms that recruitment people are able to scan a textual resume within less than half a minute for the relevant data. [BS14] suggest that further evaluation is needed because if the convex hull of a graph is suitably small, not only the processing but also the information search could be faster which would evidently be proof that an infographic resume would work better. The conditions for this to become true are solved with the two-fold approach described in this thesis - first, creating a standard and, second, letting recruiters have their own template so that they can process the information contained in a vast amount of resumes faster.

Categorisations of visualisation techniques are valid through time, even when they are older, whereas the understanding of visualisations or the perception of resumes throughout

a hiring process in the year 1990 would naturally be different than in 2017. The reason for that is that the internet has made some major breakthroughs during the last 25 years. An infographic resume back then would have most likely been drawn on a sheet of paper and the applicant would have been dismissed quite easily unless the job had specifically asked for an art-portfolio-styled resume. Infographics have grown more popular over the last years and many books on infographics, especially about how to design your resume to look like one, were published, such as [Mor14]. In this book, the author recommends a comprehensive approach to resumes, seeing them as one piece in a bigger puzzle. She talks about how to effectively use social networks, specifically LinkedIn, how to tell your story, and how to manage your portfolio. The actual resume as such appears much later in the book and apart from citing several studies that show the same results as discussed in the introduction of this thesis, i.e. the traditional paper and e-mail resumes are dying or dead already, she gives tips and explains how to present yourself better online, including social and visual resumes. The book itself is not scientific but shows that the topic is currently well on the rise.

2.2 State of the Art in Industry

Resumes have several levels that need to be considered when researching the impact of creating infographic resumes and possibly introducing yet another standard. One such level is of course academic research itself which we have investigated in the chapter 2.1. The next thing to look at is the state of the art in the industry and how money is made through resumes.

A quick web search for "create visual resume" and "create infographic resume" already yields a lot of options, designs, and opinions on how to create a visually appealing resume to draw the attention of a potential employer. Hundreds of websites offer services that visualise users' resumes. Most of them are not transparent, though, and do not give the user the freedom of choice whether to register or not. Common factors all these platforms share are proprietary code. Some are entirely free for the user and it is not clear how they generate revenue. Since there are no ads and registration is mandatory, one can either assume that the data are being collected for processing somewhere else or that some of these services really are just a side project for companies or private persons who want to establish their brand. From the mass of resume creation websites, some simply offer textual resumes which are formatted nicely where the user fills in their data through a form. Others are a little more complex and offer customisation of fonts and colours, but the basics of a traditional resume are unchanged. Those are not of interest for our research. Instead, we will examine six services which let users create graphical resumes before we move on to other software used by businesses for recruiting.

Kinzaa As shown in figure 2.3, Kinzaa [Kin17] uses a still traditional boxed grid layout for its infographic resumes. Naturally, they claim the high importance of an infographic resume throughout their website. The resumes created by Kinzaa

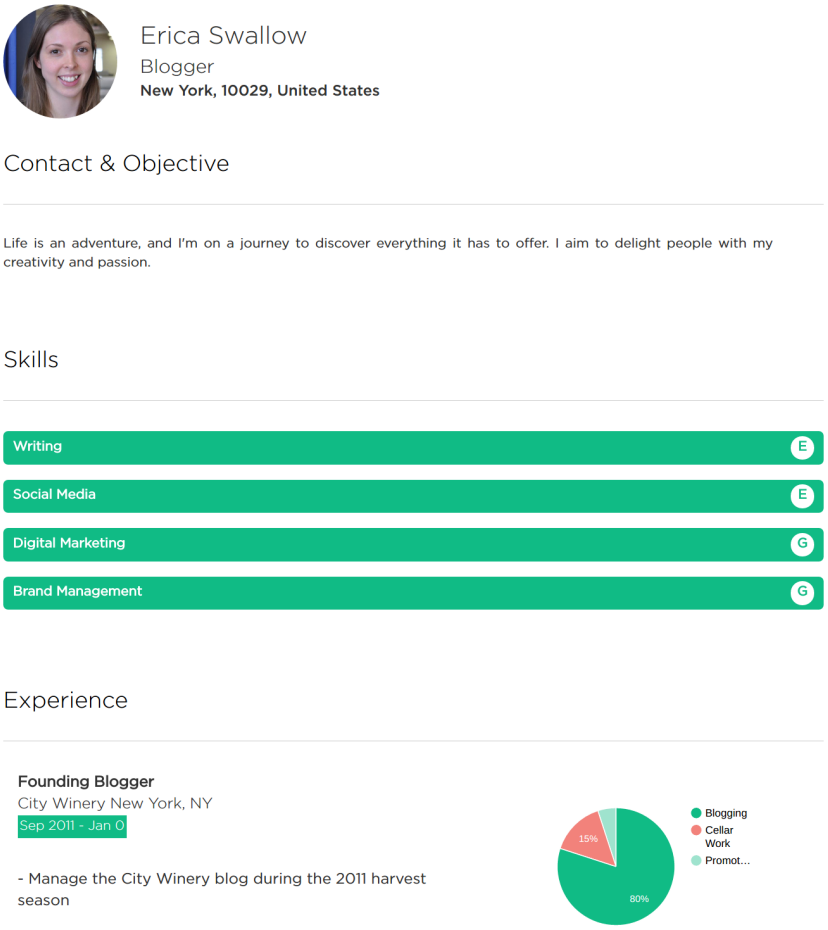


Figure 2.3: Screenshot from one of the featured resumes on the Kinzaa website, exemplifying a clear design with simple and easily understandable charts. [Kin17].

can contain several well-known diagrams, such as pie charts, completion bars, and parallel timelines. In Kinzaa's example resume 2.3, light colours are used, a photo of the person is added making the infographic more memorable, and the visualisation techniques are used quite well to depict the data, although the order of the boxes does not seem to be perfect since the skill bars take up a lot of space and the professional experience seems cut off. It is also not perfectly clear what the skill bars are supposed to be exactly as they all match up and there are different letters in them, probably signifying the level of experience. Without a label, this leaves us to guessing, though. The format is well-suited for printing. Registration is mandatory and Kinzaa has an applicant's data. There is no way of creating a resume on their site with leaving out sensitive data. While the service is free, they generate revenue through paid job postings on their site.

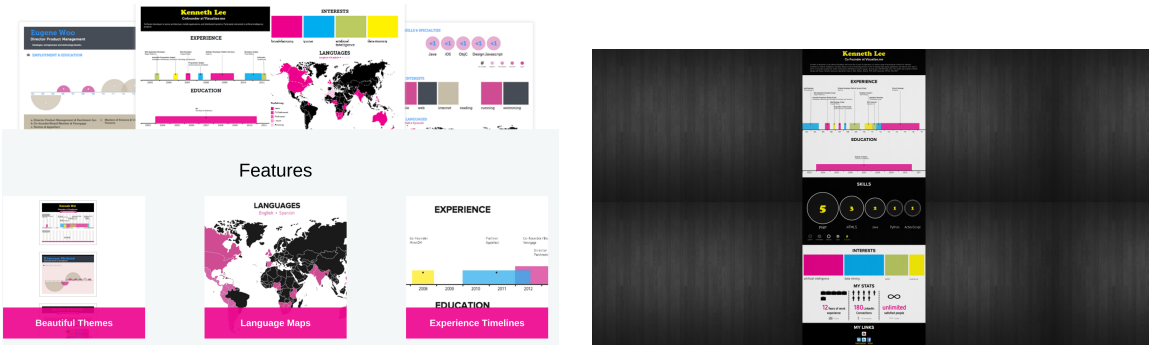


Figure 2.4: Vizualize.me website (left) and example resume from co-founder Kenneth Lee (right). [Viz17].

Vizualize.me Vizualize.me [Viz17] generates graphically sophisticated resumes, as seen in figure 2.4. Here they use several different visualisation techniques, such as bubble charts, bar charts, timelines, and countable icons. The format is too high to be printed sensibly and the colours are not very printer-friendly. Similarly to Kinzaa, an applicant's resume is meant to stay at their site and be shared as a link. They focus their marketing on the assumption that visual resumes offer beauty and elegance whereas Kinzaa's pitch was mainly the fact that infographics are the better resumes. It is not clear whether and how Vizualize.me generates revenue. On their *About* page, they state that they are a division of "Parchment, leaders in credentials and etranscript management" [Viz17].

VisualCV Figure 2.5 shows one of the example resumes featured on the VisualCV website [Vis17] which loads very slowly at times. These times are bridged by showing various inspirational quotes while loading. Sensational speech such as "mind-blowing" and "resume black hole" are as much part of their repertoire as claiming that they have a user base of over one million. In one of their landing paragraphs on the website, they state:

> "Only 2% of applicants get the interview.
>
> First impressions matter when competing for the job you want. Recruiters spend less than 6 seconds deciding whether your resume or CV is worth a second look." [Vis17].

This statement is one of many examples of claims made just on the VisualCV landing page. Registration is mandatory, although they do have an extra section dedicated to mentioning that the applicants' data are theirs alone and that they can delete their account and all information at any time.

PictoCV PictoCV [Pic17] comes closest to our topic of infographic resumes. As shown in figure 2.6, their whole product offering is based around infographic resumes. They have a freemium model with two free templates and two paid subscriptions

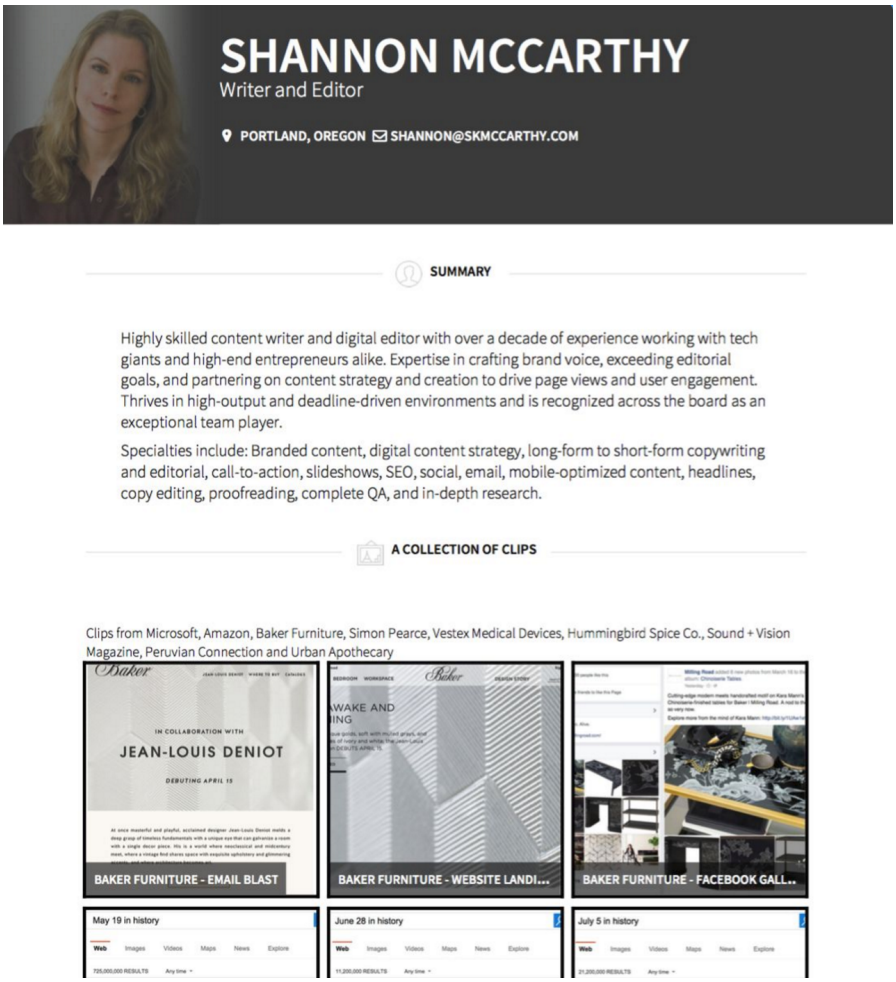


Figure 2.5: One of the example resumes featured on the VisualCV website - photograph, plain text, and a few clips are shown. [Vis17].

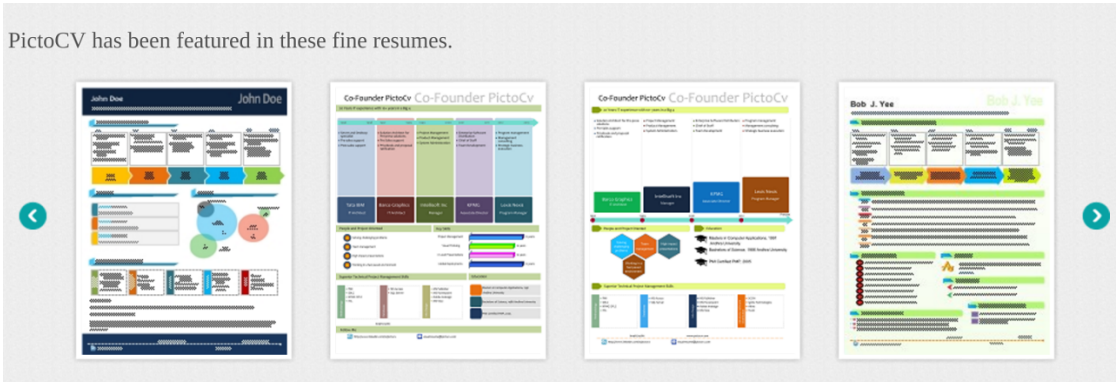


Figure 2.6: Examples of PictoCVs as shown on their website. [Pic17].

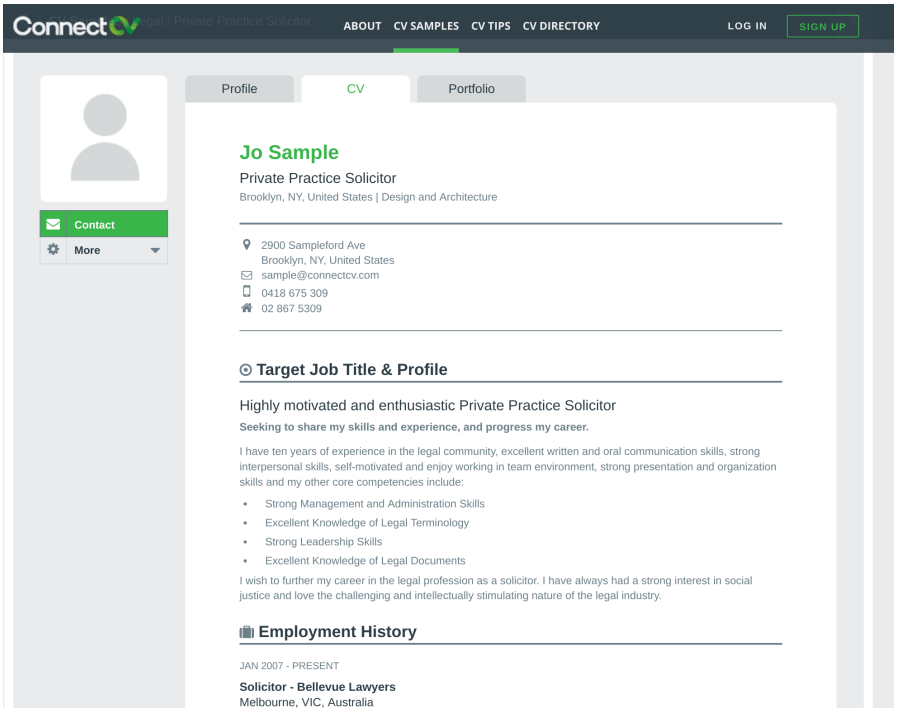


Figure 2.7: One of the simple CV samples on the ConnectCV website. [Con17].

with access to all available templates targeted at both applicants who want to present themselves and employers who want to showcase their company. Quite accurately, they describe an infographic resume as "highly organized dashboard view of your education, experience, talents and goals" [Pic17]. Unfortunately, the data are again saved proprietarily on their own website to share via social networks while offering only a simply PDF and image download.

ConnectCV Figure 2.7 demonstrates the simplicity of one of many services offering a user input form that then turns into a fairly traditional style of resume that is textual with some added colours and pictures. ConnectCV [Con17] aims at being a directory of applicants where they can easily manage their resumes and switch to different resumes depending on the job they are applying for. They have the option to make their resume(s) private or public.

ConnectCV is marketing itself not as a resume generator but as "Career Asset Management system" [Con17] on their landing page. For revenue generation, ConnectCV offer enterprise solutions, specifically in the field of recruiting graduates and entry level professionals with dedicated offerings.

ResumUP In figure 2.8 a range of categories where ResumUP can offer solutions are demonstrated. On their website they claim: "Job seekers are 75% more likely to get noticed with a visual resume." [Res17] While ResumUP is mostly known as

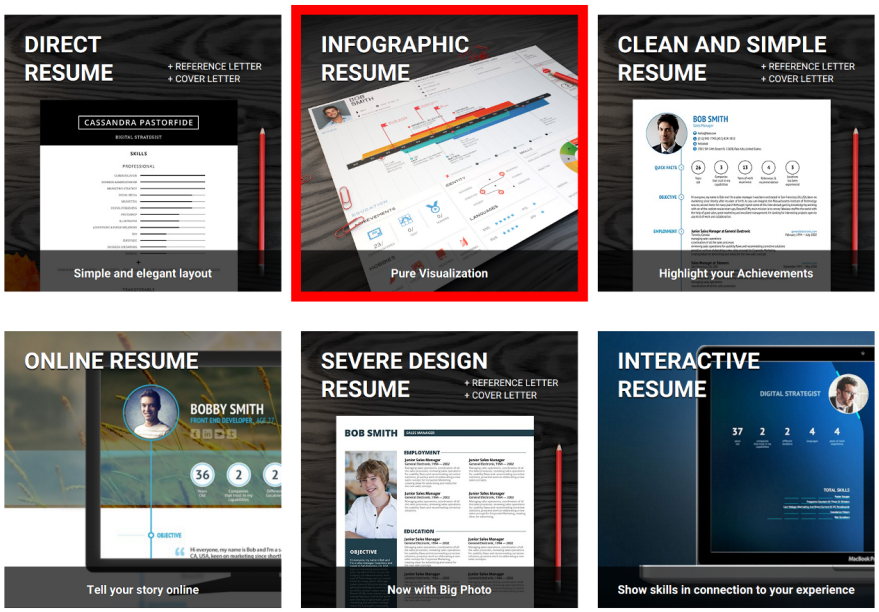


Figure 2.8: ResumUP offers different styles and templates loosely categorised by functionality. [Res17].

a resume generator, it has added several functionalities over the years and now serves three different purposes. First and foremost, it is still a visualisation tool for resumes with some sophisticated and some simple designs to choose from. Other than that, it also offers a career planning tool where users can input their current position, where they would like to go, and the tool will show the best ways to achieve that position by visualising what kind of skills are usual in the current position and what kind of skills need to be acquired for the desired position. In addition, it will show the current jobs that are placed on ResumUP's own job board. As a third option, ResumUP offers enterprise solutions for recruiting and talent management, similar to ConnectCV.

To recap some of the information we have gathered from examining services where a candidate can create their visual resume:

- All of the services claim (without sources) that having a visual resume boosts a candidate's chances to get noticed or even hired.
- All of the services aim at keeping an applicant's data at their site. While options for downloading the visual resume are given, it is not an option to continue editing the resume after downloading (the download options are limited to PDF and non-editable image formats like PNG or JPG).
- All of the examined services have a mandatory registration.

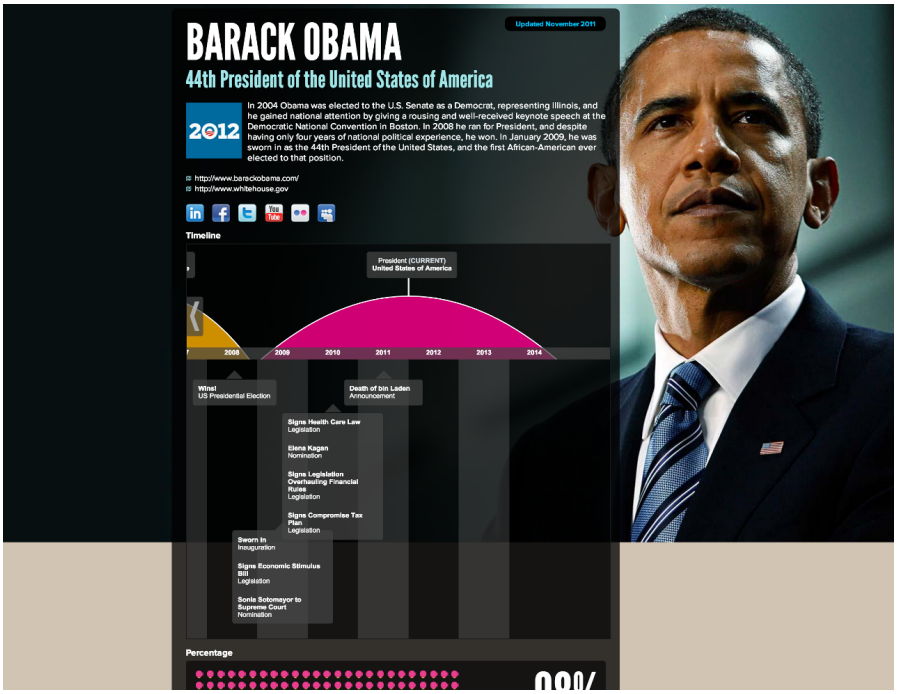


Figure 2.9: Barack Obama's infographic resume on re.vu, a service which existed for a few years and was shut down for reasons that have not been stated publicly. Screenshot taken in December 2014 when the site still existed.

- There is no transparency other than the *FAQ* and *About* sections on the respective websites. The source code is proprietary.

As mentioned, there are hundreds of services that allow for the creation of resumes. Graphical resumes are a part of this mass of services and we have examined only six of them. There are also several rudimentary services that offer the option of using them without prior registration. The result is usually a textual PDF file, sometimes with font and colour customisation. Since research around this topic started, there have been several sites that were shut down, either through having been acquired by a big company or through unknown reasons. One of these services is re.vu which was available for several years at *http://www.re.vu/* at least until mid 2015.

Figure 2.9 shows an emphasis on colours and photos. They use little graphical elements and more text, the general impression is still very graphical, though. This resume is unprintable and definitely only works online due to its dark colours and high size.

There is little consideration in regards to online and offline usage or acceptance from recruiters with services creating resumes for users. The centre of attention is the applicant and their resume, although the resume needs to be seen as only one gear in the hiring machinery. A resume has one target group - the potential employer. Therefore, it is

not sensible to create services around resume creation that are targeting applicants exclusively. This is where recruiting tools and talent management software come in.

During the writing and in the last steps of development for the CV 2.0, I have worked full-time for three months as a Recruitment Analyst at epunkt, which is a recruitment company with a strong focus on IT jobs. Among data analysis tasks in this job, I supported recruiters by sourcing people. Sourcing as a recruitment industry term means finding people for jobs if not enough suitable candidates have applied for a vacant position. I have found that none of the recruiters read or even looked at cover letters. Out of a sample of at least 10 recruiters I observed and interacted with during the hiring process from over 20 people for different jobs in the IT industry, 0% of recruiters looked at the cover letter. Without exception, they all worked following the same schema:

1. search the existing database in the recruitment software by keywords that are relevant for the job they are trying to fill
2. ask colleagues whether they have some leads who might be interested in the job
3. move on to social media networks if the previous database search did not yield anything

Evidently, the recruiters I worked with are hiring people in a highly specialised field and therefore do not have as many applications from people, which means they have to actively source possible candidates. Other jobs, such as marketing positions or entry-level jobs, do not need extensive sourcing and usually receive a flood of applications, where - again - the recruitment software is responsible for filtering and sorting the candidates.

We have found that the state of the art in industry is two-fold. On one hand, there are products that view the applicant as target group and let them create resumes, mostly encapsuled within the product. On the other hand there is talent management software that companies pay in order to manage their applicants and employees. Some software is meant to be purely applicant-based whereas some is a general HR tooling for managing both applicants and employees, usually also incorporating time sheets, salaries, expenses, and other necessities. Obviously, not all companies rely on recruitment software but the bigger a company gets, the more it is likely to employ and benefit from such a tool.

As an example, epunkt created the spin-off company eRecruiter which, from March 2017 on, is officially partnering with and 51% owned by karriere.at, the largest job board in Austria [eRe17]. For eRecruiter, this move made a lot of sense because they are combining their recruitment efforts into an even bigger offering for employers and applicants alike. With a job board and a recruitment platform, they make additional resumes obsolete as long as the applicant moves on their platform only. In the filtering options there is also location enabled through the address given by the candidate, which means a recruiter can search for people in a custom area around the job location and find people who fit the keywords.

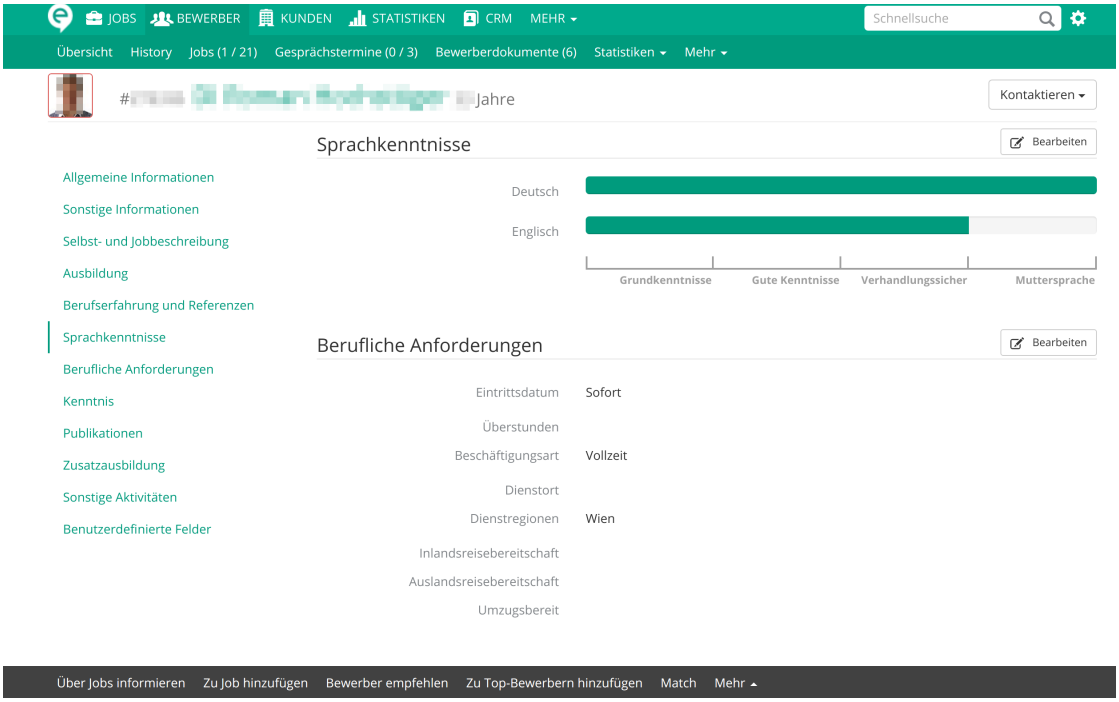


Figure 2.10: The eRecruiter software showing part of an applicant's profile.

Visualisations are not present in the eRecruiter software with the exception of language skill completion bars, as shown in figure 2.10. The CV 2.0 initiative is a suitable addition to existing recruitment software as it unifies the data format and enables many options for designs and filtering whereas current implementations are proprietary and meant to stay closed in order to push market reach. The problem is that these solutions stay local and, ultimately, big companies who manage to get more reach dominate the recruitment market with little option for progress and discourse.

There are several names for recruitment software and how it is being marketed - it is either simply called recruitment or recruiting software, Application Tracking System (ATS), or Talent Management Software. In essence, they have the same goals, with some having more or less functionality and features:

1. serve as a job board, internally or externally (i.e. within one company or as a portal to external job applicants)
2. let applicants register with their personal data and apply for jobs
3. filter applicants
4. save applicants

5. further simplify recruiters' daily tasks with automatic rejection messages, message template creation, interview invites, creating invoices
6. fulfulling other HR functions such as timesheets and vacation planning for employees

The CV 2.0 initiative only solves the input and filtering of personal data which means it is not a direct competitor to complete solutions. It rather serves the purpose of unifying data and making it easier for applicants as well as recruiters to input and edit their data as well as apply for jobs while being visually more appealing to recruiters. Additionally, the CV 2.0 solves resume formatting problems for people with disabilities, has the potential to tackle diversity problems within a company because any existing bias can be avoided by not letting people see the data that triggers their bias, and equally important, a CV 2.0 in its raw format is a small text file with no executable code and no macros inside. With proper security measures when reading in the data in order to display it in the desired design, the CV 2.0 is also a very secure system with minimal footprint (it requires text-only uploads and forwarding).

While some of the functionality of recruitment software becomes partly obsolete by an open source standard resume format, a lot of frustration for users can be taken away if they can reuse their data instead of having to fill in a new form with every employer, even though they already have a resume. On the recruiters' side, it becomes easier to filter and sort applicants plus they can use their own preferred visualisation to view resumes.

Current talent management or ATS are useful due to the lack of a standard resume format and user-friendly visualisations, they simplify tedious recruiting work, but this happens at the expense of applicants who have to go through numerous repetitive actions for each company that employs such a system. Resumes are only a minor part in today's talent management systems as they offer all or some of the following features relevant in the hiring process:

- talent acquisition through job boards, candidate management, automated candidate screening, onboarding
- employee trainings
- goal and performance management
- employee growth management
- employee reviews and recognition for potential in employees through custom metrics

While recruiting mostly serves as a synonym for the actions happening in the hiring process, there are many companies focusing on specific parts instead of offering a whole package like talent management systems do. Apart from the more academically trivial tasks of event organisation, job postings, and talent screening, some companies try to

solve problems from a more scientific approach. Most scientific appliances come in the field of sourcing, i.e. finding people via social media or otherwise on the internet to incorporate them into the wider search for candidates.

One notable company is Joberate who try to predict a person's willingness to change their job based on their social media updates and other metrics which are not transparent. They have trademarked the *J-Index* [Job17a] based on an algorithm that they did not open source, making it inaccessible. The software takes a web profile link from a person and outputs a number between 0 and 1, indicating the probability of their job willingness where 1 means 100% likely. It is not verifiable from the outside whether it actually is a complex machine learning algorithm or potentially a combination of simple calculations that outputs a number based on predefined conditions.

In order for such a system to actually work with reasonable significance of the output score, one would need to ensure that the following criteria are met:

1. historical data of the targeted social media profiles is present and can be accessed
2. the algorithm's core has to be a model that takes into account the various options why someone is updating their profile
3. the training data have to have a sufficiently high number of data points
4. the output scores have to be evaluated and verified for their veracity

These criteria all have their caveats which is why when Joberate state on their homepage that "No other platform has created so many opportunities to leverage insights about the global workforce." [Job17b], it is an entirely unverifiable statement unless the algorithm or parts of it are made public. Starting with the first item in the list, the storage of historical data from social media users can be grounds for legal issues especially with EU citizens, since Joberate would need to ask permission from each user it is tracking. Continuing with the second item, the model would have to take into account each company that is mentioned, their job positions, and what these positions entail. As an example, a person working in the public relations department of any company, is evidently more likely to post regular updates to a network than a regular employee whose daily job does not involve external communication. Addressing the remaining two points of sample size and result evaluation, we see that there is only the option of verifying if a person actually changed their job after the fact of changing it which would mean they had a 100% probability in job change willingness at a certain point in their profile history. Unless the scored people are manually asked whether they are willing to change jobs and they state that they are not, the model can only guess based on predefined conditions without learning much because an automatic verification of the results is not possible for the high amount of data that are needed in order to make the model function correctly in the first place.

Another notable product in the hiring industry is CVlizer [CVl17]. It is a CV parser from the Austrian company JoinVision used within several recruiting software back-ends which can parse information in various languages and, supposedly, it can parse "alle gängigen Dateiformate" (English translation: "all established file formats"). [CVl17] SVG (Scalable Vector Graphics) is not among the list of what JoinVision classified as "established", though. While CVlizer cannot process SVG, it is nonetheless a useful parser that is able to not only extract information from a resume, but also from certificates, cover letters, and other documents an applicant might send.

2.3 Existing Resume Standards

There were and are many attempts at creating a resume standard over the past two decades. Evidently, there is a demand by the three stakeholders - recruiting companies, employers, and employees - to update the current archaic process. Success for each of the resume standards varies and many have been abandoned. Some are mentioned on some pages from the early 2000s, but the respective websites are not available anymore. We will take a look at the current resume standards that are still available, mentioned several times on the World Wide Web on various sites that deal with resumes, and explore their potential for infographic resumes.

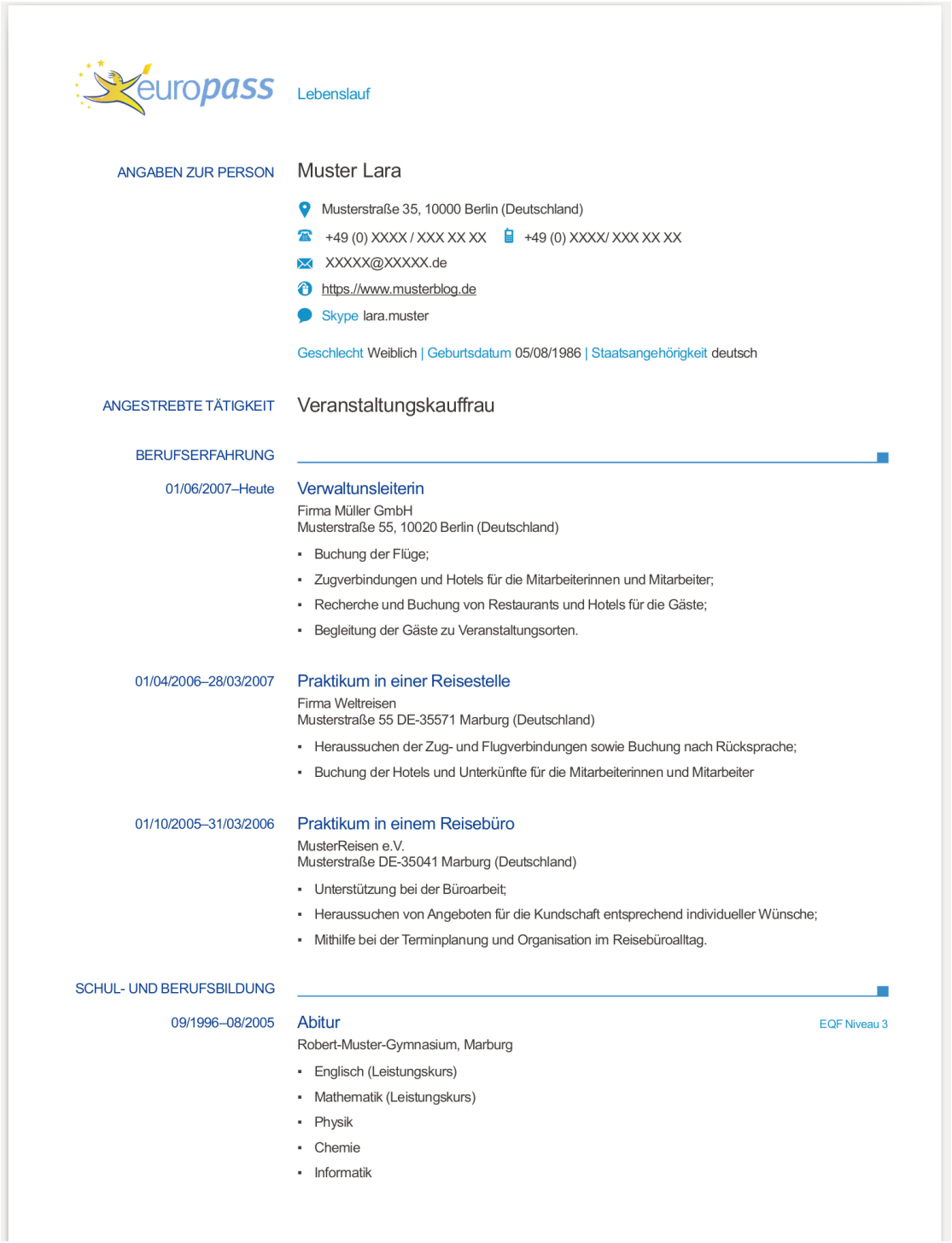
2.3.1 Europass

Europass [Eur17] is the European skills passport available in many different languages, showcasing personal information, language skills as defined by the EU as well as diplomas and certificates. Similar to the CV 2.0, Europass lets you do the following:

- enter your information line
- update your data by uploading your previous resume (your data can be extracted from PDF and XML files)
- download several CV templates

The Europass templates differ in language, but not in style. There is one design which is meant for all languages. This schema has no visualisations and offers no options for creativity or individualism. It might be well-suited for entry jobs or jobs which have a low skill requirement, but jobs that have a clear focus on design or technology will need other resume styles for applicants. There are no options in the Europass to include branding, be creative, or further edit the template without violating the principle behind Europass.

Figure 2.11 features a German Europass example taken from the official website, including a typo ("Verwaltunsleiterin" instead of "Verwaltungsleiterin"). While there is an informative guideline sheet with the template download for Europass explaining that a



europass Lebenslauf

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Geschlecht Weiblich | Geburtsdatum 05/08/1986 | Staatsangehörigkeit deutsch

ANGESTREBTE TÄTIGKEIT

Veranstaltungskauffrau

BERUFSERFAHRUNG

01/06/2007–Heute

Verwaltunsleiterin

Firma Müller GmbH
Musterstraße 55, 10020 Berlin (Deutschland)

- Buchung der Flüge;
- Zugverbindungen und Hotels für die Mitarbeiterinnen und Mitarbeiter;
- Recherche und Buchung von Restaurants und Hotels für die Gäste;
- Begleitung der Gäste zu Veranstaltungsorten.

01/04/2006–28/03/2007

Praktikum in einer Reisestelle

Firma Weltreisen
Musterstraße 55 DE-35571 Marburg (Deutschland)

- Heraussuchen der Zug- und Flugverbindungen sowie Buchung nach Rücksprache;
- Buchung der Hotels und Unterkünfte für die Mitarbeiterinnen und Mitarbeiter

01/10/2005–31/03/2006

Praktikum in einem Reisebüro

MusterReisen e.V.
Musterstraße DE-35041 Marburg (Deutschland)

- Unterstützung bei der Büroarbeit;
- Heraussuchen von Angeboten für die Kundschaft entsprechend individueller Wünsche;
- Mithilfe bei der Terminplanung und Organisation im Reisebüroalltag.

SCHUL- UND BERUFSBILDUNG

09/1996–08/2005

Abitur EQF Niveau 3

Robert-Muster-Gymnasium, Marburg

- Englisch (Leistungskurs)
- Mathematik (Leistungskurs)
- Physik
- Chemie
- Informatik

Figure 2.11: German example Europass resume taken from the official website. [Eur17].

resume should be checked carefully, the obvious typo in the Europass' own example does not follow these guidelines too closely, at least in regards to thorough spell checking.

Historically, the Europass started in 1998 when the European Commission set a goal to increase transparency around vocational issues, involving mobility in the European countries, new initiatives and dialogues around jobs and job applications, and bringing together the various representatives of each country. Several documents were created in this EU effort: the Diploma Supplement, the Europass Language Passport, and the Europass Mobility. All of these are aimed at making vocational topics work cross-border and allowing people to be vocationally mobile within the EU. They were incorporated into a single framework and shaped into the current website as a single point of contact for all matters around the Europass [Eur17]. There are also several national Europass centres coordinating efforts around the Europass and promoting it.

As a base for the CV 2.0, the Europass is unfortunately not the right path. Progress is slow and difficult to obtain since there is a clear political hierarchy and too many levels of bureaucracy to incorporate graphics. In addition, the Europass and the CV 2.0 are going in opposite directions - while the Europass aims at standardising the resume look, it offers no options to both give a standardised format for machine processing while achieving individualism on the applicant side and appealing to individual visual preferences on the recruiters' side.

An evaluation document from 2013 about the Europass [Eur13] clearly shows that while the Europass in general is successful, it is tightly coupled with other EU projects, mostly regarding youth and cross-border mobility. In terms of serving as a standard to use for the CV 2.0, the Europass is not the right choice, but it is possible to upload CV 2.0 resumes and have the form on the Europass website create a Europass-styled resume from the provided information and additional data the Europass form potentially requires.

2.3.2 HR-XML

In contrast to the Europass, HR-XML was developed to facilitate development in HR software and the automated exchange of information. The initiative is led by the HR Open Standards Consortium, who describe themselves as independent organisation "dedicated to the development and promotion of a standard suite of specifications to enable human resource related data exchanges." [Sta17].

As their main goal is interoperability, their focus is not on the design and look of resumes, therefore presenting the opposite approach of the Europass resume. The HR Open Standards Consortium is a business-motivated organisation with board members including people from SAP and Oracle who have their own widely used ATS to manage employees and applicants. HR-XML is a small subset of what the HR Open Standards Consortium offers as they also have specifications including other areas of the hiring process, such as assessments, employee benefits, performance measuring, trainings, recruiting, and several other topics in the field of Human Resources.

Examples

```
<EmploymentHistory>
    <EmployerOrg>
        <EmployerOrgName>General Electric</EmployerOrgName>
        <PositionHistory>
            <Title>Vice-President</Title>
            <OrgName>
                <OrganizationName>Aircraft Engines (GEAE)</OrganizationName>
            </OrgName>
            <Description>
                Key Player in the GE growth initiative...
                Ensured fundamental IT capabilities were present in...
                Led several new market opportunity assessments...
            </Description>
            <StartDate>
                <AnyDate>2002-02-01</AnyDate>
            </StartDate>
        </PositionHistory>
        <PositionHistory>
            <Title>E-Business Program Manager</Title>
            <OrgName>
                <OrganizationName>Aircraft Engines (GEAE)</OrganizationName>
            </OrgName>
            <Description>
                Led B2Bi initiative and interface that enabled...
                Personally managed and Created Customer Relationships...
                Led cross-functional team that led to...
            </Description>
            <StartDate>
                <AnyDate>1998-10-01</AnyDate>
            </StartDate>
            <EndDate>
                <AnyDate>2002-02-01</AnyDate>
            </EndDate>
        </PositionHistory>
    </EmployerOrg>
</EmploymentHistory>
```

HR-XSL Output

```
Work Experience

   Vice-President, Aircraft Engines (GEAE). General Electric. February 1,
   2002 - Present
     * Key Player in the GE growth initiative...
     * Ensured fundamental IT capabilities were present in...
     * Led several new market opportunity assessments...

   E-Business Program Manager, Aircraft Engines (GEAE). General Electric.
   October 1, 1998 - February 1, 2002
     * Led B2Bi initiative and interface that enabled...
     * Personally managed and Created Customer Relationships...
     * Led cross-functional team that led to...
```

Figure 2.12: HR-XML example for employment history and its HR-XSL output. [Cha02].

Apart from offering specifications and certifications, the Consortium also has a variety of development tools and libraries to help with the implementation of HR-XML into hiring software, mostly using .NET and Java, which also clearly shows the enterprise focus. The latest HR-XML library to download on their homepage is version 3.1 dating back to September 2010.

As a base for the CV 2.0, the HR-XML specification does not offer any options for visualisations and legibility within the raw resume file. In 2002 there was an attempt to reformat HR-XML files into DocBook format in order to then be able to further transform the resume into various other formats including plain text, HTML, and PDF. An example HR-XML tag for one employment history item including the HR-XSL output is shown in figure 2.12.

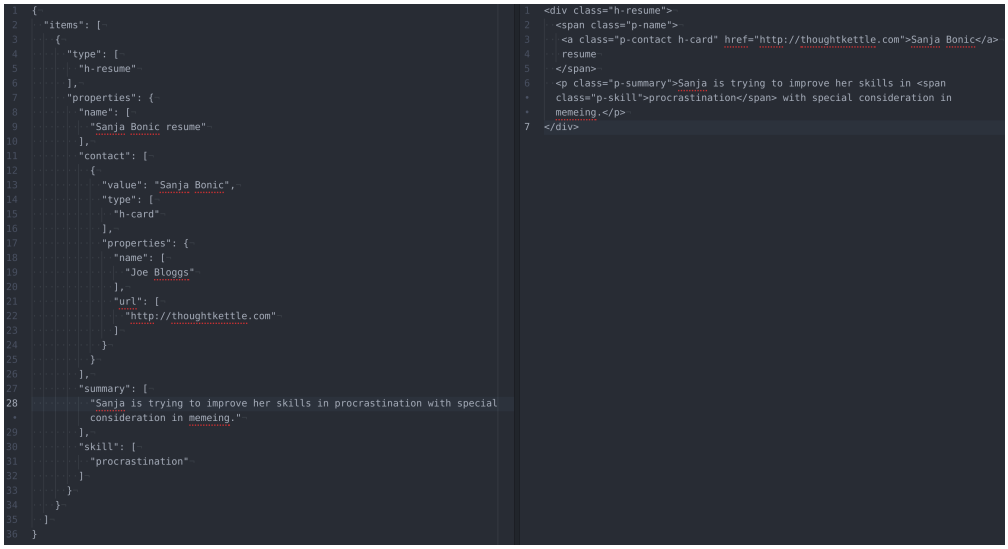

Figure 2.13: JSON-parsed hResume on the left, hResume-annotated HTML on the right.

Both Europass and HR-XML are slow-moving and embedded into big committees including politicians and enterprises with their own business interests, therefore unsuitable for the purposes of introducing a CV 2.0 where the main focus lies on visualisations, accessibility, and the two human ends of an application process - the applicant and the recruiter.

2.3.3 hResume

In their FAQ, hResume states that HR-XML was researched extensively before the creation of hResume, but the needs and goals were different and since HR-XML was developed from scratch, "it is likely to contain much that is not used by the 80% of resume publishers and thus it is unlikely that the two formats will ever converge." [Ç17].

hResume is a subset of microformats, a set of extra attributes within HTML that gives more context and meaning to content inside HTML tags. There are several microformats open specifications for different topics, among them resumes, recipes, events, reviews, and more.

Figure 2.13 shows a very small part of what an hResume HTML file would look like and its JSON-parsed representation on the left. As one can see, JSON tends to become almost as verbose as XML very quickly and it is hardly legible whereas hResume is more compact. As a base for the CV 2.0, hResume is not suitable since it is not widely used and neither actively developed nor maintained. It is also clearly (X)HTML-exclusive, which is not the focus of the CV 2.0.

2.3.4 schema.org

Schema.org [Sch17] is based on microformats, similarly to hResume, except that Schema.org vocabulary can be used within other languages than just (X)HTML as well. It is therefore a more extensive and more popular way to annotate data, hence adding microdata and semantic value to information. This information enrichment through microdata obviously benefits search engines - since Schema.org was founded by big corporations including Google and Microsoft, there is a clear interest to annotate data as much as possible. Resumes are not included in this vocabulary and there is no extension to the vocabulary featuring resumes yet since Schema.org mostly wants to annotate website data for crawling purposes. It is possible to create a Schema.org extension for resumes and was discussed on the public mailing list of the W3C Commmunity Group created for the CV 2.0 [Gro14].

While Schema.org is definitely useful as a base for the CV 2.0, it has a few caveats, which need to be addressed:

- The extension for a resume would need to be composed of several tags that already exist, such as "Person" and "Company", but since the tags were not designed for a resume, especially not a visual one, it is hard to incorporate them and would mean working against the schema in order to create something. On the other hand, there was some hesitation around and valuable input against creating a new resume format. Mostly, yet another standard for resumes did not make sense since quite a few of them already failed - or at least did not succeed on a global level - at becoming the status quo in the last two decades.
- A schema.org enriched file would need to be parsed by a parser just like any other file in order to be useful for recruiters, so there is no additional workload in having another format that is more suitable for visualisation for this aspect.
- Schema.org, like HR-XML and hResume, are too convoluted to be legible for a human reader, and since none of them are meant to be visualised (except for slightly visual formatting), one would have to adapt and bend their original specification in order to create visual resumes.

2.3.5 JSONResume

The resume format that comes closest to the idea of a CV 2.0 and is also the newest format out of the currently existing ones is JSONResume [JSO17]. It is a community-driven approach to create a JSON-based standard for resumes, centered around developers' needs for both implementation and resume creation. Started shortly before the CV 2.0 endeavour, it was done from scratch without much prior research as a hobby project, but is adopted by several thousands of developers as a simple way to create resumes. JSONResume features tags that are resume-related and defines a JSON file that is, in essence, a resume format.

Listing 2.1: Part of a JSONResume.

```
{
  "basics": {
    "name": "Sanja Bonic",
    "label": "Student",
    "picture": "",
    "email": "thoughtkettle@gmail.com",
    "website": "http://thoughtkettle.com",
    "summary": "Hier die Zusammenfassung.",
    "location": {
      "address": "Entenhausenstr. 313",
      "postalCode": "12345",
      "city": "Entenhausen",
      "countryCode": "Duckborough",
      "region": "Disney"
    },
    "profiles": [{
      "network": "Twitter",
      "username": "thoughtkettle",
      "url": "http://twitter.com/thoughtkettle"
    }]
  }
}
```

As shown in 2.1, JSONResume can get slightly convoluted, but is still more legible than other formats presented in this chapter.

There are a few resume creation sites featured on the JSONResume homepage which have adopted JSONResume and it is simple to use visualisation libraries to create interactive visual effects from the JSONResume contents. The community has also mapped out a JSONSchema. Having a concrete schema obviously is part of the intent of the CV 2.0 W3C Community Group as well. Since fragmentation should preferably be avoided, I have already talked to the JSONResume creator in 2014 but the two projects did not seem similar enough to warrant cooperation in the early stages. Now they seem to converge more so it is a good time to think whether the JSONResume can serve as a basis for the CV 2.0. It is not the same project, because JSONResume focuses on developers and ease of use in implementation whereas CV 2.0 focus is on applicants and recruiters. It is possible to combine the two projects, though, by using JSONResume as an underlying basis for the CV 2.0 instead of the proposed .cv2 format. The only things that are not possible to easily recreate in JSONResume are references, e.g., custom scales for skill values and references to them as will be further explained in chapter 4.

2.4 Conclusion

After having delved into the state of the art of research, industry, and existing resume standards, this section aims at shortly summarising our findings. To conclude, there is little research targeted directly at the resume creation process. Industry solutions are mostly proprietary and try to gain revenue, therefore a vendor lock-in is expected, but not beneficial to the overall hiring process on a global scale. Existing resume standards have gone through two decades of trial and error, with most of them being deprecated, old, or slow to progress. In the meantime, resume creation websites which again try to lock the applicants into their own site through mandatory registration and no data export, are coming up and also being shut down.

As of 2017, there is no known non-proprietary approach to solving the problems applicants and recruiters have to face on a daily basis in one complete system. JSONResume as mentioned in chapter 2.3.5 is most similar to the CV 2.0 and is also the youngest effort prior to the CV 2.0 while the other attempts to standardise a resume are mostly deprecated, barely used, or present possible baselines for a CV 2.0, but are not actually targeted at resumes.

CHAPTER 3

Methodology

Starting in November 2014, research around the topic of visualised resumes went through five stages before leading to a complete thesis. Some of the steps were conducted in parallel. One minor dilemma when researching the topic of resumes is the actual term "resume" or "CV", since search engines and scientific databases will interpret "resume(s)" as conjugations of the verb "to resume", and "CV" is also a popular abbreviation for computer vision whereas a regular search for just "CV" will result in a flood of pages about tutorials on writing (and formatting) CVs. With the proper additions such as "formats", "infographic", "hiring", "recruiting", and similar terms, it was possible to find good resources nevertheless.

Apart from carrying out continuous research, conversations and field work regarding resumes took place with many people inside the recruiting world as well as with members of the W3C (World Wide Web Consortium).

1. **State of the Art** Research started in November 2014 during a course at the Vienna University of Technology in order to write a state of the art seminar paper on *Visualising Resumes* without further task list. There was one link showing several infographic resumes. The goal here was to find a research question regarding that topic and write an unpublished paper about it. After a rudimentary search for what a visualized resume actually is, I decided to conduct two qualitative interviews to see if this kind of resumes is known to people who hire on a regular basis since those are the most likely to have been exposed to visualised resumes or have some insight that could be valuable in further research.

   The interviews lasted about 15-20 minutes each. One of the two interviewees is a regional manager for the CEE/MEMA (Central and Eastern Europe/Middle East, Mediterranean and Africa) region, regularly hiring people for his own team and the other is owner of an outsourcing and recruiting company hiring for multinational

Figure 3.1: Christopher Perkins designing his resume in the style of a subway map. [Kru10].

companies in several countries, such as HewlettPackard and Sony. The interviewees both have a Master's degree and are well-educated. Both have never heard of infographic resumes before. I showed them three infographics 3.1, 3.2, 3.3 that all looked different from each other after asking if they had heard of them before. The initial reactions were not positive.

The person hiring for his own team stated, "(...) this is too convoluted, it needs too much thinking, who would look at that until he figures out the meaning when there's other things to do? (...)" suggesting that the processing time was too long. He also said "the graphic should support the application, not be the main part of it". After a little exchange he said the best applicant he ever had and hired on the spot was a person who had researched his team's working process and made a plan of it. It was textual but it showed that the applicant had really put an effort in her application, making her the ideal candidate who stood out from the rest.

The person who owns the outsourcing company said, "I don't know anything without explanation, this is cluttered and unorganised. The pages are packed and

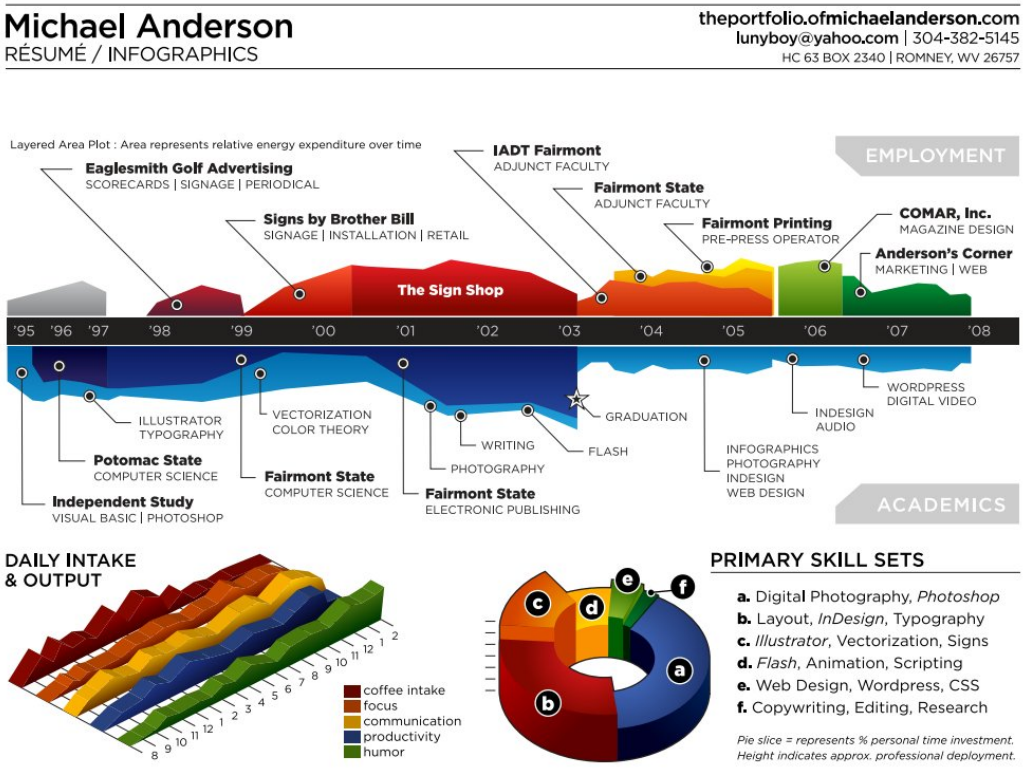

Figure 3.2: Michael Anderson's colourful infographic resume featuring several visualisation techniques, as seen at [Kru10].

such a resume would only make sense if it is really tailored to the company, but we usually don't tell what company we are hiring for." He further said, he looks through an average of 50-70 applications per job, and already knows what to look at, so he would not be spending time on this kind of resume unless the person has already attracted his attention with their textual resume. This interviewee suggested that it is a must to send a traditional resume and that no recruiter he knows would look at the infographic for data extraction in addition to the textual resume, so the effort is mostly wasted. According to him, his employees look at a resume for about ten to fifteen seconds until they decide whether to investigate further or drop the application.

Both interviewees stated that they would neither use nor recommend an online system that creates infographic resumes unless it has become an accepted standard like the Europass 2.3.1 for current CVs. Being asked directly about what visualisation techniques they would prefer on a resume that is just slightly graphical, the person hiring for his own team said he would not mind seeing bar charts or similar

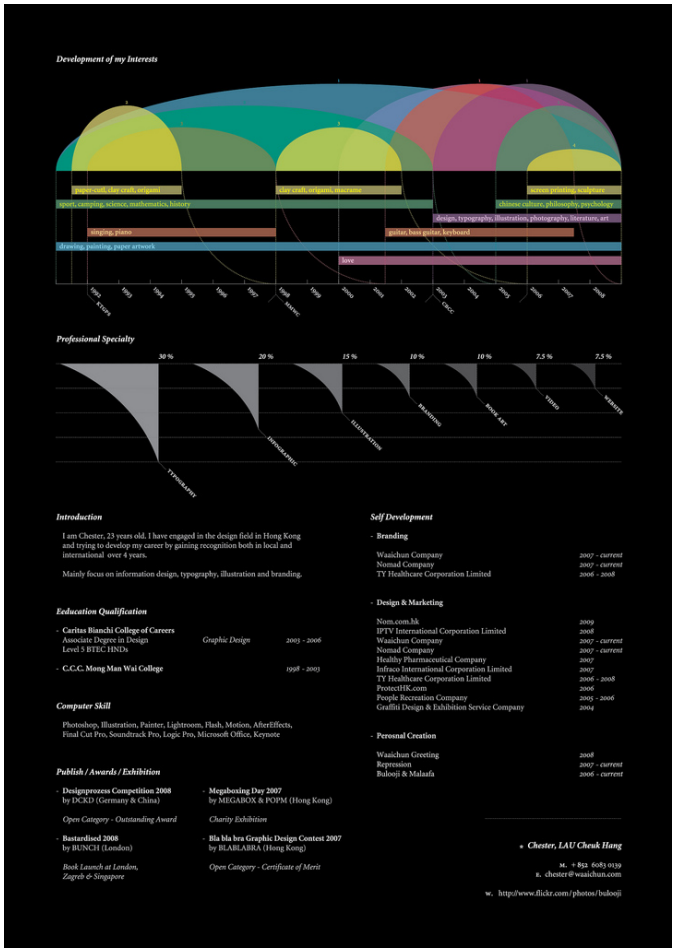

Figure 3.3: Chester Lau Cheuk Hang displaying his creative abilities, see [Kru10].

well-known charts for certain skills or interests or some sort of very clear timeline whereas the other person said he is used to scanning the resume to exactly what he needs, so unless it is a standard, he would not engage any further in an application containing any charts.

In addition to the qualitative interviews, I did a small survey among 24 colleagues working or studying in the fields of design or user experience. They were shown the same infographics as the two interviewees. Altogether, 26 people were showed three infographic resumes and they only had to rank them in their order of preference, adding comments if they wanted to. Out of the 24 survey participants and 2 interviewees, 75% chose 3.1 as the best infographic resume in their opinion. The infographic featured in 3.2 would have had more positive responses if the upper and lower left chart were easier to understand as the graphics were visually appealing for everyone but more than 40% of the participants did not know how to interpret them. 3.3 was not received well by any of the participants. This might have been

because it was not presented online but on photo paper where the black colour made it look less than ideal. One participant commented that it would have been a good resume "for a funeral home".

Aside from the interviews and small survey, the state of the art paper featured a short introduction to related work that is also incorporated in this thesis, albeit larger and more detailed, as well as a first idea and proposal for a *Gobal Resume Standard*. The latter then evolved into the CV 2.0 as presented in this thesis.

2. **Project I** At the same time as the seminar mentioned in the first step, a course called *From Design to Software* accompanied the seminar for those who wanted to design and/or implement something practical. In the initial proposal for this project, there was an outline for an open source system that would generate visual resumes which would serve as a graphical improvement over traditional resumes. The idea was that visualised resumes all seemed too different to be useful for anything other than demonstrating an individual applicant's design skills; ergo a system that would generate readable, maybe even accessible, visual resumes was a starting idea. A big focus lies on the open source part since almost all existing approaches to generate any kind of visual resume, independent of the formats used, are closed source and proprietary. There is a big and profitable market associated with resumes and hiring, so most companies or groups who come up with a certain way to improve the status quo of resumes want to generate revenue. While the commercial viewpoint is understandable, the many solutions to one problem significantly hinder the advancement of the application process. *Project I*'s goal was to provide a very rudimentary backbone system that could serve as a jumping point for future projects.

   In the scope of this course, the system was not meant to be visually appealing or output real infographics yet, but rather be a backbone architecture for a potential *Project II*. The main focus was to in the future develop a functioning system that creates SVG and HTML files with user data submitted through a form. Registration options and saving data were part of neither *Project I* nor *Project II*. At first, *Project II* was mentioned as possible future work where improvements to the system from *Project I* were in the foreground, such as adding actual functionality, templates to choose from as well as the option to generate individual templates through a programmatic templating system. Key decisions from *Project I* were meant to stay, such as leaving the registration optional and being open source.

   Project I also allowed the experience and examination of pitfalls and drawbacks of developing a similar system to those that already exist. The main workflow for all systems is:

   - fill out a form
   - system generates resume with some visual elements

   Since the majority of existing systems keep user data on their end and require registration, these are not valid options for real advancement in the area of resumes.

The purpose of *Project I* was to find out how current systems work and how visualised resumes could be created in an open source environment with templates that could then be edited by the users themselves in their own applications, thus supporting them with the initial creation of a visualised resume.

3. **Project II** Having investigated the state of the art of visualised resumes and introduced a basic system, *Project II* was meant to build upon that system to generate visualised resumes. The problem that *Project I* as well as the state of the art research identified was that recruiters are used to a special textual standard. They do not like even textual deviations from that as it makes the information they are looking for harder to find. None of the existing visualised resume systems help with solving that problem due to the lack of a standard that recruiters can and are willing to learn. There simply are no perceived benefits for the recruiters who already have a workflow with which they work reasonably fast.

   After examining how existing systems work and identifying that recruiters are used to a special textual standard and do not really want to see visual resumes that all look different from each other, two problems were defined. Firstly, there is no standard for visualised resumes. Secondly, there is no system that would use that standard to create, extract, filter, and visualise resumes. Therefore, *Project II* aimed at:

   - creating a standards specification using existing data and tools
   - developing a system that is able to evolve into accomplishing all of the following points:
     - creating resumes
     - extracting information from resumes
     - filtering information in resumes
     - visualising resumes

   The seminar paper accompanying *Project I* already mentions a CV 2.0 as possible future work and gives some ideas about how that could be accomplished, taking into account the feedback of a small sample from a survey and research about the state of the art of visualised resumes and resumes in general.

   After steps 1 and 2, step 3 was about improving *Project I* and defining a CV 2.0 in more detail as it was only presented as a basic idea before. *Project II* was an opportunity to start thinking about the impacts of a standard for visual resumes, what such a standard and its implementation would look like in the real world, and how people would be able to create, distribute, and read visual resumes. *Project II* already started with being divided into two parts - a specification and a system. Both evolved into the *CV 2.0 - Global Resume* and *cv2.io* during the course of this research, earning their own chapter in this thesis.

   Initially, naming of the CV 2.0 fluctuated between CV 2.0 and GRS which was meant to stand for Global Resume Standard. The decision to name it CV 2.0

has no special reasoning behind it other than it being arguably catchier and more modern, making it a better candidate for steps 4 (Business) and 5 (Community).

The purpose of a CV 2.0 specification as explained in *Project II* and a system implementing it was to be able to use both the specification and the system and develop visualisations based on them, so that:

- every recruiter can have their own preferred visualisation of all resumes they receive as long as those adhere to the standard
- every applicant can either use the website provided in *Project II* or any other website that provides such a service, since the specification is free and visible for everyone to build upon
- current systems that create visualised resumes only need to adapt their code so that a file according to the CV 2.0 specification is created and can be distributed, thus not invalidating, but rather enriching systems and services that already exist

We will look at the specifics and reasoning for the CV 2.0 in its dedicated chapter of this thesis. The system that implements this specification was given the project name *cv2.io* with the intent of changing it eventually once it reaches an MVP level, i.e. the level where it can be called a minimum viable product with basic functions and features implementing the specification and certain usability necessities such as an input form. From designing to implementing the system, the main focus was on not using any external libraries and frameworks wherever possible, so that the system is capsuled and ready to be embedded elsewhere or used as a standalone service without further overhead, bloat, or dependencies, no matter whether they are proprietary or open source.

The separation into two directions that crystallised from *Project II* can be further experimented with by creating a commercial business on one side and a community on the other. Future templates are meant to be good enough for the users to be able to directly apply for jobs or present themselves without further editing, but are not within the scope of this thesis.

4. Business As confirmed by two owners of recruitment companies, a company that hires via external recruiters pays roughly three times the monthly gross salary of the hired person. It is safe to say that the hiring market is big and highly competitive. According to data from Statista as presented in [Sta16a] and [Sta16b], the staffing and recruitment industry has been generating 130 billion or more US dollars since 2014 in the US only. In comparison, the expected revenue in Germany is about 26.9 billion dollars for 2016. With these numbers, it is easily explicable why there is an abundance of proprietary solutions trying to keep users on their own platform using their own services while retaining user data.

In order to test the viability of *cv2.io* as a brand and product in general, I submitted a proposal to the EU-funded Horizon 2020 Framework Programme as well as a

business plan to an Austrian institution that distributes ideas and business plans to investors and business angels. Both submissions happened in autumn 2015. They were both rejected. Specifics of the proposals are shared in the respective subsections of this chapter.

5. Community In addition to the business aspect of this research, there is the question of backwards compatibility and the frustrations of too many proprietary formats, plus the existing formats do not support the creation of graphical elements from the data which would therefore need to be added later into a separate file, obsoleting the purpose of one format. The details of the state of the art of various formats for resumes can be found in chapter 2. Since the current formats are lacking a representation for visualising the data into meaningful charts and diagrams, there is the need for a format that can combine the automation and filtering options as well as the semantics of existing formats with a way of attributing values and enumerations in a simple manner.

For the purpose of creating a specification that is publicly available and reviewed by other people with experience and interest in the topic, I have created a W3C Community Group. More information about the community efforts can be found in section 3.2 and chapter 4.

Thesis The thesis proposal started with the challenge of creation, usage, and legibility of a new and innovative form of resume that benefits both recruiters and applicants. A new global specification for resumes as well as an open backbone system that can evolve into creating, importing, and exporting these standard-conforming resumes into semantically useful files such as HTML and SVG are identified as a combined solution.

Two questions crystallised as follows:

- What defines a CV 2.0?
- How can global acceptance for this next-generation resume be achieved?

The main hypothesis is that current visual resumes are and should not be the norm due to their illegibility and processing difficulty, and that only an open system accompanying a global standard will be able to achieve the critical mass of acceptance. Therefore, the thesis is split into two parts. One is having a real and working standard that other developers can use to create new systems or with which they can improve their existing services. The other part is showcasing such a system that uses the standard from the ground up. In chapter 1 we have identified three problems we want to solve that play into the less specific questions of defining a CV 2.0 and finding ways to garner acceptance for it as mentioned before. Redundancy, file formats, and visual representation of information have to be solved before any attempts to achieve acceptance can be undertaken. These problems are solved by the combination of community efforts and having an open system. Open in this case means open source as well as free of charge. The system

needs to enable applicants to fill in their data once and download various versions, such as semantically correct HTML and clean SVG for further usage and editing as well as a textual PDF, and a new file format that is defined in the standard with community efforts. Recruiters can then import standard-conforming files in bulk, filter information, and apply their preferred visualisation style to each imported file.

Acceptance is then garnered slowly by taking several steps that can follow after both parts of the complete system that combines into a global resume are completed. See chapter 7.1 for ideas and steps on how to achieve acceptance once the necessary tools are in place. Actually doing them is of course not part of this thesis as this is an endeavour of at least a decade and is purely practical, needing a lot of resources such as marketing, proper financing, and - afer all - time.

This thesis is a documentation of the thought processes, research, and collected experience that helped lead to the creation of the CV 2.0. It serves as a solid foundation and jumping point for resume research and progress. It also gives one possible solution to improving the current status of resumes and questions whether it needs to be done at all. During the research process and several unrelated full-time employments, I came into contact with many international and Austrian recruiters and had between 50-60 informal and formal conversations about recruiting and the various processes that happen during the "time to hire" period. "Time to hire" is one of many ambivalent recruiting terms. It either - more commonly - denotes the time between a job being published and a signed contract or, more applicant-focused, the time from when a person sends their application to signing the actual employment contract. Through my research and resume efforts, I was asked in summer 2016 to take on a full-time position as Recruitment Analyst in the biggest recruiting company in Austria, which I accepted a few months later, while already in the process of writing the thesis. This direct exposure to the recruiting world as opposed to seeing resumes from a purely academical point of view with a bit of user research has influenced some views and especially conclusions drawn in this thesis. Therefore, the thesis comprises knowledge that originates in research, actual relevant work experience, and qualitative as well as quantitative interviews, conversations, and observations.

3.1 The Business

As noted in the previous explanation of five research and development steps and subsequent creation of this thesis, there is a business aspect to the topic of resumes due to the big revenue potential of the hiring market. This section breaks down the options to get acceptance for the CV 2.0 from a commercial point of view and why it is hard to combine global acceptance with commercial interest.

3.1.1 Horizon 2020

Horizon 2020 [EU15] is an EU-funded programme with several tracks such as *Excellent Science*, *Industrial Leadership*, *Societal Challenges*, and more. The section that was most fitting for the CV 2.0 was *Industrial Leadership*, specifically the subcategory *Innovation in SMEs*. SMEs are small to medium-sized enterprises. Normally, a real company is needed but when signing up via the EU registration form, entry as sole proprietorship was possible. Therefore it was a valid option to sign up and submit a proposal as sole proprietorship with a trade licence. Chances of approval for the submission were very low but I wanted some realistic feedback from several angles at the CV 2.0 idea.

The proposal was submitted on September 15th, 2015. After answering EU-specific questions regarding ethics and authenticity, the proposal itself consists of an abstract and a more detailed project description that is supposed to be separated into three parts: Excellence, Impact, and Implementation. The *Excellence* chapter focused on objectives, relation to the work programme, the general concept, ambition, and competitors. The *Impact* chapter was about defining the expected impacts on the market as well as measures to maximise that impact. *Implementation* then covered work packages, deliverables, and resources to be committed.

The general objective of this innovation project was a proof of concept and real world demonstration by creating a pilot system according to the standards specification for a CV 2.0 as well as finding partners who would support its further development. This would have paved the way to changing the status quo of the hiring process. The pilot system was supposed to be a better version of the system implemented throughout the two previous design and development projects if the submission had been accepted.

There were two possible funding options within this work programme. The CV 2.0 was submitted for the lower EUR 50,000 funding option where the concrete objective according to the work programme had to be a feasibility study. In this submission, the objectives for the feasibility study were defined as follows:

- final design for cv2.io
- implementation of a pilot that uses the CV 2.0 standard including partial exports to at least HTML and SVG
- detailed business plan that can be presented to potential investors so that the service can be developed further

The cv2.io system as defined in *Project II* was a bare system with many bugs that needed further development in order to be presentable as a minimum viable product (MVP). While the bare prototype is good enough as a proof of concept, it is understandably not seen as a product in terms of business. In terms of relation to the work programme, the CV 2.0 fits seamlessly within the scope of the Open Disruptive Innovation Scheme topic for Horizon 2020 as it fulfils the criteria of being innovative and disrupting existing models.

It is a new approach to CVs from both sides of the hiring process. Existing services always cater to either applicants or recruiters instead of seeing the resume as a tool that is used to visualise a person's life snapshot in order to convey a hiring message to a decision maker. The system developed during the steps leading to this thesis changes this by being involved in the creation of a standard that specifies the creation and usage of a CV 2.0 as well as focusing on its worldwide adoption which is only possible with external funding, ideally starting locally in Austria with some test runs once the prototype evolves into an MVP.

Furthermore, the *Excellence* chapter explained that the current application process is dissatisfying for both ends. In the section about concept and approach, the process, the problems, and the solutions were explained in more detail. At the time of the submission, there were six members with different backgrounds in the community group. While the community group is entirely independent from any commercial aspects, it needed to be mentioned as any commercial systems would always be working with the specification created by the community group.

Two stakeholders were identified in chapter *Impact*, namely applicants and recruiters both. The submission focused on describing the benefits for both, including improvements from other areas such as accessibility for people with mainly visual disabilities who cannot easily create resumes with formatting on their own. Apart from identifying the target group, the possible impact on competitors was defined. Some of them will experience an added value with a CV 2.0 in place whereas some might have to change parts of their own services and will steer against it, because their systems will end up being partly or fully obsolete. The main competitors comprise different markets. Applicant Tracking Solutions on the recruiter side are not direct competitors, but have parts of what the CV 2.0 solves. They automate resume filtering with different formats and at various success rates. One solution for them is to incorporate elements of the open sourced system that was to be provided with this project and change it according to their needs. On the applicant side, there are many tools that create resumes, but their development is stagnant and they mostly offer resumes exclusively on their site or as a PDF export, therefore offering no improvement to the hiring process as a whole.

The new solution was planned to be initially introduced to companies in the ICT sector and to recruitment companies as those are most likely to be primary customers to help reach the critical mass for global adoption. The relevance of market barriers is directly related to the possible revenue generation. A market barrier for both ends of the hiring process is that people need to be aware of the existence of a CV 2.0 without having to actively think about it. Ideally, this happens if they can download a .cv2 after any form they complete from any company. For the next company they apply to, they could then simply import the same .cv2 and they would not even have to worry about a CV 2.0 altogether. People who are aware of it can edit the file and use it for visualisations, the others simply have less effort in their job search through using one file throughout their job search. Recruiters on the other hand can import the .cv2 files and choose how to filter and visualise them based on their preferred ways. Companies that want to focus on

Table 3.1: ESR score

Chapter	Score	Threshold
Excellence	3.35	4
Impact	3.30	4
Implementation	2.66	4

diversity can tweak their filtering software so that recruiters and decision makers cannot check nationality, race, gender, or other factors within the first rounds.

Apart from the visual features, the CV 2.0 movement separates itself from the competitors by being transparent and open. No registration is needed and there is neither intellectual property nor knowledge protection or other regulatory issues.

The last part of the submission featured the implementation. The expected objective for the EU was to have a report on the results of the feasibility study plus a detailed business plan for future work packages and investment search. In this chapter, details about work packages and a time schedule were provided.

This submission was not funded due to the score in the evaluation summary report (ESR) not reaching the minimum threshold but the exact score points per chapter were given and good feedback can be deduced from those.

Evaluation Summary Report

The ESR was received on November 4th, 2015. The submission reached a score of 9.31 points. 13 points were needed for funding. Notably, points were lost for not having the relevant resources, team experience, and other business factors that could not have possibly been provided with this submission.

Things that were found *good to very good* (3.5 - 4.49) and which scored high points were (note: sentences in quotes are direct citations from the grading criteria of the ESR, including missing or too many spaces):

- "The proposal indicates in a convincing way that there will be demand/market (willing to pay) for the innovation when the product /solution is introduced into the market"
- "The targeted users or user groups of the final product/application, and their needs, are well described and the proposal provides a realistic description of why the identified groups will have an interest in using/buying the product/application, compared to current solutions available"
- "The innovation /solution has a clear European dimension both with respect to commercialisation and with respect to competitor / competition evaluation"

- "The proposal includes a realistic and relevant description of status and strategy of knowledge protection, the need of "freedom to operate analysis", and current IPR situation, which could include a plan for achieving this information.If relevant, potential regulatory requirements are also addressed"
- "The innovation aims at exploring new market opportunities addressing EU/global challenges"
- "The proposal provides a realistic description of the current stage of development and added value of its innovation as well as an understanding of the competing solutions. Includes good comparison with state-of-the-art, known commercial solutions, including costs, environmental benefits, gender dimension , ease-of-use and other features, or includes plans for achieving this information
  Note:In relation to the project content, e.g. gendered studies, clinical trials, etc."

Factors that proved to be *insufficient to fair* (scoring 1.5 - 2.49) were:

- "It is described in a realistic and relevant way how the innovation has the potential to boost the growth of the applying company"
- "The proposal demonstrates the alignment with the overall strategy of the participating SME(s) and the need for commercial and management experience, including understanding of the financial and organizational requirements for commercial exploitation. The initial commercialisation plan is outlined and explains how will be further developed (in-house development, licensing strategy, etc)"
- "The team has relevant technical/scientific knowledge/management experience, including a good understanding of the relevant market aspects for the particular innovation. If relevant the proposal includes a plan to acquire missing competences"

No parts of the submission were considered *insufficient* (0 - 1.49) or *very good to excellent* (4.5 - 5), some received a score of *fair to good* (2.5 - 3.49). As expected, the submission as a sole proprietorship with only one person proved to be a credibility issue. The scores for the potential of the innovation as well as the possible options for market needs and the target groups' use cases proved to be a step in the right direction, though.

3.1.2 Private Investors

Between September and December 2015 I have sent a business plan to three private investors as well as the *aws* (*austria wirtschaftsservice*). The *aws* is a non-governmental institution with close ties to the Chamber of Commerce and other governmental institutions. They provide advice, funding, and loans to startups and enterprises [aws16]. I contacted them around the same time as writing the proposal for the Horizon 2020 in order to garner as much feedback as possible from the commercial point of view.

For this stage of research, I needed to find out how to write a business proposal and focus on previously irrelevant things, such as revenue generation, clearer demographics, and licensing. Also, the language used for the EU proposal and previous academic writings needed to be adapted by simplifying sentence structures and introducing more numbers and less citations. After introducing the general idea and describing the status quo of the hiring process, there was a small section on privacy, licensing, and a brief project history of what had been done until the business plan. More importantly, exact plans on how the investment money was going to be spent were needed. After having dedicated some time to learn the financial aspects of a business proposal, the process of creating the business plan was fairly straightforward since the target groups and demographics were clear from previous writings. Another unknown field was marketing which is undoubtedly related to the research question of how to gain global acceptance. Marketing was proposed in the business plan to be conducted from several angles, like the following:

direct marketing to businesses Businesses will be individually approached to adopt the cv2.io system and integrate it to suit their recruiting needs. This includes free local instructions and free support for a certain amount of time.

direct marketing to applicants Unemployed individuals will be approached through job search websites and social media to use cv2.io since they can use the .cv2 to generate all common resume formats. Additionally, these customers will be encouraged to recruit additional users through premium template vouchers.

push marketing Businesses who adopt the cv2.io system will require their applicants to send a .cv2 file for applying with the company, thus introducing additional users to the service.

developer awareness One big sector of cv2.io marketing will be adoption by developers. cv2.io will offer an excellent documentation alongside an API that developers, including competitors, could integrate into their own systems. This will ensure that cv2.io becomes and stays known as being the original system using a CV 2.0. Proprietary software and closed-off internals are not be beneficial to wide adoption and global acceptance.

community building cv2.io will not only directly advertise its services via social media, but also create useful posts and tips on resume creation. As a comprehensive solution to resume creation, it will also regularly create templates and tutorials on subsequent editing of cv2.io's output files. Design contests will pull in more designers in order to guarantee a vast pool of templates that applicants (and recruiters) could use.

government cv2.io will approach Vienna's *AMS* (*Arbeitsmarktservice*, the governmental employment agency) first and will expand to other job centers in Austria and Europe in order to reach adoption and a solid customer base. cv2.io will also work on establishing itself as part of the curriculum in resume writing courses since unemployed people can then focus on the cover letter writing rather than formatting their application themselves.

These steps were all meant to happen gradually, but at the same time in order to increase awareness of the global resume project. Another significant part of the business plan were competitors, including a comparison between them and what separates their features from cv2.io. The standardisation efforts from the community group were not part of the business plan as they have no commercial interest whatsoever. However, they were mentioned as the system builds upon and implements the decisions of the community group.

Interestingly, two of the three possible investors including three consultants from the *aws* had the same answer, one did not reply at all. There is one flaw in the business proposal and most likely it is the same flaw that the EU commission saw as a hindrance to the growth of the "applying SME": the factor open source and the underlying transparency. Today's startups often call themselves open source while most of their core system is not in fact open sourced. They open source a part of their services while the rest stays proprietary or they build a corporate system, an Enterprise Edition that offers support for a fully open sourced project. This enables them to appeal to the open source community while staying strong on the commercial side. Two companies working with this model are GitLab [Git16] and WordPress [Wor16]. GitLab is a direct competitor to GitHub, both are a VCS (version control system). WordPress is a blogging engine. Both systems have a corporate edition with support and hosting as well as on premise solutions that everyone can use freely on their own servers. In the business plan for private investors, a similar model to those of GitLab and WordPress was suggested for cv2.io. According to the unanimous responses, it is not a strong enough business model, though. Since the core business is an easily formatted visual resume file, it can be copied into bigger systems without effort since it is open sourced, therefore making the cv2.io obsolete which directly results to a risk too high for any investor. These concerns are fully valid and the main point of the global resume is not to make profit but to change the hiring process. Unfortunately, this needs resources which leads us to the only valid option and to the next section: Bootstrapping.

3.1.3 Bootstrapping

In the startup scene, *bootstrapping* a startup means the founders pay with their own money instead of searching for third party investments. On the one hand it enables them to work without restraints, on the other hand their restraints are defined by the limits of their own financial capabilities. Having established over the course of four months that investors need a commercial value that cannot and should never be extracted from this next-generation resume movement under the cost of compromising transparency and openness, it is clear that the financial aspects of an endeavour such as a system implementing a new type of resume will need to be carried out without external funding.

Since the actual development of the system was carried out during two projects and this thesis, there are no additional development costs for the prototype. For a polished product, even with minimum viability, it is inevitable to spend more time than the projects and thesis allowed on creating better branding, graphics, usability, and functionality.

3.1.4 Conclusion

At first glance, it seems impossible to combine global and inclusive resume progress with commercial value. The word *inclusive* here refers to diversity and accessibility efforts which are often overlooked in most commercial projects due to their perceived additional efforts in design and implementation versus the possible profit margin. The greatest hurdle for external funding seems to be the openness, i.e. the loss of intellectual property and patent options that come with being open source and allowing for redistribution. The innovation potential and general idea were acknowledged and well-received by both the EU Evaluation Summary Report as well as the aws and private investors.

For the means of awareness and acceptance of a CV 2.0, the capabilities of the system that implements it definitely need to extend the proof of concept created throughout this thesis and previous projects.

3.2 The Community

As mentioned in earlier sections, the specification is decoupled from the system implementing it. As a means of having a peer-reviewed specification and an option for the specification to evolve into a real standard, I have created a W3C Community Group in August 2015. The W3C (World Wide Web Consortium) is responsible for web standards and standards that initially started with web-related topics, but also comprise other relevant areas such as SVG, secure payments over the internet, digital publishing, and other loosely related areas. Since the CV 2.0 is a global movement and has SVG as its distinguishable feature, a W3C Community Group seemed to be most suitable in order to promote visual resumes. Read more about the community group in its dedicated chapter 4.

3.3 The Technology

Research started with a state of the art paper and a very basic framework idea for *Project I* as previously described. Since *Project I* happened at the same time as the paper research, it was only an idea without any fundamental research behind it. *Project II* then refined *Project I*. The exact technology and reasons behind the system are explained in chapter 5.

After conducting two qualitative interviews and a small-sample survey with 24 people, I had a base from which I could work on a concept for a real advancement in the area of resumes.

Table 3.2 shows which steps were taken when in regard to concepts, design, and technology.

Once the initial knowledge gathering process was completed, a basic system idea emerged from it. For this first design it was important to be lightweight, stay flexible for further possible projects which were not fixed yet, and be able to serve as a proof of concept. In

Table 3.2: The cycle of steps taken throughout this thesis.

2014 Q4	state of the art research
	interviews and survey
	basic system design
2015 Q1	basic system implementation
	design improvements
2015 Q2	advanced system design
2015 Q3	specification structure and content
	advanced system implementation
2017 Q1	state of the art research and further improvements

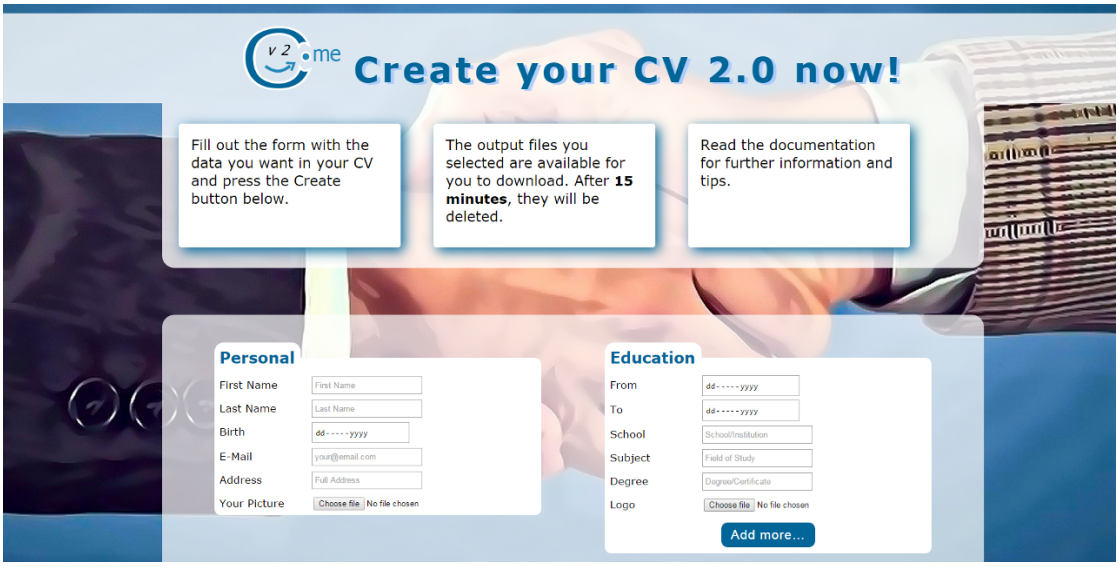

Figure 3.4: Part of the very first of many design iterations for cv2.io, initially named cv2.me.

the third quarter of 2015, both projects and the paper were completed, as were several iterations of system design and implementation.

Figure 3.4 features the first in a line of many design iterations and implementations for the system, even before there were any efforts to create a standards specification. The first design was shown to eight of the previously surveyed people and one front-end engineer who works for XING which is the direct competitor to LinkedIn, both platforms being social networks for professionals and highly frequented by recruiters and applicants. XING and LinkedIn play a vital role in the recruitment process. According to all nine people who were shown this first design iteration, it did not live up to what the system should be - a common "complaint" was that it looked too playful. Therefore, it was clear that more iterations were needed, especially around the logo and background picture.

Both design and a functioning implementation are important to gain the acceptance needed for the CV 2.0 to reach the momentum of self-perpetuation.

The development of the system happened locally on one computer and one virtual private server (VPS) that is remote and acts as the web server. Since file and object permanence are not needed, indeed quite contrary to the cause of privacy, a database was not needed for the proof of concept. Created files get deleted after a certain time amount and the code is open sourced so users can convince themselves whether and how their data are saved. This builds up the trust that is needed in order for such a system to work for a broad demographic. Since the system was expected to be further developed after the thesis, it was important to enable people to embed it into their own applications as well as build and run fast without having to download external dependencies and bloatware. Thinking ahead, it was also necessary to make the system as high-performance as possible since the generation of SVGs from form data will require some computing power as well as the generation of an actual next-generation resume format and other formats that the user might want to output, such as HTML and PDF.

3.3.1 Data Models

During the first concepts and for the first project, data models were not considered because they were not needed in the form of data in a database. What was considered within the constraints for the second project, were data structures, how the form data are actually saved, and whether to save a .cv2 first and then use that data to generate different formats, or whether to generate the formats first and simply consider .cv2 a format as well. While the second option seems counterintuitive to the whole research project since the aim is to generate a .cv2 which can then be translated into other formats, this is a general concept that has little to do with the actual implementation and optimising it for fast computing times. Data models are not part of the CV 2.0 specification as they can vary per implementation and are not important in regards to a CV 2.0. Theoretically, a CV 2.0 does not even need to be saved as a .cv2 in regards to format exports, it only serves as a format to save data so it can be imported easily for further changes and exports. For more details around data models, please read chapter 5.

3.3.2 Design Methods

Regarding design methods, the first steps were collecting visual resumes as well as looking at visual resume creation sites. After the collection phase, there were three different design foci to be considered. During the seminar and projects, the website for a possible CV 2.0 implementation and the templates were two foci. The third aspect is less about visual design and more about textual presentation and specification design, so there was another collection phase of standards specifications and possible templates in order to produce a specification that would resemble similar standards.

As shown in figure 3.5, sketches of colours were mixed with minimal wireframes and general brainstorming. Usually, one design session involved every aspect of the expected

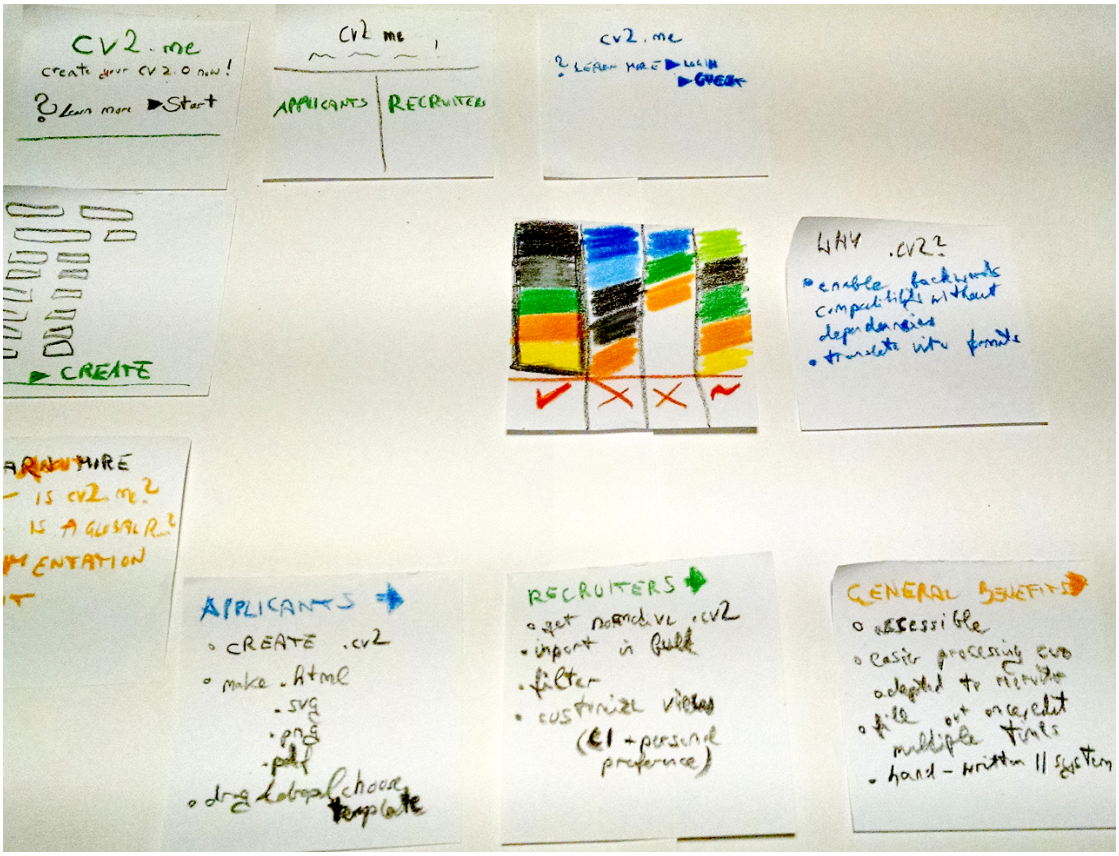

Figure 3.5: Small part of the sketches created during the initial website and paper writing design process.

results rather than focusing on one particular aspect such as colours, wireframes, template designs, or the specification itself. The sketches were then shown to one to two available colleagues working in the design area to verify whether the sketches were going in the right direction. The result of those "going public" steps was mostly negative, as in "the logo does not fit the material design approach" or "the website does not look sophisticated enough". After some inquiry, *sophisticated* mostly meant that I should have used popular templates for the website which was not the goal of a minimalist project with potentially big impact. Since the project is open source and embeddable, there is the option to use the back-end and enrich it with any library or framework desired. One important design decision of this thesis and previous projects was to stay as lean and self-sustained as possible without relying on too much or any external sources for the sake of extensibility, performance, privacy, and security.

3.3.3 Programming Languages

The programming language was a crucial decision because the whole system's ecosystem depends on it, which servers can be used, what libraries, how fast it is, how good the existing documentation for each of those parts is, and how well the system is able to be integrated into other software. All these concerns needed to be taken into account. Most programming languages need to be supported by existing web servers such as Apache or nginx. Other options are web servers specifically targeted towards a certain programming language like Apache Tomcat and Jetty for Java. The problem with Tomcat and Jetty is that usually they run on a server that also needs to serve static sites as well as run scripts that are not written in Java. Therefore, Tomcat and Jetty are usually coupled with a server like Apache and nginx in order to cover all use cases which impacts the performance due to several servers running at the same time. For the proof of concept, only a minimal web server with URL rerouting and static site serving was necessary. While Apache is a great server for a broad range of websites, it is too big and bloated for our use case plus embedding the software somewhere else is not as easy if the system is designed to be used with Apache. At best, some parts of the software would need to be rewritten for the embedded use case. Since the embedded use case is a vital part of the system concept as a whole, it made no sense to start with Apache, nginx, or Tomcat for that matter. Jetty is a great server for both standalone and embedded web applications, but using Java means using a JVM which again is a performance setback plus at least one web framework and a templating library would be needed in order to be somehow efficient. While Java Server Pages (JSP) without a framework works well enough, it would have rendered the efforts of the projects and thesis out of scope because the standard Java library does not feature the things needed for the CV 2.0 system. C++ is not really a web language and many dependencies would have been used in order to develop the proof of concept, so the choices were between Node.js, Python, PHP, Ruby, and Go. Python, PHP, and Ruby either need frameworks or complicated processes in order to work so the decision fell towards Go for several reasons.

Go is a language that is very fast and has a powerful standard library that is not bloated and features all the things our system requires without having to pull in external dependencies. According to several benchmarks that can be found online, one of them at [Ali16], Go's performance lies between C and C++ on average. For most programming problems, it is several times faster than Node.js, does not need an additional web server, and has an efficient templating language which is good enough for the CV 2.0 requirements. Hence, Go was the go-to programming language for our system from the very beginning. The complete back-end of the application is written in Go whereas the front-end features HTML5, CSS, and vanilla JavaScript. The back-end includes a full web server as well, meaning the whole system is entirely independent and can run on any computer that has Go installed. If Go is and will not be installed, the system will need to be pre-compiled for the computer it is meant to run on.

3.3.4 Standards Specification

During the first project, the CV 2.0 was a simple bullet list defining what a CV 2.0 should include and what it should not include. Most of these items were in one way or another integrated into the real specification that followed after both projects. The biggest focus was that even a visual CV should still be easily printable since the premise was that recruiters tend to print a lot of the CVs they receive, therefore invalidating CVs with dark backgrounds and bright text. This idea evolved into writing a proper specification, resulting in more research around standards and the decision to create a W3C Community Group. The W3C recommends their own set of templates for deliverables of a community group, such as reports or specifications. One such template was chosen for the CV 2.0 standards specification.

For the contents of the specification, several iterations of implementation, discussions with the community group, and brainstorming sessions were needed. The decision for an own format with the .cv2 extension was made via the community group on September 9th, 2015. The possible options were several existing standards that are not widely used or creating a new one with proper visual components that would be hard to incorporate into the existing schemata. While it is generally not a good idea to create a new format when there are several others available, the CV 2.0 focuses heavily on visual elements and better information processing as well as semantics and human readability. For more details about existing standards, please refer to chapter 2. More information about the discussions within the community group as well as the syntax can be found in chapter 4.

3.3.5 Conclusion

The technology used throughout the research and implementation phase encompasses several stages of software design and development such as sketching, wireframing, qualitative and quantitative user experience research, actual development of both front-end and back-end, server setup and maintenance as well as format specification and participation in a user group. What has been developed is a minimal, embeddable system that is based on a specification for a new text format that might be usable for other types of information where graphical data need to be incorporated into a visual file without the manual work of editing the graphical file itself. More details about this possibility of future work can be found in chapter 7.1.

CHAPTER 4

CV 2.0 - Global Resume

The idea of resumes and the resume process are presently still old-fashioned but there is a trend towards innovation. Unfortunately, the energy that is put into innovating the process is mostly hidden inside proprietary solutions, therefore avoiding propagation and ultimately leading to many fragmented solutions of one and the same thing, both on a political as well as a corporate and community level.

For the purposes of gathering the specification and use cases needed for a next-generation CV on an open and transparent platform, I have started the CV 2.0 - Global Resume W3C Community Group [Bon17]. The World Wide Web Consortium (W3C) is responsible for several standards used in the World Wide Web, including HTML, CSS, and SVG. As I was a member of the CSS Working Group, the creation of a Community Group around the CV 2.0 seemed the right choice to enable a properly global next-generation resume with worldwide participants. The group needed several signatures after announcement to be founded. Proposed on August 1, 2015, it was founded with the signatures of five supporters shortly afterwards on August 10, 2015. As of May 2017, the group has 16 participants, coming from universities around the world as well as front-end developers and recruitment consultants. Participation on the mailing list has been low so far and there have not been any contributions by members yet. This might also be due to the strict rules set by the W3C regarding contributions and archiving of communication.

The group's goals are first and foremost:

- specifications on the creation and usage of a CV 2.0
- guidance on the implementation of new systems using the CV 2.0 and integration into existing professional networks or resume filtering software, templates, and style guides

The main deliverable for the CV 2.0 - Global Resume group was a global resume specification, including a best practice recommendation and a clear description of what a next-generation resume entails. Other deliverables are and could be use cases, templates, design recommendations, style guides, APIs, and further implementations. A CV 2.0 is a well-formed and accessible resume format that supports applicants as well as recruiters. Requirements in knowledge that are needed to understand the full extent of what a CV 2.0 needs are:

- recruiting process
- current resume standards and existing markup languages
- HTML, CSS
- SVG
- WCAG (Web Content Accessibility Guidelines)
- interaction/graphic design and user experience research

All software, if any, developed by the community group is open source and subject to the MIT license, as stated in the community group charter. There are therefore no issues of proprietary code or required registration to use anything the community group produces. The community group is a solely volunteer-based interest group in order to create a specification that benefits all people involved in the hiring process.

For the purpose and the extent of this thesis, the community group was created and a rudimentary specification was created [Bon15]. We define a CV 2.0 in its graphical form as follows:

- screen view: zoomable and still readable at a standard resolution in fullscreen (1280px width)
- representing the main parts (professional experience and skills) with visualisation techniques that convey the information that would have otherwise been presented in textual form
- no hovering elements
- no animations
- avoid dark colours for background elements

There are two concepts to differentiate. In essence, a CV 2.0 file is a machine- and human-readable file that supports more efficient creation, editing, and information processing of resumes. A CV 2.0 as term overall is the concept of a global resume as well as the

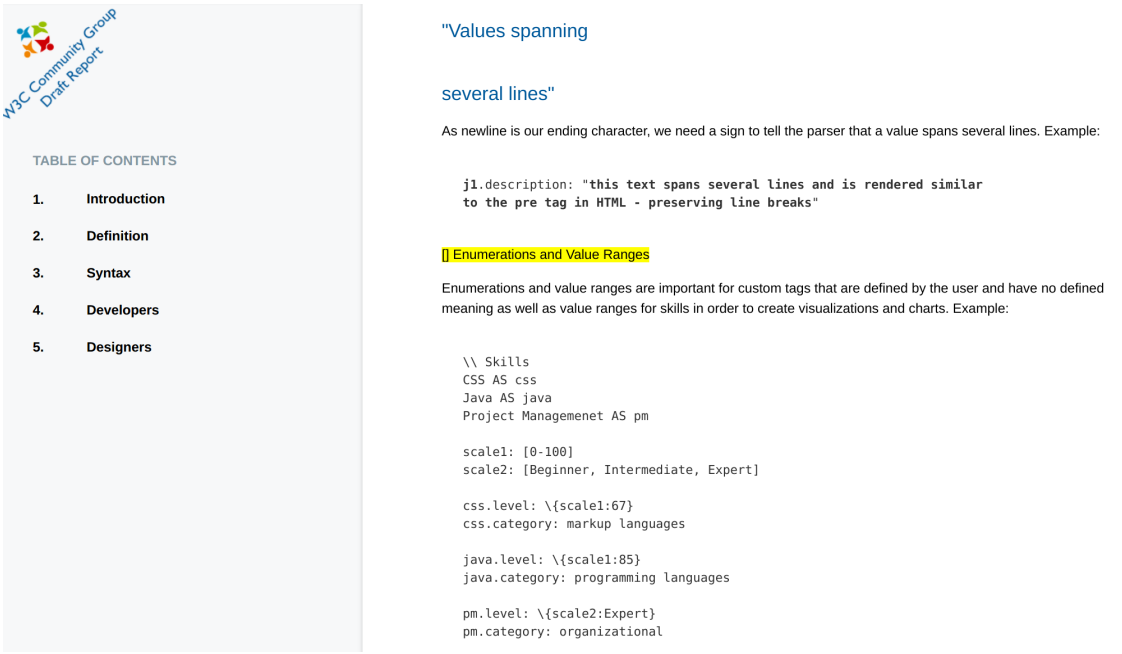

Figure 4.1: Screenshot of the CV 2.0 specification showing the syntax for scale values to be used for visualisations.

actual files used. While the specification does recommend a legible syntax that allows for incorporation of graphical differentiators through custom scale elements, it is not mandatory to use a CV 2.0 (.cv2) file in order to produce a CV 2.0. There are not many options to use as underlying basis though, only JSONResume provides a still fairly legible way while not introducing too many tags and being too difficult to parse. That means, any implementation of a CV 2.0 would need to use a CV 2.0 syntax as described in the specification or JSONResume, which has the implication that references and custom scales for values are not possible and therefore make visualisations difficult.

As shown in figure 4.1, scales can be defined in the .cv2 syntax by the applicant in order to show their value in the resulting visualisation. This is valid for any kind of visualisation that needs to reference values in order to order the information, including but not limited to one of the most common visualisation techniques: bar charts.

To reiterate, one of the most distinctive features of a .cv2 and JSON are references that can easily be used within the file. While JSON and therefore JSONResume are purely descriptive, the .cv2 adds meaning and value to the data while staying as minimal as possible.

Listing 4.1: CV 2.0 syntax example for skills.

```
\\ Skills
CSS AS css
Java AS java
```

```
Project Managemenet AS pm

scale1: [0-100]
scale2: [Beginner, Intermediate, Expert]

css.level: \{scale1:67}
css.category: markup languages

java.level: \{scale1:85}
java.category: programming languages

pm.level: \{scale2:Expert}
pm.category: organisational
```

The code featured in listing 4.1 shows the custom scale values that can be assigned either automatically in the implementation or by the applicants themselves. The syntax slightly resembles SQL and features aliases, so that attributes can be added to a value. In this example we have *Project Management* aliasing to *pm* and are using the previously defined *scale2* with its values *Beginner, Intermediate, and Expert* to assign the *Expert* status to our *pm* skill, also categorising it into *organisational*. These attributes are not contained in any of the existing resume standards because those were not intended for visual representation.

The difference of JSONResume to the CV 2.0 is that JSONResume has a clear focus on developers and implementation whereas the CV 2.0 sees the resume creation implementation as one part of the process. We are working on a usable resume format and a next-generation resume, not another machine-readable resume, although JSONResume does offer much better solutions and new options than HR-XML, hResume, or Schema.org for reasons mentioned in chapter 2.3.

The existing resume standards are not competitors to the CV 2.0 as a whole since they do not offer comprehensive solutions but rather tools for developers and for one particular markup. They were a consideration when deciding on creating a new resume format named .cv2, though. A public discussion on the decision for a new resume format can be read on the public mailing list from the community group ([Gro14]).

One way to implement the CV 2.0 with the functionality of referencing that the CV 2.0 needs are nested JSON declarations within a file. Unfortunately, for a large file as results from a JSON-formatted resume, this would be fairly illegible for humans (similar to XML), albeit quick to parse for machines.

Listing 4.2: Nested JSON as an option for referencing.

```
{
"basics": {
  "foaname": "Sanja Bonic",
```

```
  "education": [{
    "school": "Vienna University of Technology",
    "degree": "yes, please"
  }]
},
"scales": [{
  "name": percent,
  "type": percent
},
{ "name": level,
  "type": fixed,
  "width": 3,
  "labels": [Beginner, Normal, Expert]
}],
"skills": [{
  "class": "Computer Science",
  "type": "Programming Language",
  "name": "Go",
  "scale": {
    "name": level,
    "value": Expert
    }
]
}
```

Listing 4.2 shows that cross-referencing within a JSON file gets illegible and prone to syntax errors, which means a human should never edit this file, defeating the purpose of quick edits. The CV 2.0 motto is *edit once, use anywhere*. For people in the technology sector, editing their CV 2.0 file is a matter of seconds if the syntax is simple and legible, and means their private data are not uploaded anywhere whereas others can either upload it to a system they trust, or use an implementation of it locally to edit their CV 2.0 once and then have the output in several formats without ever using an online service for it.

Resume content should be separate from the application and implementation. It should only contain information relevant to the person's data and skills, hence microformats' hResume, Schema.org, and HR-XML do not fit. They are too verbose and designed for other use cases, as has also been cleared up on the public mailing list. In the case of JSONResume, the references are difficult to implement, but there is one advantage to JSONResume over .cv2, namely performance. Since JSON syntax is rigid, it will always be able to parse faster than a .cv2 file. Benchmarks for this would be a part of future work as writing an actual lexer and parser for the .cv2 goes beyond the scope of this thesis. On the other hand of the argument, as mentioned, JSONResume is not able to cross-reference within a file and add data wherever in the file. One example for the CV 2.0 is that an applicant can manually edit their .cv2 file by adding new work experience

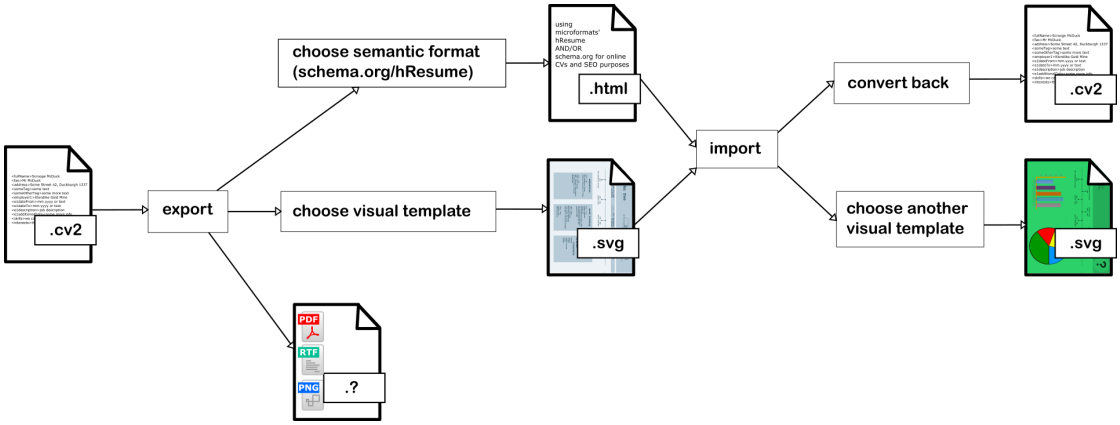

Figure 4.2: Graphical explanation of the CV 2.0 process.

wherever in the document, so it can become a cascading resume file without having to take care of a particular order, as long as the tags are correct. This also means that old information can be kept intact, if the applicant wishes because if two items are identical, the .cv2 output generated will only consider the latest addition, in the same way that CSS (Cascading Stylesheets) works.

Existing solutions are based on one way to present a resume, thereby mostly excluding other options, formats, and visualisations. Much like a passport has all important data needed for travelling, a CV 2.0 represents a job passport that can be filtered, printed, and viewed in several formats and visualisations. Translation tags have been considered but would add bloat to the CV 2.0 file, so that the recommendation is definitely to have one file per language as a compromise to legibility.

As demonstrated in quote 2.1.1 in chapter 2.1.1, spelling out clear characteristics of what is looked for in a job applicant does not directly translate to the highly subjective process of screening a candidate's resume. While the CV 2.0 cannot solve the problem of people being biased for various reasons, it can minimise the effects by hiding certain attributes, such as name, gender, or race. Even other attributes can sometimes be used for hiding, for example when a team wants to focus purely on developer experience, but do not want the decision makers to be influenced by seeing that someone has x years of experience in their favourite programming language.

Regarding accessibility, all resume creators that allow input through a form and then generate a pre-formatted and styled resume are helpful. As long as the form input is properly tagged with the correct semantics for people with disabilities, blind people and people with other visual or motoric disabilities can fill out the form and have their resume created for them without needing additional help. This positive trait is not exclusive to the CV 2.0, but definitely an important factor in its overall usefulness.

Figure 4.2 is a graphical explanation of the CV 2.0 process. Ideally, a .cv2 file can be exported into various other standards and file formats as well as converted back without

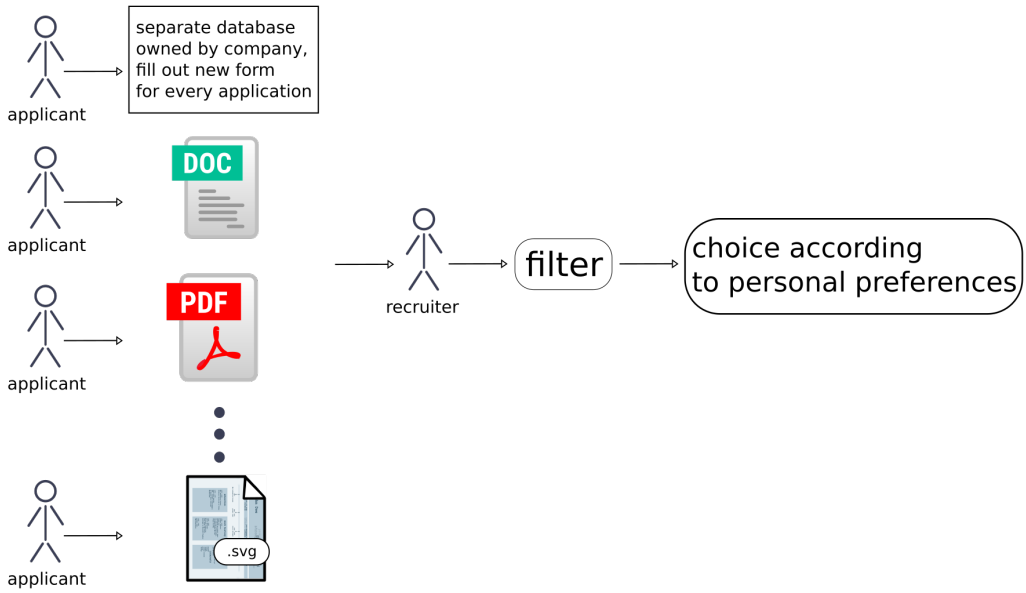

Figure 4.3: Simplified graphical explanation of the old resume process for recruiters and applicants.

too many additional steps lowering the overall performance.

Figures 4.3 and 4.4 showcase the old resume process versus the CV 2.0 one. In the old resume process, the applicant would have several ways to send his resume in various formats, mostly having to maintain several formats since companies require different formats sometimes, but also applicants often have to input their data repeatedly in various databases. With CV 2.0, if the acceptance grew, applicants could optionally send just their .cv2 details either by uploading them into the form where they would usually have to input their data or they could just send the raw data format. Naturally, they could also send the generated output files instead. On the other side, the recruiter can filter more easily because the system can be more accurate since the data files are in one format. This would render parsers like CVlizer as mentioned in chapter 2.2 obsolete.

When designing the CV 2.0, several use cases were kept in mind after interviewing recruiters about their day to day job. Some use cases in simple form are as follows:

Filter Resumes for Java Experience The primary actor chosen for this use case is: **Recruiter (Sascha Selection)**

Scenario: Agent Smith has three jobs to fill for his client, a bank. He is looking exclusively for developers who have at least three years of experience with Java. He is using his corporate system to filter the applications he receives via e-mail and via the form on his company's website.

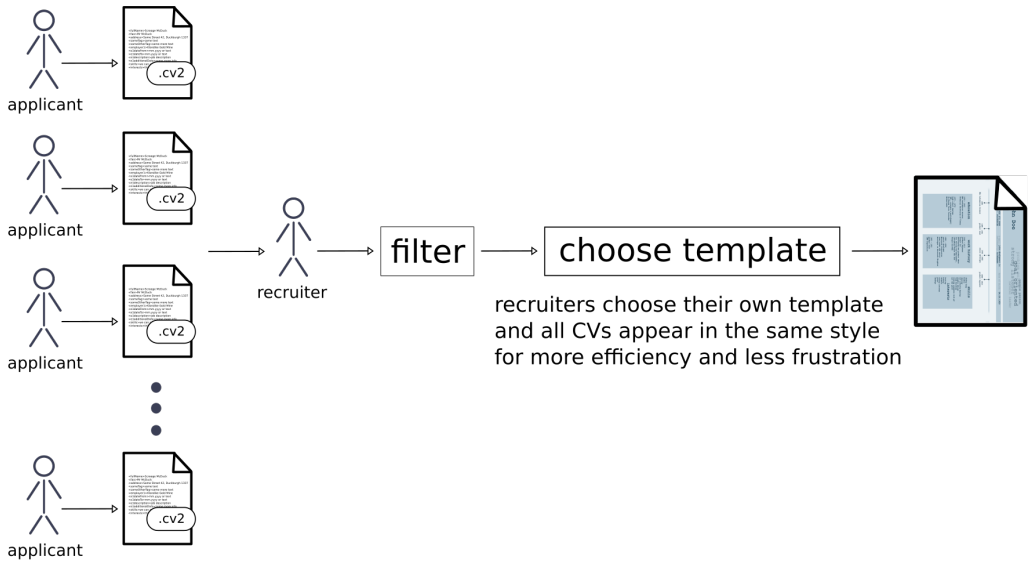

Figure 4.4: Simplified graphical explanation of the CV 2.0 process for recruiters and applicants.

Unemployed Saleswoman Learning Resume Writing The primary actor chosen for this use case is: **Applicant (Anna April)**

Scenario: Anna is participating in a course on resume writing because the job centre sent her there after she has been unemployed for half a year. She has no computer skills apart from using the browser and needs to create a resume.

Blind Person In Need of Formatting Support The primary actor chosen for this use case is: **Blind Applicant (Bruno Blind)**

Scenario: Bruno is blind and knows that formatting in a resume is important, even if people know he is blind. He needs a service that lets him input data without having to take care of the formatting.

Recruiter prefers visual representations of data in all resumes The primary actor chosen for this use case is: **Recruiter (Vera Visual)**

Scenario: Vera Visual sees a lot of resumes each day and is tired of the time-consuming factor of having to understand some of the "unusual" formats candidates provide. She'd prefer if all the resumes that land in her work process look the same and have the relevant parts properly visualised so she can understand the skill set and employment history at a glance.

Full-Stack Developer wants to apply for several jobs with different files The primary actor chosen for this use case is: **Applicant (Fiona Files)**

Scenario: Fiona Files can code back-end and front-end services and needs to apply with different file formats. For the "cooler" companies she wants to go with infographic resumes, but for the more conservative approach she just needs a clean PDF for her application. She does not want to edit two files, so she creates a CV 2.0, edits it by hand and just adds her newest experience to the end of the file, then uses a local application she downloaded from GitHub to output the PDF and infographic in PNG format as she needs.

These use cases give an overview of the benefits of a CV 2.0. They are the simplest form – of course one could go into more detail and explain what kind of files Sascha Selection receives and what happens in case of both successful and unsuccessful filtering. That would involve the entire hiring process instead of just the resume part. The simple use case form is usually enough in order to be able to explain what a certain group of people might need the most from a next-generation resume. The desired future work for the CV 2.0 - Global Resume group is to ideally collaborate further on creating a Schema.org extension as mentioned in the public mailing list as well as implement conversions to and from the existing resume standards, although those conversions will not be lossless as the formats do have no use and no representation for the visualisation scale values (yet).

The CV 2.0 has no local or regional boundaries, which is well-reflected in the community group with participants worldwide. It works on a global scale and the specification is intended to be adopted as such.

CHAPTER 5

cv2.io

cv2.io is one of the potential beneficiaries of the CV 2.0 - Global Resume W3C Community Group. It is intended to be a proof of concept for the idea behind the CV 2.0. As suggested, the CV 2.0 tackles the problems of redundancy when having to edit several files at once just to maintain one resume, accessibility for people with disabilities, and privacy. No registrations to a system are needed and the specification as well as the minimal proof of concept are open source. Any future work has to happen within the bounds of the contribution agreements of the W3C Community Group which means it is always open source. Personal copyrights to the code and other contributions are waived, so no contributor can withdraw their contributions at a later point. These rules ensure that the specification, system, and other documents stay uncompromised.

5.1 Concept and Approach

The CV 2.0 is taking a new approach to the hiring process by simplifying resume creation on the applicant side and enabling homogenous resume visualisation on the recruiter side. The current application process is dissatisfying for both ends. Either the company uses their own recruiting software which usually means the applicant has to fill out a form in addition to sending their CV in a separate file or the recruiter has to scan through a varying amount of different resumes in order to find the top candidates they would like to invite to an interview, which means that they have to be able to quickly differentiate the relevant from the redundant information for all kinds of textual and visual resumes. Separating the information is increasingly difficult since personal preferences of the recruiter play a role in the selection process as well. This is especially a problem when the recruiters themselves are sourced out and do not really know the team the applicant would work with in the end.

The CV 2.0 solves this problem by enabling recruiters to change the data homogenously for all CVs, thereby enabling them to:

- filter the data more efficiently
- programmatically by using the CV 2.0 standard and creating .cv2 files that have semantic data and no noise
- manually by giving the recruiter an option to apply their own template to all the resumes received, so that the information they are looking for is always in the same position using the same style
- select top candidates without taking into account recruiters' personal style preferences
- eliminate subconscious discrimination by allowing them to hide photos, names, nationalities, or other sensitive data in bulk before any CV gets displayed while still retaining the information for after the selection of top candidates for the job in question

The posterior visualisation on the receiving side, i.e. the recruiter, means that there is a lot of potential to increase diversity and and reduce personal preferences that inevitably play a role in the hiring process. Those preferences will not disappear entirely since the selection process through resumes and candidate search is only a small fraction of the complete hiring process.

This concept of ease-of-use of creating a file once and then being able to solve several use cases with it improves speed and usability for both stakeholders, candidates and recruiters. Repetitive tasks such as filling out similar forms for different companies and editing the same content in several files are eliminated. The other improvement potential of the CV 2.0 and any implementation thereof with regards to the current hiring process lies in the fact that it offers transparency and privacy protection through free features and open source code, but also a unified process for resume creation. Graphic designers as well as web designers can be encouraged to upload their templates as the CV 2.0 supports both HTML and SVG formats. Possible future scenarios go the route of employers posting jobs and filtering people who have opted in directly from cv2.io, as was the case with many other existing solutions.

5.2 Options for Adoption

Adoption and revenue are both mentioned in this section because they are intertwined. Without people who work on the adoption of the CV 2.0, the system is an academic suggestion with solid research behind it. But in order to thrive and actually enable an improvement in the hiring process, it needs a community that is willing to put in effort regularly to maintain and extend what has been discussed in the scope of this thesis. Possible adoption strategies have been outlined in chapter 3 as part of a business plan proposed to investors.

Table 5.1: Comparison of five different services for resume creation.

	vizualize.me	**re.vu**	**kinzaa.org**	**JSON Resume**	**CV 2.0**
resume creation	x	x	x	x	x
export to offline formats (edit once, use anywhere)	.pdf		.pdf	.html .pdf .json	image formats (.svg, .jpg, .png, .html w/ microdata) .pdf .json
visualisation options (creating side)	x	x	x	x	x
visualisation options (receiving side)					x
revenue generation	unknown	unknown	previously ads on the resumes, now paid job postings	none	none
guest/local access, no registration required				x	x
current status	stagnant	shut down	stagnant	side project by developers	university-initiated

As the concept of cv2.io offers a comprehensive solution to the hiring process, we are faced with several competitors from different markets. On the recruiters' side, cv2.io is a mediocre threat to ATS with their own implementations and data models becoming partly obsolete by an open sourced standard resume format. ATS are widely used because they offer talent management and hiring systems that are useful due to the lack of a standard resume format and user-friendly visualisations. It is time to move away from an old-fashioned way of recruiting, though, and many services have already emerged from that need for modernisation.

See table 5.1 for a comparison of some popular resume solution competitors that are also mentioned in chapters 2.2 and 2.3 which have applicants as their target group. The CV 2.0 and cv2.io do not disable or make them obsolete. An API that any ATS, professional network, or other service can use to incorporate into their own user base would enable them to use the concept of CV 2.0 within their own systems. This allows the CV 2.0 to work with partners instead of competitors. Instead of competing by reinventing the wheel and eliminating good existing solutions, one can build upon and improve the parts

that might not be as good presently. The CV 2.0 aims at innovating the hiring process, not trying to create yet another solution that has a few features and lacks others.

There is one challenge with ATS: cheating. Applicants have understood that companies employ software that automatically filters their resumes. Naturally, people came up with ways to trick the system. One such way is to put invisible keywords into the resume by including invisible metadata that will get processed by the ATS or placing the relevant keywords over the resume several times strategically. These methods do work and applicants employing them will automatically gain a higher ranking in the systems. Clear tagging as happens in JSONResume or .cv2 only prevent some of these these methods, like adding invisible (to humans) metadata because the parser would simply not process those file contents.

Adoption of the cv2.io can only be seen in a combined effort to propagate the CV 2.0 as a next-generation resume, not only as a format to be used, but as a concept. It is possible for the concept to flourish, but it will happen slowly and user-friendly implementations are key for adoption. This is where revenue or other forms of funding come in as a necessary goal. An adoption barrier for both ends of the hiring process is that people need to be aware of the CV 2.0. Once aware, applicants do not have to register, so they can freely try out the system without even using their real data. The benefits of legibility mean that people can use fake data in the form or generate a template .cv2 file, then fill out the correct data offline, if they have enough technical knowledge to edit a raw text file.

5.2.1 Global Acceptance

Unfortunately, it is impossible to set up a CV 2.0 initiative that actually gets adopted and improves the hiring process without people actively advocating for it. Therefore, we will shortly investigate the economic aspects in order to get a general idea of options to generate revenue in order to propagate the CV 2.0 initiative.

- membership fees within a CV 2.0 organisation
- funding through governmental institutions
- funding through independent investors
- revenue through applicants
- revenue through companies

Evidently, there are also several risks with each of these four approaches. Funding through governmental institutions and independent investors means that a lot of effort will go into applying for funds and adapting the CV 2.0 to fit the calls for funding or investors' interests. Revenue through applicants and companies seems to be the better

solution, as it is more independent. Membership fees within a CV 2.0 organisation would mean having to move out from the W3C Community Group which is a solid and widely accepted institution into something entirely independent.

In the concept for cv2.io, users can select or create a template to visualise their resume for each format they choose for exporting. The system is free of charge. One option to generate revenue here is similar to an app store, designers could upload their templates and offer them for free or for a fee in which case applicants have to buy the template in order to use it. In order for CV 2.0 to be able to generate revenue from this exchange, a small commission could be asked for providing the service. As the organisation would be non-profit, all revenue would go into enhancing the service and the specifications while providing utmost transparency.

The part where companies would provide revenue is a yearly fee for user licenses for their recruiters which enables companies to use all available templates free of charge or create their own private templates following a corporate identity. They would also get access to filtering functionality and bulk visualisation of imported .cv2 and JSON files. Additionally, they can host the whole service on their own private network on-premise for free which means they only get the standard system without the premium templates. Companies that want to use the system in their own network could pay for support via an SLA (Service Level Agreement).

The economic benefit for applicants is that they can use a free service which enables them to fill out their data only once and then send either the standard .cv2/JSON file to recruiters if those are aware of it or they can use one of the exported formats to send, depending on the position they are applying for. Applicants save time in any case - either the recruiters know about the CV 2.0 and are using the system already or the applicant sends a common PDF file, an infographic, or a link to the online version of their resume. In all of these scenarios, only one file has to be edited in order to achieve an output in all the mentioned formats - *edit once, use anywhere*. Privacy is guaranteed through the use of a local application rather than an online service with required registration. Smaller companies that can not afford or had no need for a talent management system can use cv2.io for both filtering resumes and for visualising each resume according to their recruiters' preferences in order to improve the speed of the selection process.

cv2.io is targeting a high volume market consisting of applicants and recruiters worldwide. Any combination of awareness between applicants and recruiters is possible and marketing in order to generate awareness can be applied from several angles. Getting enough companies on board means they can request .cv2 files instead of their usual form behind an ATS. For applicants, that would mean there is no difference to the current application process for them, other than less redundancy and not having to fill out several forms if applying for multiple companies. If the awareness tilts more towards applicants, they will use CV 2.0 templates and services to create their resumes and send the exported formats while companies catch on. Additionally, job centres could offer pilot runs in resume writing courses until the system reaches a critical mass.

For the CV 2.0, generating revenue means that it would have to transition into a non-profit organisation rather than a community group, similar to the HR Open Standards mentioned in chapter 2.3. Ultimately, it would have the fate of every bigger organisation, i.e. moving slowly and not adapting fast enough to innovative ideas and market demands. That is one of the risks. Other risks of revenue generation are that membership fees within an organisation often lead to conflicts of interest.

Funding through governmental institutions has the potential risk of trying to adapt the CV 2.0 to the calls of the respective funding programme and therefore endangering the general idea and concept. The same challenge occurs with fundung through independent investors since they usually have an interest that they want fulfilled.

Therefore, the only really viable options are funding through offering a good service which means the implementation of a CV 2.0 specification and other documents needs to go hand in hand with the CV 2.0 itself. This also provides a good opportunity to test things and be aware of potential problems one might induce with a purely theoretical specification.

5.3 System Architecture

In a nutshell, cv2.io is meant to be a web service and standalone local application offering resume creation, filtering, and visualisation. Visualisation options are available for both applicants and recruiters whereas creation and filtering are targeted towards their respective end of the hiring process, i.e. creation for the applicants and filtering for the recruiters.

Two iterations for a design and implementation of this project including research and surveys have already been completed, as mentioned in chapter 3. The current system features the following functionality:

- webserver that is able to add virtual hosts
- front-end with a basic input form
- output of HTML and SVG files containing parts of the input data
- automatic purging of user data

The system is set up with a modular architecture, therefore it is possible to create APIs for the system in the future, which allows for other services to pick up the CV 2.0 into their own architecture. cv2.io is set up in order to support the following scenario: When applicants visit cv2.io, they edit their data via a form and then get the information exported into several formats that they can then subsequently edit. If some of their data change, they just need to either manually edit the .cv2 file that hosts the data or they import it into cv2.io, edit it there, and then export it to various formats again while

retaining the visual styles of the templates they were using for each output. Privacy and data protection within the system are guaranteed only with local usage of the system on the user's computer because server and client are then both controlled by the users themselves - the privacy and data protection of any additional architecture depend on the cloud provider as well as connected services. In the prototype system, the server deletes user information once a guest leaves the session.

The architecture model is based on minimalism and independency to external libraries. This is mostly for reasons of embedding, so the system can be reused within an existing application instead of accessing it via an API. Having an API means that there is a service somewhere that needs to be online and always available whereas embedding can happen within an on-premise solution that does not necessarily have to be online.

In 2018, the General Data Protection Regulation (GDPR, see [EU17]) by the EU will come into effect. This is valuable information for systems like the CV 2.0 which process personal data. The GDPR is a regulation that ensures the rights of EU citizens more rigid than previous regulations. In its essence, the regulation enforces three things:

- protection of natural persons regarding personal data
- right to information about processing and storage of personal data
- free movement of personal data

It is recommended to instate a Data Privacy Officer in each company that processes personal data, which in reality is every company. Data Privacy Officers are obligated to ensure that the infrastructure in the company they are working for is aligned with the GDPR. The CV 2.0 is extraordinarily well synchronised with the GDPR as it allows for free movement of resume data and also has rigid views on the processing and storage of personal data as a major component in its ambitions. There is no vendor lock-in, no data storage, and the whole system can be used offline by design.

CHAPTER 6

Evaluation

The concept suggested in this thesis has undergone several points of evaluation through various methods and should continue to strive towards dynamic, qualitative progress. After the preliminary research on infographic resumes, interviews with two domain experts and a small survey among 24 colleagues from a design course in university were conducted as first points of evaluation regarding infographic resumes in general. This approach and its results are described in chapter 3. The summarised results are:

- In order to be widely accepted, visual CVs need a standard and a coherent way of looking at them because recruiters have a limited time span to process the resume in front of them and they will not take the time to understand unusual visualisation techniques for regular jobs outside of the field of design and similar artistic job areas.
- Some visualisations are too complex to understand at a first glance and should not be used for resumes - this problem is solved by the cv2.io catering to both recruiters and applicants as an ATS incorporating the CV 2.0 into their system can override an applicant's visual preferences in favour of the recruiter's preferences.
- Visual preferences are rarely neutral, an infographic usually generates a strong appeal or dislike. These results mirror those of [HRC15].

In addition to the interviews and survey, a proper business plan was shown to various investors and the EU programme Horizon 2020 in order to evaluate the sustainability and actual value of the concept to the non-academic world. These results as detailed in chapter 3 show that the idea and concept are highly valued, but profitability according to experts is low due to the open source and decentralised nature of the concept.

On the side of applicants and recruiters as non-business and non-academic entities, a W3C community group was created in order to be able to have a public and archived

dialogue regarding a possible CV 2.0 before the full concept was formed and in order to enable people who are stakeholders to vote on what is needed from a CV 2.0. More on the community group and its results can be read both in chapters 3 and 4. Since the community group is obliged to follow rules on decision making and proposals, the concept is also reviewed from a community perspective.

6.1 Hypotheses

The solution suggested in this thesis stems from the main hypothesis that *CVs need a decentralised and transparent way to be both created and viewed in order to evolve with minimal frustration for the people involved in the resume process.* As has been shown through interviews, a survey, involvement in a community group, and state of the art research in academia as well as industry, the solution is a valid approach to prove the hypotheses introduced in chapter 1. The following nouns describe the core statements of each sub-hypothesis, that are solved with the proposed system:

Redundancy reduction. *Sub-hypothesis:* It is important to offer people a way to express creativity while keeping a certain standard so the editing frustration that applicants are usually facing does not transfer into viewing frustration for recruiters.

Decentralisation and transparency. *Sub-hypothesis:* Any solution for this problem cannot be closed source or in any way blocking for the stakeholders involved in its evolution.

As described in chapter 2.2, resume services can be shut down with no way to retrieve or export user data once the service is gone. It is also often unclear how and if personal data is used elsewhere. This problem is partially solved with a decentralised and open sourced service which can be started locally on a user's computer. If the service is integrated into another software or used within a website, data privacy depends on the privacy policy of the third party.

Flexibility and sustainability. *Sub-hypothesis:* Any solution has to be flexible enough to adapt to changing patterns in the hiring process and cater to special needs, such as from people with disabilities.

As demonstrated with the use cases described in chapter 4 that evolved from interviews and state of the art research, redundancy reduction as well as flexibility and sustainability are main factors for the success of a system that aims at becoming the next-generation resume. Decentralisation and transparency, while not necessarily noticed by applicants nor recruiters, are concepts that are important for developers and designers in order to further use and embed the system where needed.

6.2 Example Application Process

The following is an example application process with a CV 2.0, introducing fictional actors in a scenario of a hiring process where *Bruno Blind* as mentioned in the use cases of chapter 4 applies for three different jobs. Bruno is blind just to exemplify that the CV 2.0, while not specifically designed with persons with disabilities in mind, fits this purpose perfectly.

Bruno, a visually disabled young man with some job experience as accountant and a BA in History, is looking for a job and has found three roles he could apply for. He has set up the CV 2.0 system at home so he does not need to use a third site. With the browser pointing to *localhost*, Bruno starts filling in his data. His screen reader walks him through the fields and Bruno chooses three different output formats for the three different roles he plans to apply for. He gets a .cv2 file, a .pdf, and an .svg.

One role is at a bigger company that employs an ATS which has already incorporated the CV 2.0. He can therefore just send the .cv2 file without further formatting and writes a quick cover letter into the text field designated for it. From Bruno's side, this application is done. On the receiving side, the recruiter is close to retirement and is visually impaired as well. So the recruiter lets a screen reader walk her through the contents of the resume. Both creating and receiving side never had to worry about formatting anything while the information is present and delivered accurately in way suitable for the recruiter with ease-of-use on the applicant's side. Unfortunately, Bruno is not an interesting candidate for the company and he gets a standard rejection letter the next day.

The second role is for a small traditional software company where Bruno wants to apply to be a presales consultant. He knows that the company owners will not be bothered by his disability but he knows that formatting still matters for a first impression and since the company definitely is not using any HR systems, he sends an e-mail with the .pdf file output that looks similar to the Europass standard resume. There is no recruiter in this small company, so the owner of the company receives an e-mail with a nicely formatted standard-looking resume and Bruno gets an interview. His disability does not even come up until the interview takes place.

For the third job, Bruno wants something special because it is a job with more responsibilities at one of his favourite organisations. He could send the standard resume as he did for the presales job but he is afraid of being overlooked and he does not have the right qualifications or network to look for an extra way to propel him towards the desired interview. So he decides that in this case, he will use the generated .svg as seen in figure 6.1. The organisation Bruno is applying for has never heard of a CV 2.0, but they really like Bruno's visual resume, especially as they realise that he is blind and yet took the time to create an infographic to convey his skills and go the extra mile to make an impression. Bruno gets the job.

In a fourth scenario, Bruno could apply for other jobs where recruiters/companies who are aware of the CV 2.0 could import a CV 2.0, enabling them to display many CVs in

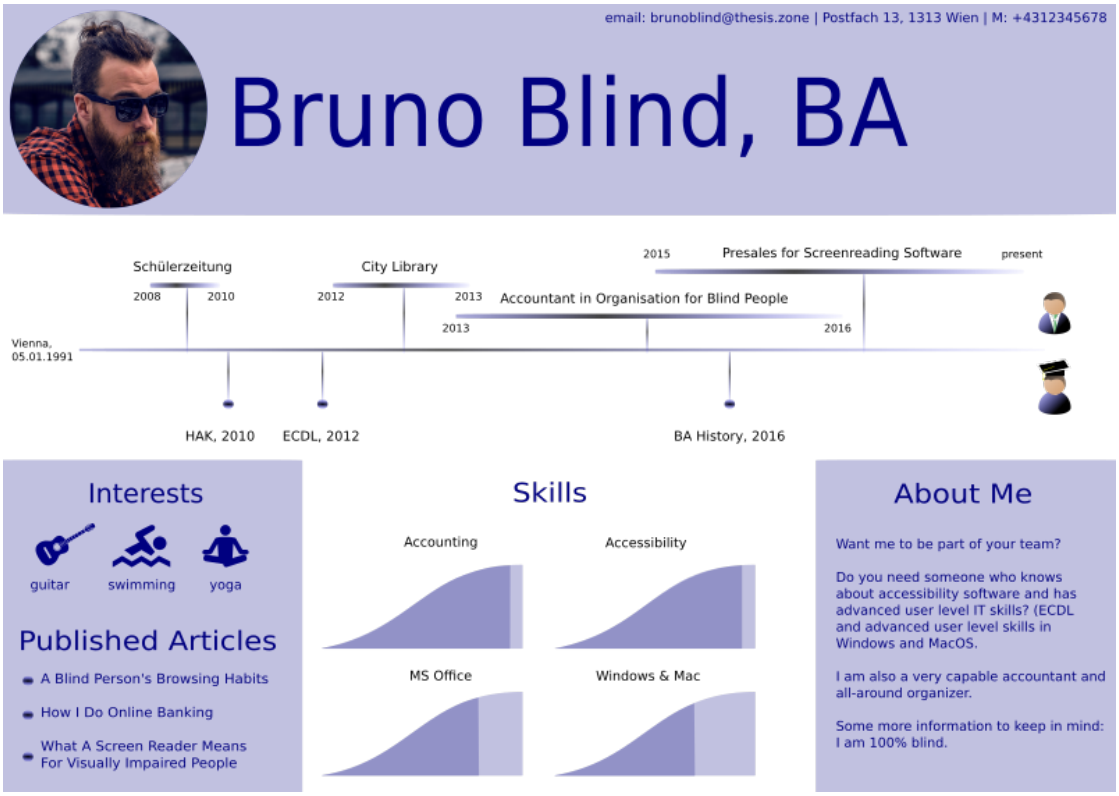

Figure 6.1: Bruno Blind's fictional resume.

the same individually preferred way for very quick processing while still taking time to find this one eye-catching attribute which a normal automated resume filter that just scans for keywords might overlook.

CHAPTER 7

Conclusion

As can be seen in chapter 2.2 and 2.3, the status of the currently well-known solutions for resume creation is stagnant since the market is competitive and there is no comprehensive solution yet. Creators have tried and failed because a solution that drives people into one corner and onto one platform is not able to succeed. As the main hypothesis of this research suggests, a decentralised and transparent way of resume creation and viewing is needed in order for resumes to move forward as companies tend to keep user data on site, mostly without ways of exporting personal data in an editable format. Therefore, our approach is to unify the process and to look at it from a different angle which is simplifying both the creation for applicants as well as enabling new visualisations for recruiters. It is a new take on resumes which emerged from academic research in an Information Visualisation Master course at the Vienna University of Technology.

The CV 2.0 and its accompanying proof of concept implementation represent a new global resume standard for the next-generation resume: the CV 2.0. It benefits both applicants and recruiters through increased speed and usability in creation, filtering, and visualising resumes.

State of the art regarding resumes has to be split in different categories: research, industry, and existing resume standards. While some of these overlap to a certain degree, it is evident that resumes are a globally important issue that has been around for many decades. Currently, the situation is shifting towards resumes being less important since professional networking and recommendations are overruling resumes during the selection process, but this shift is only valid for higher level jobs and certainly not for entry level jobs or jobs with low skill requirements.

For the purpose of this thesis, a community group has been created at the World Wide Web Consortium (W3C) with 16 participants as of May 2017. The community group aims at creating a specification for the CV 2.0 as well as additional documents that enrich this specification. The focus of this specification is the CV 2.0, which has as its ultimate

goal the improvement of the current hiring process on both ends of the hiring process - applicants and recruiters. Existing systems and standards usually just satisfy one side while the other is left out and has to deal with additional complications. On the applicant side it means redundancy and having to fill out many forms for multiple companies while additionally sending their resume whereas on the recruiter side, applicants who use a generated resume from one of the existing services usually disregard the fact that the recruiter then has to manually enter the information into their ATS or might not even be able to properly process the information contained in the resume, depending on the complexity of the format.

For the specification implementation, either a specified new resume syntax contained in files ending with .cv2 has been proposed, or JSON files as a base for the CV 2.0 work as well. The JSON solution is not ideal, though, because manual editing is difficult due to JSON's legibility and it is prone to errors, leading to parsing problems later on.

With a CV 2.0 in place, applicants can choose to manually edit their resume file or enter their data in a form. They then get several output files with the same data as output while keeping the data private, if a local application was used. Recruiters on the other hand can receive CV 2.0 files in bulk and choose to filter them to their needs as well as visualise every resume in the same way, suiting the recruiter's personal visual preferences and eliminating potential bias in the selection process.

The vision for the CV 2.0 is that applicants do not have to follow various job search procedures while having to repeatedly input the same data for a number of jobs anymore. Recruiters can focus on the qualitative aspect of their work - interviewing people and finding the right person. The system and the specification itself are open source and free for everyone, including existing ATS which could use the CV 2.0 to enhance their product. Ways to achieve adoption through awareness and generate revenue for further propagation have also been discussed in this thesis as means to show that this research can be used for more than a purely academic approach.

Interviews, community involvement, and a look at related work both in research and industry have shown that, as introduced in chapter 1, it is important to offer people a way to express creativity while keeping a certain standard so the editing frustration that applicants are usually facing does not transfer into viewing frustration for recruiters. The proposed solution of a community group that oversees specification efforts as well as an open sourced, adaptable system enable the stakeholders of a hiring process to implement the decentralised, transparent new version of resumes.

7.1 Future Work

In order to reach worldwide adoption the CV 2.0 needs to cooperate with LinkedIn, other professional networks, and job boards. All of these generate revenue from having the data exclusively on their website and locking in applicants, so the question of adoption will have to follow a bottom-up approach, where applicants and recruiters demand this

feature. Additional features that can be implemented for company clients are visual summaries of all applicants that applied for a job or all jobs at this company and several other reports with regards to the hiring process. In the far future, it could also become a platform where people can offer cover letter writing skills or interview training to applicants as well as a rating system for companies – but this is not part of the plan for the next five years and these ideas still need to be researched for their added value.

Future work definitely is to continue working on the community group deliverables as well as finish the implementation within cv2.io. This is more an enterprise or big community endeavour, though, as it needs testing, product management, and clear tasks. Optionally, when using a finished implementation of the CV 2.0, default templates suggested to recruiters and applicants could have gender as a possible indicator for which default templates get shown first in the list. One would assume this is discriminatory behaviour, but according to [HRC15] mentioned in 2.1, the opposite genders do respond differently to colours and visualisations.

Most importantly and as a logical next step regarding technology, a lexer and parser are needed for the CV 2.0 syntax. Unfortunately, this was out of the scope of this thesis, but it is an interesting future endeavour. One would need to ideally provide implementations in various languages. Due to loose typing and the possibility for comments within a resume file, parsing cannot be as efficient as within a JSON file, so it would be an interesting task to further evaluate the .cv2 syntax for performance.

The project not only needs a functioning lexer and parser for .cv2 files, but also a secure web server, enhanced security features that protect both the data of voluntary registrations as well as the system itself, mature resume templates, and an API that can be used by already established professional networks or visual resume sites.

There is some discussion between recruiters whether parsing algorithms and software that analyses social media networks for potential candidates will absolve the creation of resumes because highly skilled candidates do not even need resumes anymore since they switch jobs due to professional networking and recommendations. This is true to some extent, but highly skilled workers are only a small part of the entire workforce and resumes are still widely needed. Geolocation tags help with finding a good match in the candidate's vicinity. ATS and other recruiting software use geo-matching already, as is the case with eRecruiter mentioned in chapter 2.2. A candidate's address gets matched against the job location so applicants who are too far away can already be filtered out. In some cases, this is obviously not a good idea since people might be willing to relocate.

Europass (see chapter 2.3) templates could be part of the templates that work with the CV 2.0 as well as a Schema.org (2.3) extension to include search engine optimisation for online resumes. A plugin system to add additional features also needs to be considered. Adding certificates and other documents into one resume file is not recommended, but linking the data is definitely one future work task. Translations into various languages could be done semi-automatically through adapting tools and libraries used by professional translators and specifying a language tag within the resume, which would mean only

minimal extra editing by the applicant.

Additional future work entails actual work on the propagation of the CV 2.0 in order to get acceptance for the system as a whole. Accessibility is a trending topic since government websites and public institutions already have to be accessible. The CV 2.0 can definitely offer features in this area that other resume standards cannot do as easily because the CV 2.0 was created with accessibility and diversity in mind.

CHAPTER 8

Appendix

The two links where all additional information about the CV 2.0 can be found are:

- The CV 2.0 - Global Resume W3C Community Group at: `https://www.w3.org/community/cv2/`
- The GitHub organisation accompanying the community group: `https://github.com/cv2globalresume/`

List of Figures

List of Tables

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