CHALMERS
UNIVERSITY OF TECHNOLOGY

The Interaction Design Competency Framework

A tool to understand what industry wants from interaction design education

Master's thesis in Interaction Design & Technologies

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REPORT NUMBER 2016:136

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Gothenburg, Sweden 2016

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Abstract

Voices within both industry and academia contend that interaction design education falls short in preparing students for their contribution in the workforce. While some of this may indeed be due to inadequate education, industry practitioners themselves disagree with one another on what interaction design education should include, making it difficult for education to answer those needs.

This master's thesis focuses on finding and understanding what industry expects from interaction design education. Based on literature reviews, interviews with industry and academic personnel, analysis of job listings in the field, and surveys of design practitioners, common factors emerged that identify critical aspects of this understanding.

These factors—including disagreements within industry and within academia, the limitations of education in covering the breadth of possible subjects, the importance of the portfolio in hiring, and the de-emphasis industry gives to formal education—make it clear that there is not just one ideal list of educational subjects that all interaction designers should possess. Instead, thinking of competencies (i.e. the skills and knowledge needed to be an interaction designer) in broader categories makes it easier to accommodate differing perspectives while still considering them as part of interaction design.

The Interaction Design Competency Framework formalizes these competency categories, presenting the results in a format that provides a simple overview of what areas are the most important for interaction design. This framework structure then makes it possible to summarize the emphases of a given job, job category or degree program, as well as provide a mechanism for comparing them with one another—something that wasn't possible before. An accompanying website, WhatsaDesigner.com, provides a survey for users to submit their own opinions on what industry needs and expects and see the results of that information in an interactive visualization of the Interaction Design Competency Framework. In this way, one can determine what industry needs and expects from not just education but from any interaction designer, who in turn can better prepare for jobs in interaction design.

Keywords: interaction design education, design competencies, design students, skills and knowledge, gap between industry and academia

Contents

1. Introduction

> *"One way or another HCI education is not working, is not teaching the lessons that are required to the people who need them."*
>
> *—Edwards, Wright & Petrie 2006*

After I co-presented at the SIDeR 2015 conference in Kolding, Denmark, a professor from another school objected to what we had shared. Saying that our presentation was "too slick" and "pro-technology", she objected that we hadn't devoted enough time to our methods and had glossed over underlying concerns about our approach. In a subsequent one-on-one conversation, she broadened her complaint to me by saying that "all you Scandinavian schools are too focused on products and not enough on process." (D Wilde 2015, personal communication, 28 March).

The passion behind her questioning surprised me. I thought it was a good thing that we focused on our results in the presentation rather than dwell on the minutia of methods as found in our accompanying paper (Dunford and Castillo Antolin 2015). Other students I spoke with agreed. Yet viewing subsequent presentations at the conference with this perspective, I noticed a clear divide between those which emphasized outcomes and those that focused on process, between what could be considered an industry mindset and an academic mindset.

I wondered, was one better than the other? Perhaps my 15 years as an interaction designer and manager "in the industry" had biased me against the academic approach she was endorsing and I wasn't learning what I needed to from the master's program I had begun. or maybe her theoretical viewpoint prevented her from validating the constraints of implementing interaction design in real-world situations and business settings.

From these thoughts, an underlying question emerged: what makes a good interaction designer? and by extension, what makes a good interaction design (IxD) education program?

As it turns out, this is neither an easy problem to solve, nor is it a novel one. The tension between academia and industry has existed since human-computer interaction

(HCI)[1] emerged as a discipline (Churchill, Bowser & Preece 2013; Grudin 2008; Löwgren 2001; Perlman et al. 1994). What is the role of interaction design education? Is it to address industry needs or is it to push boundaries within research? Is it to provide vocational training on the tools used in the field to produce skilled craftsmen, or is it to introduce design methods to create good thinkers?

As someone who had interviewed and hired newly graduated designers in the past and often found them lacking basic skills or abilities, I was inclined to believe that education was the problem, that if only their schools had been more focused on industry-oriented competencies and more attentive to the latest trends and tools, those applicants would have been more qualified for the positions they were interviewing for. At the same time, I empathized with the educators at these schools too, for I had also spent some time as an adjunct instructor of web design at a small vocational college, and felt that the curriculum and time schedule I had been given to teach was woefully inadequate in giving my students what they needed to succeed in careers after graduation.

Embarking on this master's thesis, I wanted to uncover whether a standardized education in interaction design could be found. Or if it didn't already exist, whether a standard set of classes, subjects, and skills could be combined into a degree program that would produce superior interaction designers, while accommodating for the tension between industry and academia. Fairly quickly into the process, I encountered three challenges to interaction design education, as follows.

Problem Area & Research Question

The first challenge to interaction design education is accurately recognizing where these tensions exist. One might assume that the primary problem is between industry and academia, the so-called "gap" resulting because the two sides have different expectations of what an interaction designer should do. While this assumption is somewhat correct, it ignores the problem that academics themselves don't agree on what interaction design should cover as a discipline, leading to degree programs with considerably different subjects, methods, and practices (Glushko 2008).

Without that consensus, schools will continue to produce graduates in interaction design that differ drastically in skills, leading to the second challenge: people in industry with the title of "interaction designer" also don't share the same knowledge and abilities. And industry is no better at resolving exactly what an interaction designer should know either; instead of agreeing to some sort of common credentials, they have instead taken to creating job titles that are more like word salads than actual

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[1] the terms "human-computer interaction" and "interaction design" and are not, strictly speaking, synonymous terms, with the former used primarily in research and the latter in industry, which is why I use the latter. Later in this thesis, in the Theories and Concepts chapter, an attempt to is made to distinguish the two.

names, like “Usability UX/UI Interaction Designer Senior Principal”[2] and “Front-end User Experience Developer / Designer”[3] in an attempt to differentiate what they need.

This relates to the third challenge within interaction design education: obsolescence. Even if academia and industry could miraculously agree on a curriculum, because of the rapidly changing nature in the technology and skills of interaction design as experienced in industry, this curriculum would become rapidly outdated and would need constant adjustments to stay relevant. To remain current, MacDonald suggests the creation of a “living curriculum” that is dynamic and modular, yet structured and moderated, as it would give educators the flexibility to respond to what they see as changes in the world around them (2014). Yet this would still result in cases where one school has chosen to modularize in one way and another school in another and they are right back where they started in the first place: with inconsistent interpretations for what interaction design education should include.

Perhaps, however, the problem has been approached in the wrong way. What if, instead of trying to arrive at the “one true” interaction design education, one instead seeks to understand why industry and academia fail to bridge the gap in interaction design education? Or, as stated in the core research question for this thesis:

> **What guiding factors clarify what industry needs and expects from interaction design education?**

This thesis explores just what an ideal interaction education should consist of, from the perspective of industry. It approaches the problem first from a theoretical, research-oriented point of view, utilizing different design methods, such as interviewing and data analysis, to uncover what underlying factors influence how industry and education consider the necessary skills and abilities of current and future interaction designers. Then, rather than assigning a specific set of criteria for all interaction designers, it instead proposes a matrix of competencies that reflects the ways that different programs and jobs may choose to interpret interaction design differently. This framework is intended to make it easier to understand and explain the concepts, skills, and information that IxD education should be imparting to students. Then, because this framework should respond to technological advancement and design trends, an online survey and visualization platform is proposed to allow users from industry and academia to submit their own opinions for what a designer should know, visualized in the competency framework.

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[2] the title of an actual job listing from Dell for an “Interaction & Visual Design Senior Engineer”: https://www.linkedin.com/jobs/view/144393951

[3] http://blog.debugme.eu/front-end-user-experience-developer/

2. Background

Before one can learn what industry needs from interaction design education, one must first appreciate the context in which interaction design is currently understood, as well as the history for how it got to that place.

Dozens of schools teach interaction design in undergraduate and graduate courses and degree programs. Hundreds of students graduate each year to take the thousands of jobs available in this relatively young field. However, voices within both industry (Rutledge 2010) and academia (Faiola 2007) contend that IxD education is inadequately preparing students for their contribution in the workforce. The most common assertion is that education is not keeping up with the rapid changes in interaction patterns and technologies that emerge, a conclusion that has been repeated for many years (Culén, Mainsah & Finken 2014; Faiola and Matei 2010; Foley et al. 2005; Grudin 2008; Myers 1998). At face value this makes sense; after all, the ACM SIGCHI Curricula for Human-Computer Interaction hasn't been officially updated in the 24 years since it was first published (Hewett et al. 1992).

Yet considering the variety of degree programs in interaction design, not to mention alternative learning paths such as certifications, online learning and self-study, these broad complaints simply cannot apply to all interaction design education. Instead, further investigation suggests that one of the main problems is that industry practitioners themselves disagree with each other on what interaction design education should include—for example, whether it should focus more on craft skills (Kolko 2011a) or whether there's already too much craft (Norman and Klemmer 2014). And without a clearer understanding of what is expected of interaction design practitioners, formal IxD education will continue to be considered inadequate by managers in the field (Six 2012).

A Brief History of IxD Education

To consider the future of IxD education one should begin with the past. As exhaustively detailed by Grudin (2008) and Shackel (1997), the beginnings of interaction design education predate the ACM SIGCHI curricula and can be found in the very beginning efforts of the "management science" movement. Efforts to improve workplace efficiency during the late 1800's grew to encompass observational methods and statistical analysis, and the need for formalized interdisciplinary knowledge emerged. Notable individuals, such as Lillian Gilbreth who received the first PhD in industrial psychology, combined their understanding of both technology and users to improve worker productivity in the age of mechanization.

During World War II, after design flaws in aircraft led to control misuse and thousands of casualties, disciplines like “human factors” and “ergonomics” began to be applied in more and more contexts. Efforts to improve operational efficiency soared, as did government investment into research that provided for better information management, such as computers.

Initially, the education of practitioners in these burgeoning areas was based less on formal programs of learning, and more on the specific interests of individual educators. For example, J.C.R. Licklider, considered one of the “fathers of the Internet”, originally pursued a triple bachelor of arts degree in physics, mathematics, and psychology in 1937 and later established a psychology department at MIT that trained engineering students on designing for the user (Rappold n.d.).

Parallel to these “human-oriented disciplines” (Shackel 1997), the exploratory research of computer scientists and students working and studying in university labs, resulting in the creation of many of the interaction technologies ubiquitous today. The computer mouse, hypertext, windows, drawing programs, spreadsheet applications, gesture recognition, VR and many other interaction methods were developed in places like MIT, Stanford, and Imperial College, London, from the early 1960’s and on (Myers 1998). And as computers became steadily more available, their ability to manage comparatively large sources of data, together with the ability of individuals to manage the produced information, led to the establishment and propagation of educational programs in the information sciences, typically housed in departments of library management (Grudin 2008).

Thus, by the late 1970’s, these four educational disciplines—psychology, engineering, computer science and library management—had begun to produce the broad fields of practice in human factors, ergonomics, computing, and information science (Figure 1)—ancestors and cousins to human computer interaction.[4]

Yet even as researchers within these programs recognized the need for study in the elements of HCI—as early as 1984, at least 47 schools offered the ability for students to pursue a PhD in human-computer interaction (Mantei 1984)—there was little interest in formally creating a separate academic discipline of HCI. Instead they connected in conferences and establishing professional interest groups such ACM SIGCHI, BCSHCI SG, and IFIP TC.13 (Shackel 1997, Dix 2010). As Churchill, Bowser, and Preece (2013 p.46) describe the situation, it was, “more a guild of researchers from various disciplines than a discipline in itself.”

It was during this time in the mid-1980s that Bill Moggridge—himself a multi-disciplinary industrial designer and educator—is credited with coining the term “interaction design” to describe “the design of the subjective and qualitative aspects of everything that is both digital and interactive” in HCI (Moggridge 2007 p.660).

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[4] Technically, the history of interaction design education should also include the “design” side, and could encompass the design education that flourished under the Arts & Crafts movement from the latter half of the 19th-century and from Bauhaus in the early 20th-century. Additional exploration into other fields such as sociology and phenomenology could also be included to provide a more complete story of interaction design. That history is not this thesis.

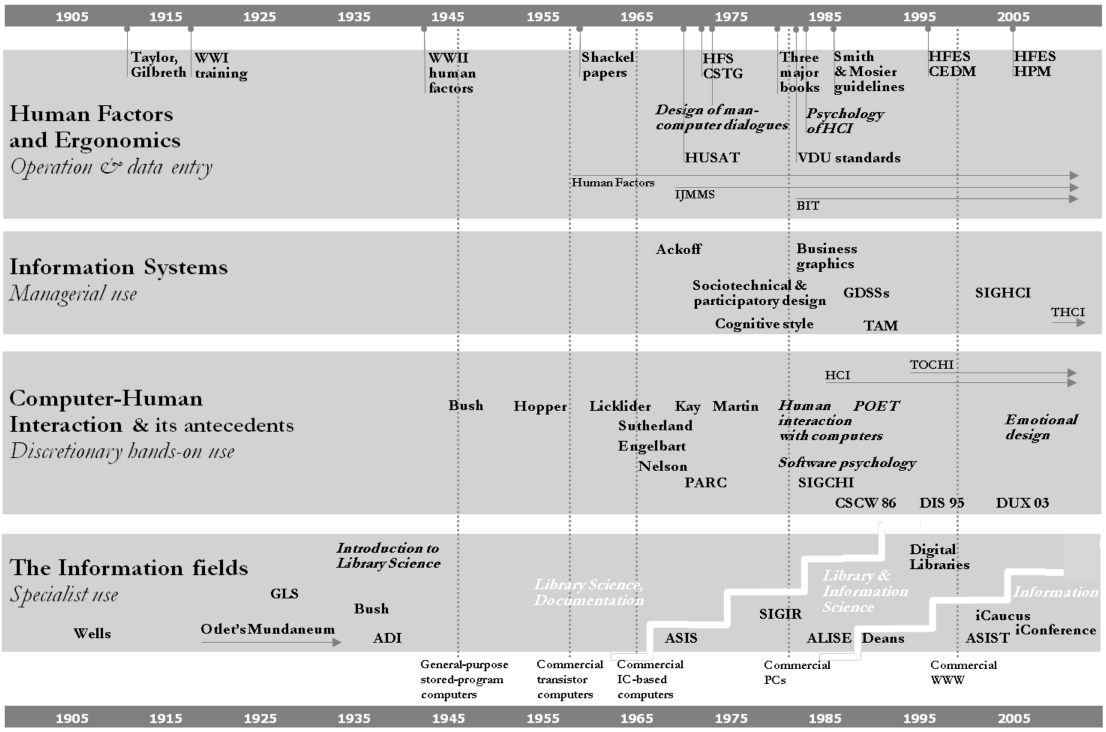

Figure 1: Four fields with major interaction design research threads (Grudin 2008)

And it was in this context that a group of HCI researchers, educators, and practitioners affiliated with ACM SIGCHI offered some of the first broadly recognized recommendations for education in HCI (Hewett et al. 1992). Based on coursework that had already been implemented by a few universities in North America, the Curriculum Development Group (which created the curricula) presented a set of undergraduate courses oriented toward HCI.

Although ACM is focused on the realm of computing disciplines and thus these curriculum suggestions were based in computer science education, they were intended to be implemented within other degree programs as well, such as psychology or management information systems. In fact, the CDG offered suggested curricula for each HCI course depending on that degree orientation, with the common themes or focus areas they suggested (Table 1) emphasized or deemphasized accordingly.

Table 1: Course Themes in the Original ACM SIGCHI Curricula for HCI
(Hewett et al. 1992)

N the Nature of HCI **N1** (Meta-)Models of HCI
U Use and Context of Computers **U1** Human Social Organization and Work **U2** Application Areas **U3** Human-Machine Fit and Adaptation
H Human Characteristics **H1** Human Information Processing **H2** Language, Communication, Interaction **H3** Ergonomics

C Computer System and Interface Architecture **C1** Input and Output Devices **C2** Dialogue Techniques **C3** Dialogue Genre **C4** Computer Graphics **C5** Dialogue Architecture
D Development Process **D1** Design Approaches **D2** Implementation Techniques **D3** Evaluation Techniques **D4** Example Systems and Case Studies
P Project Presentations and Examinations

Interestingly, despite the working group's intent on having HCI develop as an area of study in multiple disciplines, they explicitly recommended against the creation of a specific HCI degree:

> "The idea of an undergraduate degree focused exclusively on HCI therefore seems premature. At best it would be in continuing flux unbecoming a professional body. At worst it would provide a narrow training which left graduates without a base for future growth." (Hewett et al. 1992 p.56)

Notwithstanding that warning (or perhaps ignorant to it), dozens of undergraduate and graduate degrees in human-computer interaction were established during and since that time to provide specialized training to students in the field of interaction design (Perlman 1999). In fact, the first academic program officially named "Interaction Design" is believed to be the Master of Design in Interaction Design, established at Carnegie Mellon University in 1994[5]—only two years after the ACM SIGCHI curriculum was published. Befitting the multi-disciplinary background of interaction design, these various degree programs emerged from different education disciplines and school departments[6] as well.

And because of these different backgrounds—be it computer science, art, psychology, etc.—they each emphasize varying aspects of interaction design over another, preventing consensus about what should be standard content (Cooper et al. 2014). Other disciplines—such as law or business—have variations in what is taught, depending on the school. Their corresponding curricula "reflect the institution's distinct emphasis and character, which emerges from its history, location, faculty, and the typical employers for their students" (Glushko 2008 p.18). However, these variations are relatively small, and because there is a common consensus amongst these disciplines as to what constitutes a standard curriculum—often reinforced by an accrediting organization specific to the field—prospective students or potential

[5] Despite rigorous searching and numerous secondary citations, the author could find no definitive proof that the first HCI program called "interaction design" was, indeed, at CMU in 1994.

[6] for example: design – Ohio State University; engineering – University of Southern Denmark; psychology – Georgia Tech; computer science – University of Amsterdam; mathematics – University of Groningen

employers can compare programs and feel relatively confident that they understand the differences of what they offer students and graduates. (ibid.)

Interaction design has no such standard pedagogical reference model or accrediting organization (Thomassen and Ozcan 2010). And because each school and department decides just what to include in an IxD curriculum, it appears difficult for a prospective student to evaluate degree programs[7] (and having unique names for an IxD degree[8] likely only further confuses the situation).

This leads to today. The opportunities for receiving instruction and training in interaction design aren't just limited to accredited education institutions and degree program, if they ever were. Online learning courses, certificate programs, MOOCs, and training conferences proliferate alongside industry-oriented groups, such as the Interaction Design Association (IxDA), and meet-ups, blogs, and Facebook groups that further connect practitioners with practice.

The ACM SIGCHI Curriculum Development Group invited others to "keep the best of our work, to discard our mistakes, and to create an improved product" (Hewett et al. 1992 p. iii). Yet it wasn't until 2011 that SIGCHI formally revisited the curriculum to determine what had changed or remained and which new knowledge and skills were being taught (Churchill, Bowser & Preece 2013). Summarizing their findings, they described continued tensions in the multidisciplinary nature of the field, challenges between breadth and depth of knowledge, gaps between academia and industry, and contradictory desires for a standardized yet flexible curriculum.

Even though they acknowledged that a standardized curriculum or degree would make it easier for industry to know what skills students have and for students to select a program in the first place, they concluded that a "living curriculum" designed to maximize different approaches to interaction design learning and education would be the best path forward, and have invited others to participate. No new curriculum guidelines have been proposed.

Related Work

Efforts to understand the effectiveness of interaction design education have typically come from researchers within academia itself and have focused on evaluating various pedagogical approaches on students alone and then sharing those findings (Abdelnour-Nocera, et al. 2013; Culén 2015; Or-Bach 2015; Reimer and Douglas 2003; Sas and Dix 2007). or they study specific behaviors in practice to then describe

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[7] Based on comments from users on various website threads asking for guidance on which program to choose, such as https://www.quora.com/What-are-the-top-interaction-design-schools-in-the-US-and-Europe-and-why, https://www.quora.com/Which-graduate-schools-offer-the-best-interaction-design-education, http://www.ixda.org/node/33047, and http://www.ixda.org/node/26375

[8] In the United Kingdom alone: Human-Centred Systems (MS) – City University London; Human-Computer Interaction (MS) – University of Sussex; Information Experience Design (MA) – Royal College of Art; Interaction Design (MDes) – Napier University; User Experience Design (MS) – University of Brighton

overall methods or theories of performance, rather than use them to improve practitioner education (Mao, et al. 2005).

However, a few research efforts to directly engage with interaction design practitioners have been conducted and should be mentioned, as they helped to guide interview questions and places where the gap between industry and academia may be. Rogers (2004) surveyed practitioners to see whether they were not only familiar with different methods and research, but also used them in their design work (or not). Lantz, Artman, and Ramberg (2005) held small group workshops with interaction designers, teachers and academic researchers to learn how they perceived interaction design and the role of the interaction designers. Rozendaal (2010) interviewed different design businesses about their awareness of, needs for, and expertise in experience design. Hussein, Mahmud, and Tap (2014) surveyed web development professionals who had taken a course or degree program in HCI to see how they used metrics of HCI, user-centered design, and user experience knowledge in practice.

The most noteworthy related work in understanding the perspective of design practitioners was conducted in Korea (Ji and Yun 2006). This survey used multiple dimensions to categorize the respondents, including educational background, age, years in industry, company size, job title. It then asked for information about how they understood and used specific methods, tools, and theories in their jobs. Uniquely, it also probed for industry-related information, such as the nature of problems encountered in projects, and business-oriented factors such as budget or client pushback for deciding which methods to use in their work. Its main limitations were that it only covered practitioners in Korea, only focused on usability and user-centered design concerns, and did not include any specific questions on education or training.

That said, the gap between academia and industry is not unique to interaction design, and many other fields have performed extensive studies of student post-graduation competencies and career readiness. These include studies from engineering (Martin, et al. 2005; Schneider, Johnston & Joyce 2005), game development (McGill 2009), industrial design (Lewis and Bonollo 2002; Yang, You & Chen 2005), and even travel and tourism (Conradie 2012). And though the fields differ, the best elements of these studies asked questions about business challenges, soft skills, learning on the job, and expectations vs. reality, and use the language and terminology that is from industry, not academia.

One final notable work that relates to this thesis is Putnam and Kolko’s (2012) efforts to uncover common definitions for HCI professions. Their work organized and coded survey responses to create composite job descriptions for job titles in HCI, such as UX architect, user researcher, and interaction designer, finding that the most common methods for each was indeed significantly different. However, their survey was focused on a few specific user-centered activities only and did not incorporate a broad examination of more competencies across the various job titles, such as use of common interaction design methods like sketching, visual design, persona creation, or prototyping.

3. Theories & Concepts

To understand what industry needs and expects from interaction design education, one should first acknowledge the existing concepts and frameworks that clarify and contextualize how skills and knowledge are perceived within interaction design and education.

Defining Interaction Design (IxD)

The first and most fundamental concept is defining what "interaction design" means, before one can determine what knowledge areas or skillsets should be covered in an associated academic program. This is only further complicated by interaction design's interrelationship to other academic disciplines, design practices, and interdisciplinary fields (Figure 2).

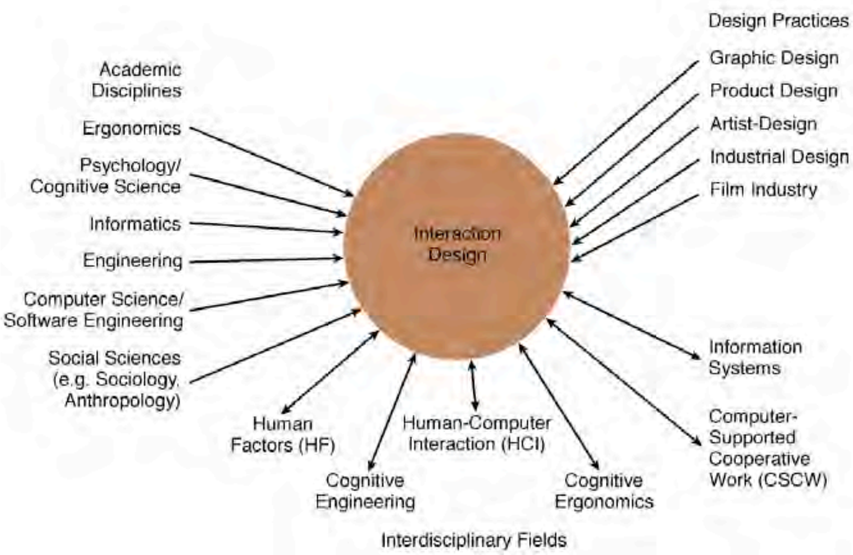

Figure 2: the trans-disciplinary nature of interaction design (Sharp, Rogers & Preece 2015)

Nevertheless, one place to begin, particularly in the context of interaction design education, is with the definition given for human-computer interaction by the original ACM SIGCHI Curriculum Development Group:

> "Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them." (Hewett et al. 1992 p.5)

Contrast that with the definition given for interaction design in one of the more prominent textbooks in the field:

> "interaction design [is] the practice of designing interactive digital products, environments, systems, and services. Like most design disciplines, interaction design is concerned with form. However, first and foremost, interaction design focuses on something that traditional design disciplines do not often explore: the design of behavior." (Cooper, et al. 2014 p.xix)

And yet another:

> "There is no commonly agreed definition of interaction design; most people in the field, however, would probably subscribe to a general orientation towards shaping software, websites, video games and other digital artifacts, with particular attention to the qualities of the experiences they provide to users." (Löwgren 2002 p.186)

The distinctions, while subtle, suggests that interaction design comes more from the designing arts, such as visual and communication design, and less from computing, and should focus less on the interface and more on the people using it. Similar sentiments from Winograd (1997) and Löwgren (2001, 2002) emphasize that while the medium of digital devices may remain the same, the path to improvement is through the design methods and approach of the "reflective practitioner" (Schön 1984).

However, that shift to design and a designerly way of thinking opens the practice of interaction design to encompass almost any subject (Buchanan 1992). Thus, no opposition emerges when researchers argue that interaction design should also include business, economics, social sciences, art, humanities, natural sciences and more (Culén 2015; Faiola 2007; Norman and Klemmer 2014). Instead of defining the subject area more clearly, interaction design researchers, instructors, and practitioners are encouraged to become more multi-disciplinary or trans-disciplinary as they apply design to more and more disciplines and projects (Adamczyk and Twidale 2007; Blevis and Stolterman 2009; Churchill, Bowser & Preece 2013) (see also Figure 3).

It is against this backdrop of fuzzy definitions and vague boundaries between disciplines that we find the explosion of titles and terms used for occupations relating to interaction design. In addition to common titles such as information architect, user researcher, interaction designer, and UX designer (Putnam and Kolko 2012), this new era of interaction design includes such multi-disciplinary positions as XD researcher, experience designer, visual interaction designer, interactive mechanical developer, medical ethnographic researcher, and more (IxDA Job Board). These are the next stage of practitioners that need interaction design education, the "specialist executors" and "polymath interpolators" (Seymour, cited in Rodgers 2007) of tomorrow.

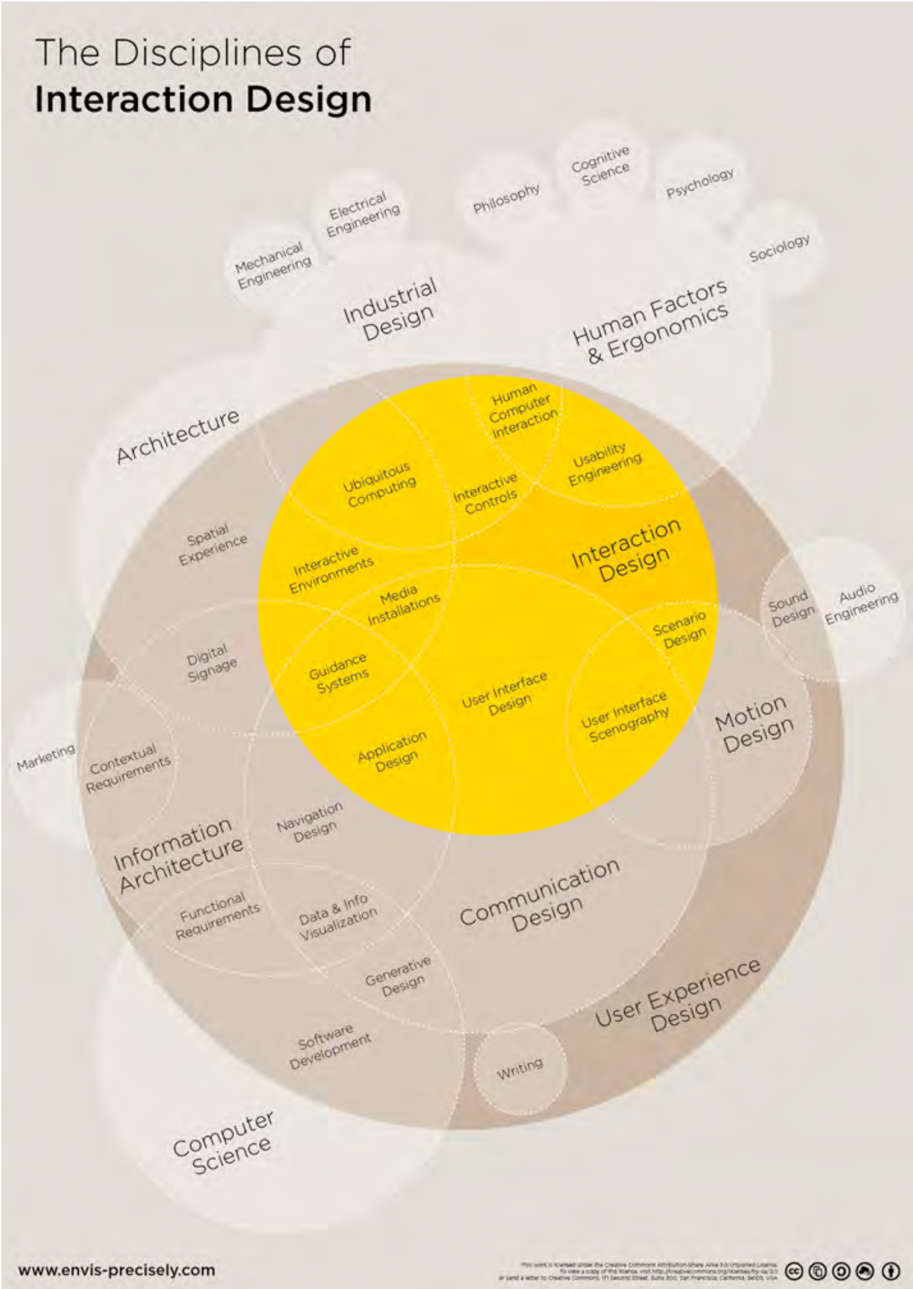

Figure 3: the multi-disciplinary nature of interaction design (Envis Precisely 2013)

And yet, while interaction design embraces more and more disciplines, there are some within the research community who argue that possibly interaction design shouldn't be considered a discipline at all. Instead, based on a lack of core research areas in the field, interaction design might be better treated as an "inter-discipline" that connects other disciplinary areas (Reeves 2015) or "might be regarded not even as a scientific field, but as a professional association, oriented toward practitioners as much as researchers" (Blackwell 2015 p.504).

When researchers can't agree on a definition for interaction design, then describing an associated education is difficult to define as well.

Wicked Problems & Design

Difficult-to-answer questions like, "What is interaction design?" are also known as wicked problems, and as such should be described further. Per Rittel and Webber (1973), a wicked problem refers to a scenario or situation that is ill-defined or complicated, includes too many criteria, and involves solutions that aren't necessarily "right" or "wrong." Instead, solutions to wicked problems are usually incomplete attempts that either cause unanticipated side effects or instead fail, and in so doing expose some element of the original problem that was unknown or misunderstood.

Buchanan calls design problems "wicked" as well, explaining that, "the designer begins with what should be called a *quasi-subject matter*, tenuously existing within the problems and issues of specific circumstance" (1992 p.17). In contrast to the natural and social sciences, design is amorphous and indeterminate, with potentially no boundary to its scope. Yet he considers this indeterminacy a great benefit to approaching wicked problems. Instead of having a defined set of general approaches or exact rules to explain phenomena or behaviors, design develops a framework from which it observes and explores.

Thus, the selected quasi-subject matter is not beholden to a body of work that has come before it, which allows the designer to approach a wicked problem in multiple ways, applying methods to break down a problem into specific aspects or parts that can then be addressed. While these parts may not individually amount to much, taken collectively, they create a more complete picture of the initial problem and amount to a series of solutions that—while not solving the entire problem—might provide some results that are "good enough" for now.

In the case of this thesis's overall subject matter—interaction design education—the "quasi-subjects" of academia, industry, and student practitioner are individually complex. And even by breaking down just the industry side of the equation, further quasi-subjects emerge, such as designer ability, industry need, employer expectation, contextual demand, client requirement, and technological progress. As such, this thesis does not attempt to solve the wicked problem of the gap between academia and industry and instead tries to provide a "good enough" solution for understanding so that further work can be performed.

Education vs. Credentials

Broadly speaking, education can be divided into two types: general education and professional education. General (or liberal) education encompasses a variety of subjects and materials and is intended to train students in the ability to frame concepts in historical contexts, think critically, communicate effectively, and work independently and cooperatively, regardless of the field (Shinn 2014). Professional (or vocational) education, in contrast, has a more focused intent:

> “Professional education is directed toward helping students acquire special competencies for diagnosing specific needs and for determining, recommending, and taking appropriate action. Professional education is also expected to socialize students in the 'thought processes' of the profession and to inculcate them with its customs, ethics, working relationships, and the behaviors expected from members of the profession.” (Hoberman and Mailick 1994 pp.3-4)

These distinctions perhaps sound like the difference between an undergraduate bachelor’s degree and a more specialized master’s degree in a discipline, the assumption being that someone with a master’s is better prepared to take a position in a given field. However, despite a student’s expectation that their degree education has qualified them for a particular job, that is not the case in reality.

Of course, some of this is based on the aptitude of the student. As a professor of interactive design described about his university’s undergraduate design program, “Not everyone will come out as a professional designer, they just don't have the skills. I don’t want them to drop out school, but I need to help them see that this field might not be for them” (M Lahey 2016, personal communication, 3 March).

And some is based on the instruction of the teachers as well. As a gentle nudge to educators in the early days of interaction design, Winograd reminded them that, “the purpose of education is to develop the student’s competence to take some kind of action. Often we lose sight of this in our eagerness to ‘transmit knowledge’ or ‘cover the material’” (Winograd 1990 p.444). Continuing, he said, “The vast majority of people we train in computer science (even those at the elite schools) will not go into academic research, but will play a variety of roles in the invention, production, implementation and use of new computing devices.” (ibid.)

To meet the needs of these current and future interaction design practitioner roles, a “particular education” will be required (Norman and Klemmer 2014). Indeed, there are many examples from the literature in which different IxD courses and programs have introduced various pedagogical techniques and design methods to improve the job-ready competencies of students, from design critiques (Culén, Mainsah & Finken 2014) and studio-based group work (Silva, Crosby & Polo 2014; Thomassen and Ozcan 2010) to apprenticeships (Sas 2006) and even design management (Liu 2009).

Despite those best efforts, interaction design presents several challenges for an instructor or degree program attempting to create a relevant IxD curriculum. After five years of teaching, instructors of an HCI program in China described challenges in mapping education to industry-relevant needs (Lian-nan, Yu-long & Jia-xun 2015):

- Staying current with the latest trends and technologies
- Presenting those trends and technologies in pedagogically effective ways
- Combining that information with existing and historical knowledge that should also be taught
- Improving students’ ability to innovate
- Designing project-oriented scenarios for students to work on

Ignoring any evaluation of the quality of instruction or the ability of the students themselves—despite even an educator's belief that they are providing valid skills that train a student for employment—the reality is that education is not enough to ensure that a practitioner can perform the tasks required for a given job or position. Instead, professional credentialing is the method used by various trades or professions to indicate that those who have been tested and evaluated according to specific requirements have the expected skills and knowledge for appropriate and safe practice of his or her profession (Balthazard 2010).

These credentials or "warrants of competence"—such as a license to practice medicine—are not issued by an academic institution, even if a formal degree is required. Instead they come after the educational program, followed by additional practice, study, training, and testing that is supervised by those in their field. For example, a license to practice medicine is granted only after a physician has completed schooling, participated in some form of residency or supervision program, and passed an exam administered by a medical board—a degree is not enough. While fields as diverse as architecture, nursing, and even hairdressing include some combination of academic education and professional licensing or credentialing, no such competency evaluation in interaction design has been created in either North America or Europe (Thomassen and Ozcan 2010).

Job Competency Models

Despite the absence of existing credentials and licensing for interaction designers, one can still conceive how credentials might be chosen by considering the idea of job competencies. Competence, in the context of a job, refers to how well a person uses their various skills, knowledge, and attitudes to accomplish specific tasks or objectives (Karmel 1993; Vinke 2002, cited by Yang, You & Chen 2005). Competencies, then, can be used as a catch-all term to describe any of these specific designations, and understanding how others group and organize competencies provides some insight into how a similar structure could be used for interaction design (which this thesis does in Ch. 5 Execution Process: Competency Framework). And research shows that job competency models are an effective way to evaluate job positions, educational programs, and the individuals that participate (Ennis 2008).

KSA – Knowledge, Skills, Abilities

The first competency grouping to mention is KSA, used by the United States government in hiring for federal jobs. These are job-specific responsibilities or tasks that are required to successfully perform in a position, and are broken into three categories (US Department of Veterans Affairs 2009):

- **Knowledge** – refers to factual or procedural information as applied to a task
- **Skill** – refers to mental, verbal or physical actions or behaviors required to perform a task
- **Ability** – refers to capability or competence shown when performing a task

While one could argue the definitions for skill and ability overlap, the KSA provides a good initial understanding that a worker's competency consists of more than just performance of set tasks, but also encompasses the knowledge required to do so.

O*NET Content Model

There is no standard set of KSAs for any given job within the federal system. However, the government-sponsored Occupational Information Network (O*NET) provides an extensive database of job descriptions, including KSAs, work activities, and tools, that are based on surveys with representative workers from each job (alas, interaction design is not one of them). These factors are then combined into a framework that "identifies the most important types of information about work and integrates them into a theoretically and empirically sound system." (National Center for O*NET Development 2013) (see Figure 4). This model points out that a job is not just about what's required in completing tasks, but also depends on an employee's values and interests to be aligned for the task to be completed well, which is certainly relevant to industry's expectations from interaction designers.

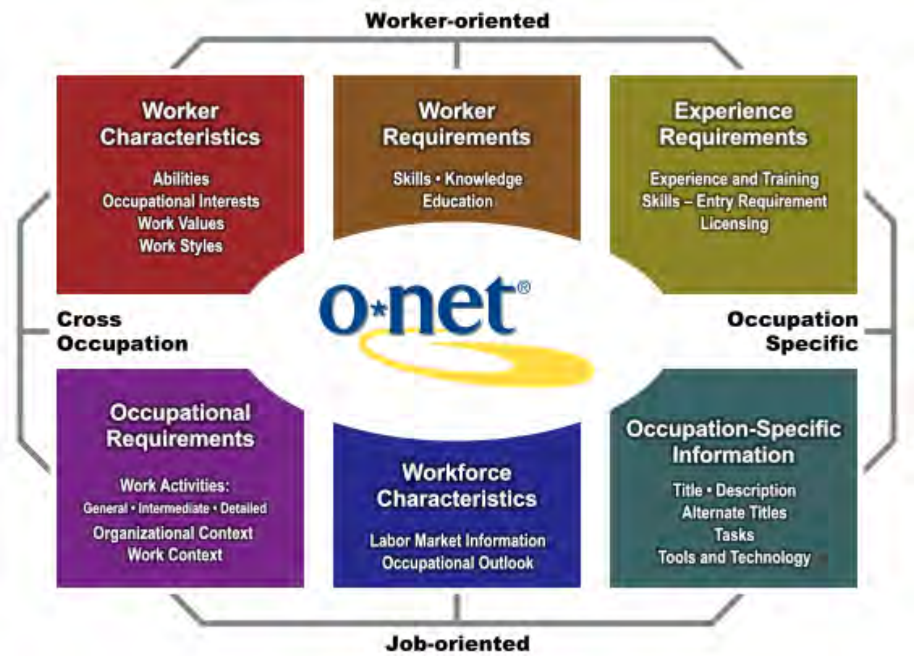

Figure 4: the six-part O*NET Content Model (National Center for O*NET Development 2013)

SFIA – Skills Framework for the Information Age

Pronounced "Sophia", the SFIA has been developed by a British consortium of technology entities to help describe the competencies required for work in information technology. It separates these abilities into three different categories—Professional Skills, Behavioral Skills, and Knowledge—and includes Qualifications and Experience as additional components of a job description (Burrows 2015). Unlike O*NET, the SFIA only focuses on specific professional skills, leaving behavioral skills and knowledge to the businesses hiring. Yet where it lacks in breadth, it makes up for in depth, with 97 professional skills grouped into 17 sub-categories and 6 high-level categories, such as strategy and architecture, development and implementation, and relationships and engagement.

The SFIA also draws out the specific ways in which particular skills should be organized in technical fields, which is similar to how interaction design is multidisciplinary as well. And it also designates whether a given competency correlates to a higher or lower level of responsibility, indicating more senior or experienced roles (see Figure 5). This is not a concept addressed later in this thesis, yet is an important dimension to remember when reviewing competencies for job postings and whether some skills or knowledge areas are not just dependent on the job (i.e. interaction design) but also the role (i.e. manager vs. junior designer).

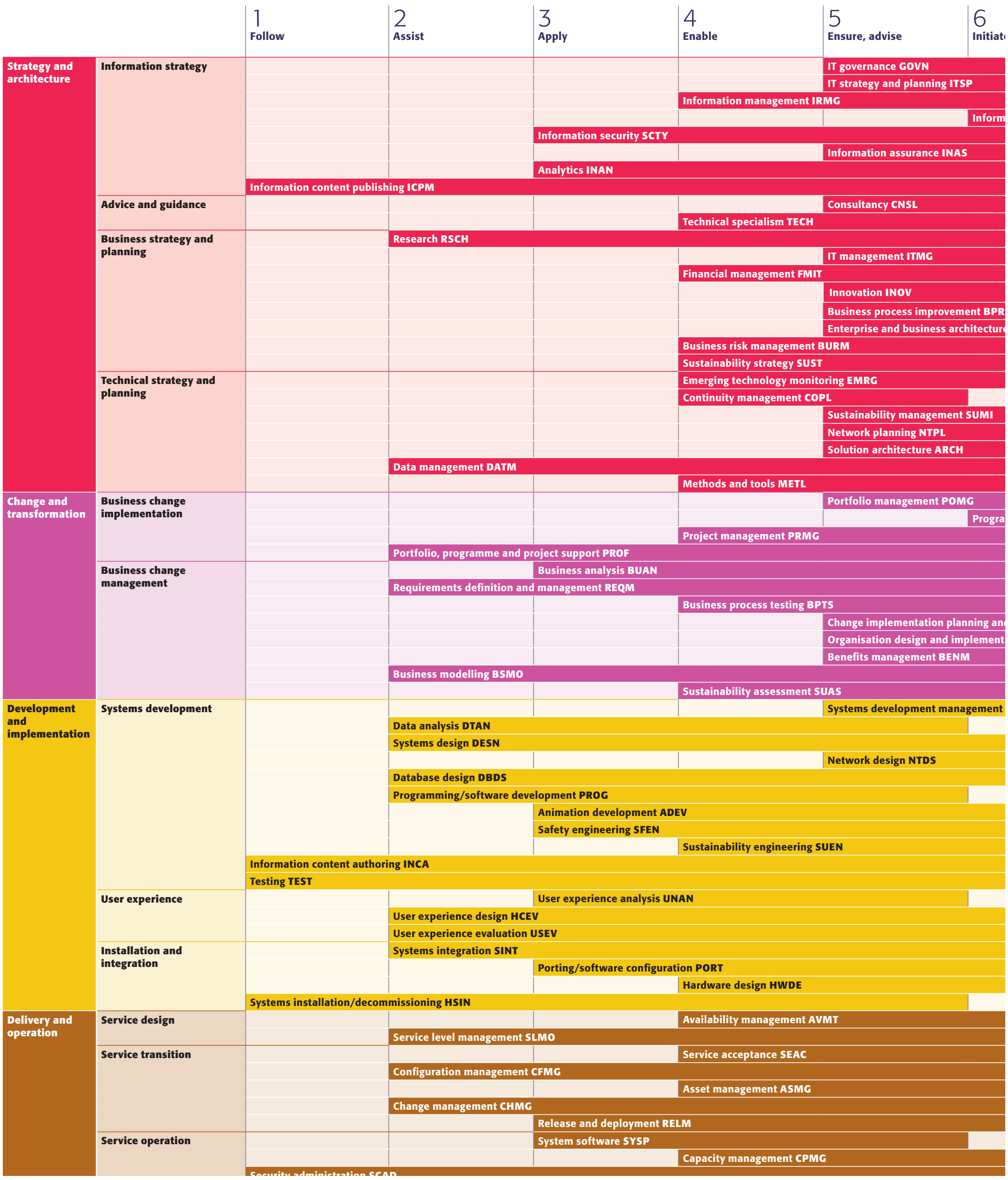

Figure 5: Excerpt from SFIA framework, showing how various competencies are divided into skill categories and organized by level of responsibility (Burrows 2015)
(a complete version is available in Appendix A: SFIA Framework Overview)

Blevis & Stolterman

While KSAs, O*NET, and SFIA provide different ways to think about job competencies in general, they don't provide anything particularly specific for interaction design. Thus, the work by Blevis and Stolterman to describe interaction design as a kind of discipline is particularly helpful. As they describe it:

> "Under practical norms, what unifies a single disciplinary perspective is the belief in common notions of mind-set, knowledge set, skill set, and tool set, where **mind-set** is what you think is important to you and to your discipline, **knowledge set** is what you think everyone in your discipline ought to know, **skill set** is what you think everyone in your discipline needs to know how to do, and **tool set** is what you think everyone in your discipline should use to practice the discipline" (Blevis and Stolterman 2009 p.48).

They go on to compare interaction design to other design disciplines like visual design and software design and list some perspectives unique to each (see Figure 6). These aren't meant to be complete or exhaustive by any means—in fact they are pushing interaction design further into a transdisciplinary perspective across disciplines—yet it helps to see how one can organize job competencies into interaction design-friendly facets.

	VISUAL DESIGNERS	INTERACTION DESIGNERS	CONTENT DESIGNERS	SOFTWARE DESIGNERS
mind-set	appearance	interactivity	message	performance
knowledge set	visual form	cognition	narrative	algorithms and data structures
skill set	drawing, sketching, brainstorming, illustrating	processes: contextual design, interaction design process, formative evaluation, iterative design, participatory design	secondary research, analysis, précis, narrative, indexing, tagging	processes: star, spiral, waterfall, joint application development (JAD), rapid application development (RAD)
tool set	image and illustration tools, photography, video, cultural artifacts	usability labs, rapid ethnography, low- and high-fidelity prototypes	classification, reportage, secondary research	software development kits, open source

Figure 6: Blevis and Stolterman's (2009) comparisons between interaction design and other disciplines

DEM – Design Enterprise Model

The final model to consider for job competency is one actually geared toward structuring interaction design education instead: The Design Enterprise Model (DEM). As its creator explains it, "DEM extends the potential of HCI by emphasizing design as a unifier for managing knowledge domains" (Faiola 2007 p.34) and does so by applying theory, application and management to four specific knowledge areas: social science, design, business, and computing (see Figure 7). While the DEM doesn't address specific aspects of a worker's job activities, such as attitudes and behaviors or mindsets, it nevertheless introduces the need for different orders of thinking and situates business demands and expectations as part of the competencies a job in interaction design could entail.

Knowledge Domains

Knowledge Operations	Social (Human & Culture)	Design (Graphic & Interaction)	Business (Market Value & ROI)	Computing (Building & Testing)
I. Theory (Foundation)	1. Cognitive psychology 2. Anthropology 3. Sociology & social informatics 4. Cross-cultural communication	1. Interface Design: Visual communication & information design 2. Interaction Design: Human-centered design theory (General theory of human action / behavior)	1. Local and global markets 2. Product and market value 3. Product business strategies 4. Return on investment (ROI)	1. System modeling and computing theory 2. Usability and HCI theory 3. Testing measures
II. Application (Processes)	1. Contextual Profiling 2. Ethnography: • Observation • Interviews/questionnaires • Focus groups • Interpretation & Analysis 3. User Modeling: • Human need, • Diversity, • New social groups	1. Problem space development 2. Product requirements 3. Conceptual modeling: 4. Rapid Prototyping 5. Dynamic Prototyping 6. Design Iteration Tools 7. Participatory design, etc.	1. Apply business strategies • Create a better targeting of customer needs • Achieving market goals 2. Integrate market value & product design • Increase product value for the user • Increase economic value for the company	Building Tools 1. Scripting / HTML 2. Flash / Director 3. Visual Basic 4. Other Testing Tools 1. Usability Testing: • Time-on-task studies • Questionnaires / Surveys 2. Heuristic Inspections 3. Observation / Interviews
III. Management (Administrations)	1. Coordinate assets within an interdisciplinary design team 2. Deploy existing skill-sets through cross-disciplinary dialogue 3. Facilitate communication that can profit all the stakeholders within the design enterprise. 4. Administer design processes to better guide teams in the documentation, organization, and sharing of information across knowledge domains.	1. Direct the prototype design process of user interfaces & other system components that account for: • Visual clarity and aesthetics • Utility, functionality, and usability 2. Manage the innovation/creation process of new technologies that have portability with functionalities: • Wireless and distributed • Networked information utilities	1. Manage user and market research for a better understanding and application of business and design knowledge. 2. Create an effective business environment that reinforces the capability of accessing, exchanging, capturing and generating new knowledge within the design process.	1. Observation / Interviews 2. Oversee product building and testing 3. Oversee quality control of product design and testing procedure 4. Oversee integration and summation of data analysis 5. Make final recommendations and prepare presentation.

Figure 7: Design Enterprise Model (Faiola 2007)

As can be concluded in these job competency models and from other research performed during this thesis project, no current framework appears to have been created that describes job needs, worker skills, and business requirements in the context of interaction design. It is in this underdeveloped area that the thesis project derives its focus, using the concepts of these job competency models to create a framework specific for interaction design, as described later.

4. Methodology

To test out and apply the aforementioned theories and concepts in a meaningful way, this thesis project applied different design and research methods in the context of an overall design process. The following chapter describes that process and explains the methods used to uncover why there is a gap between industry and academia, what industry expects from interaction design, and how a framework can be created when one hasn't existed before.

Using Research through Design to Create a Framework

Perhaps one reason there is no such framework is how others have approached the industry-academia gap in the past. Using the scientific methods of user research and analysis, they've broken down the component parts of the problem in an attempt to understand the broader picture. Yet they haven't taken the subsequent step to reassemble those parts into a cohesive whole. For designers, however, another path exists: research through design.

Research through design, as described by Zimmerman, Forlizzi, and Evenson, focuses on the creation of specific design artifacts that serve as "exemplars, providing an appropriate conduit for research findings to easily transfer to the HCI research and practice communities" (2007 p.493). These artifacts aren't just for further research by others though; they can also be iteratively developed through the course of a single project, used to describe a future outcome (Zimmerman, Stolterman & Forlizzi 2010). While these design artifacts can take different forms, a framework is a particularly relevant way to understand a problem area before creating any subsequent designs.

And what is a framework? Per Miles, Huberman, and Saldaña, a framework is a visual or written product that describes "the key factors, variables, or constructs—and the presumed interrelationships among them" (2013 p.20). It approaches a topic or domain and applies relevant dimensions to reach a level of understanding (Rauterberg 2006). Frameworks do not take a particular form or shape, nor do they explain an entire ecosystem or prescribe specific methods. Yet a framework does more than just describe a possible reality the way a theory does; it also offers an orientation that can be flexibly applied in further research and action (Gaver 2012).

Design Process

It is important to recognize that research through design is not a methodology of its own, but more of a mindset. As a basis for addressing design problems and applying process to the thesis, Jones' model of divergence, transformation and convergence offered an appropriate initial design approach (Jones 1992) (see Figure 8):

- In **Divergence**, the goals are unclear and the problem areas are vague, and so the design work revolves around describing the problems and finding possibilities.
- In **Transformation**, the effort shifts to uncovering patterns in those findings and then choosing goals to define the solution space.
- In **Convergence**, the focus moves to reaching those goals, as possibilities are selected and then implemented in one final solution.

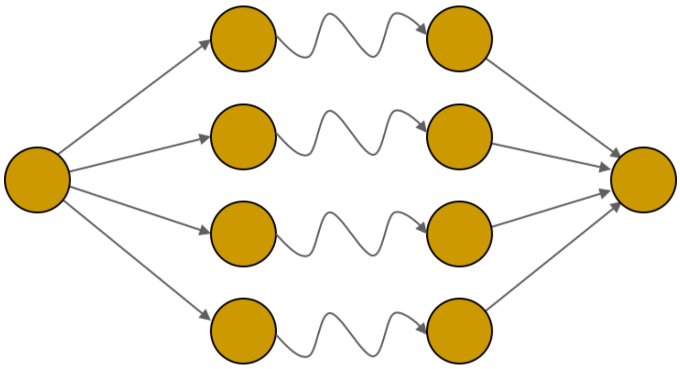

Figure 8: the stages of divergence, transformation & convergence

These various efforts are embodied in design methods and artifacts, while along the way, underlying theories and results emerge, an effect of following research through design (Barab and Squire 2004).

Yet the Jones model is not the only approach that could have been used. Human-Centered Design (HCD) and Goal-Directed Design (GDD) are other methodologies that designers can use in approaching research through the design, explained as follows.

Human-Centered Design (HCD), also known as User-Centered Design, places the user and context of use as the focus for all design decisions. Employing methods such as personas and ethnographic research and then further involving users as testers, reviewers, and even co-designers in co-creation sessions, HCD offers designers greater opportunity to profile users and understand their behaviors and preferences, and can be thought of as a collaborative effort between user and designer (Williams 2009). The International Organization for Standardization, in ISO 9241-210, gives a specific process for conducting human-centered design projects that focused on understanding the user's needs and context of use and from there determining user requirements and designing against those requirements (see Figure 9).

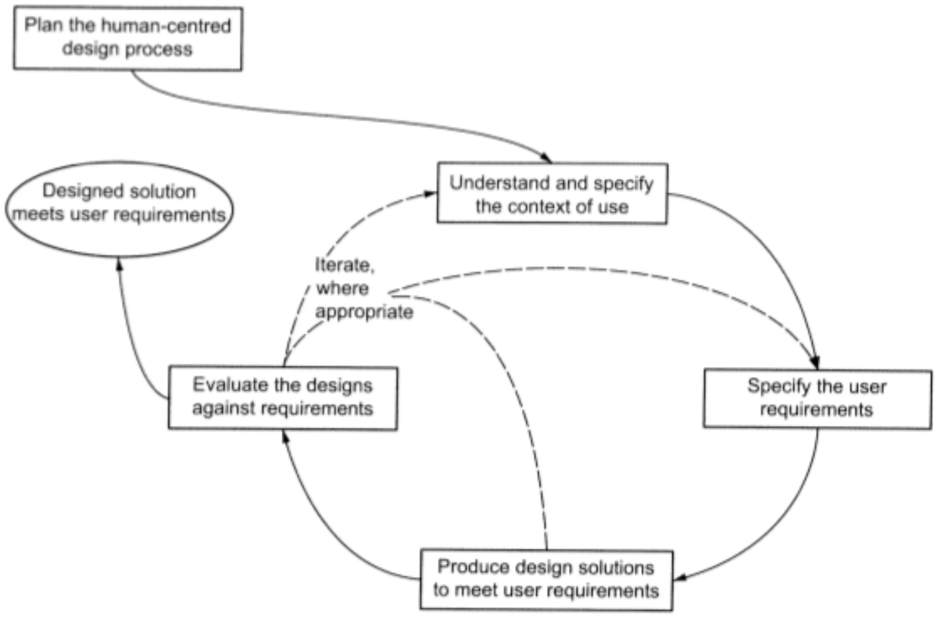

Figure 9: The Human-Centered Design process (Jokela 2010)

Goal-Directed Design (GDD), although fundamentally a user-centered design approach, is a bit different than HCD in that it focuses instead on the what the user is trying to accomplish, the goal of the activity. As conceived of by Cooper et al. (2014), GDD also differs from HCD in that it prescribes a different set of stages to go through (Figure 10), with the expected outcome to be products that both reflect user's desires and context and corresponding business aspects, technical and domain opportunities, requirements and constraints.

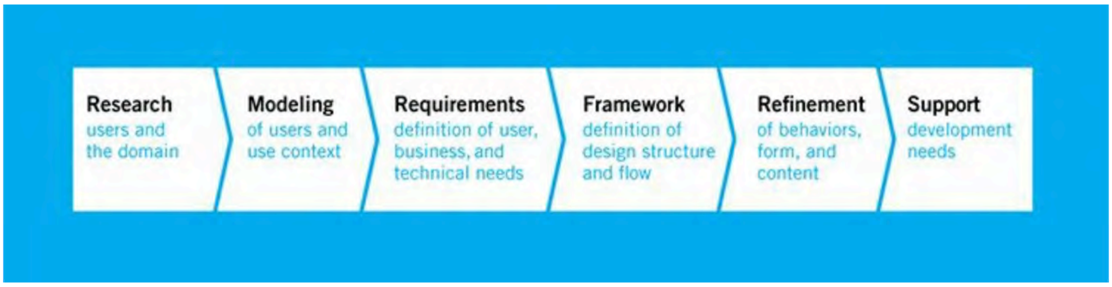

Figure 10: The Goal-Directed Design process (Cooper et al. 2014 p.23)

Compared to the Jones model, Human-Centered Design and Goal-Directed Design are more geared for creating a software product or interface—a result that was not necessarily expected in this thesis. That said, while the Jones model provided the broadest flexibility in pursuing different outcomes from a process standpoint, none of the approaches adopts exclusive methods, and in fact, techniques from across the design process spectrum were used in executing this thesis effort.

Methods

The following methods exemplify the kinds of techniques a designer may use to gather information, organize and interpret results, generate possible directions to pursue, and subsequently drive the creation and evaluation of a design solution.

Literature Review

As a way to quickly understand the problem space, a literature review involves exploring how others have studied a research area. This not only quickly builds a designer's knowledge, it also helps to map out what has been done—so as not to duplicate effort—and identify where gaps exist, and thus offer areas to explore further (Knopf 2006).

Expert Interviews

Direct user research through individual interviews was another vital way to understand the problem from the perspective of those immersed in it. While interviews are typically organized in three categories—structured, semi-structured, and unstructured (Sharp, Rogers & Preece 2015)—this thesis project relied on semi-structured interviews only, because they combine the rigor of pre-defined questions with the flexibility of allowing the interviewee to guide which questions to be asked. And because facial expression and body language provide better contextual understanding of how the interviewee feels than just a phone interview (Wadsworth 2011), these interviews were conducted face-to-face (either in-person or via Skype).

In determining who to interview, this thesis relied on a form of purposive sampling known as expert sampling. In expert sampling, the interviewees are selected specifically because their knowledge can be used to support a conclusion for which the researcher has no claim to know from experience (Trochim and Donnelly 2006).

As for what questions to ask, Wadsworth (2011) suggests that questions need to be "right" for both the interviewer and the interviewee. For the interviewer, they need to produce answers that will support the research purpose; and for the interviewee, they need to be "answerable," meaning that the subject can offer a response that they feel captures their thoughts or experiences without manipulation or coercion. Under semi-structured interviewing, an initial set of questions are created beforehand; yet questions that aren't effective for either the interviewer or interviewee are adjusted as the interview process continues, rather than standardized such that all interviewees are asked the same bad question for the sake of research precision.

Quantitative Assessment

While interviews from individuals provides a qualitative perspective and a means to validate ideas in real-time, their subjective nature can describe only small parts of a large and complex problem space such as interaction design education. Data collection then is another method that permits a more quantitative review of information relating to information that can be compared to one another, such as interaction design degree programs and job listings. In addition to expanding the scope of information, data of this nature can provide a secondary benefit, in that it can then be used in quantitative ways in visualizations, permitting others to interact with the data and make their own insights and conclusions.

With larger datasets that would be too time-consuming to gather and interpret as a whole, random sampling takes a subset that can still be considered representative. However, ensuring that it is truly representative can be difficult when the data itself may not be “clean” as expected. Multi-stage sampling is a technique that allows a researcher to take a large, low-quality dataset and then further refine it through the selection and qualification of specific clusters (such as job title) before drawing smaller samples to use (Trochim and Donnelly 2006). And because this thesis uses relatively small datasets using these sampling methods, one should recognize that the results cannot and should not be measured in terms of statistical significance in any way. Still, the sample should avoid obvious bias by including sources and samples that are logically consistent with the goals of the project rather than reflect the agenda of the researcher or author (Wadsworth 2011).

Affinity Diagrams

With data gathered, the next step is to seek to make sense of it, and an affinity diagram is a useful method to use in this regard as it involves summarizing what is found and organizing it visually in a taxonomy to describe the content as a whole (Kolko 2011b). To create an affinity diagram, relevant quotes, phrases, or keywords are written down on post-it notes (with one insight per note) and then grouped together as patterns emerge (see Figure 11). This allows the process to proceed quickly as knowledge is produced and fortified. However, because each insight is limited by the size of the note, it means the writing must be brief, potentially reducing the amount of insight that can be gathered from such a diagram.

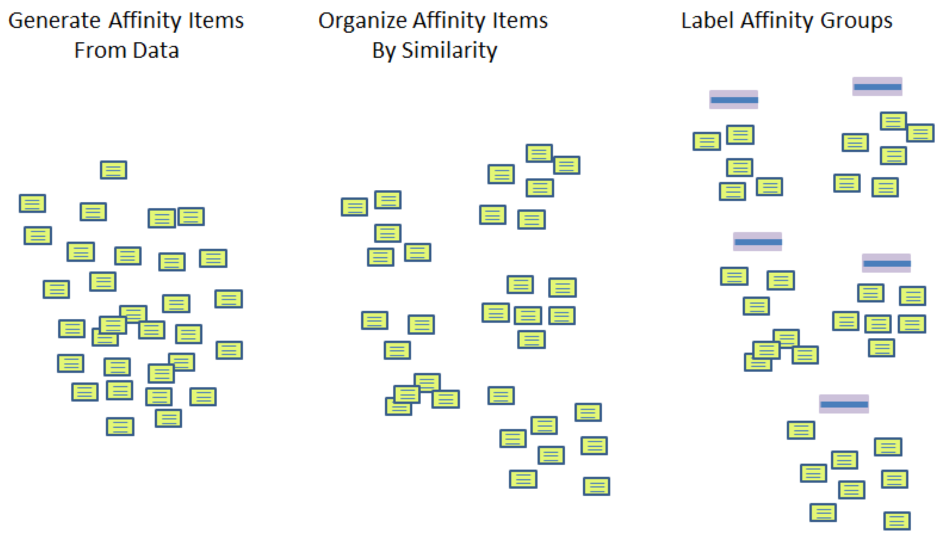

Figure 11: Creating an affinity diagram involves grouping and labeling similar concepts (Wilson 2012)

Card Sorting

As an alternative or compliment to affinity diagramming, card sorting involves taking a set of cards, upon each of which is written a term, label or phrase describing a system, and then having users organize them into groupings that make sense to them. Instead of having one single result set as in affinity diagrams, card sorting takes the separate results of several users to see preferred groupings and use those as a pattern for the terms overall. As Rosenfeld and Morville (2002) explain, card sorting can either be open—meaning users provide their own labels—or closed—meaning the labels are predefined and the users focus on the organization, yet either way, it requires that the participant have "refined organizational skills" and have a sense of the subject matter (Cooper et. al. 2014 p.58), neither of which were guaranteed in this thesis. And because card sorting is best suited for smaller sets of labels, that made it impractical for the hundreds of competencies uncovered in this thesis.

Content Analysis

With larger sets of data inputs (such as job listings and degree programs), affinity diagrams can be too time-consuming or difficult to create easily. Content analysis can instead be used to make sense of the potentially vast amount of qualitative textual data produced from any data collection effort. In content analysis, words, phrases, and sentences—even drawings and actions—are compressed and grouped into categories, which can then be analyzed quantitatively, uncovering trends and patterns that might not appear in strict word analysis (Stemler 2001). And while software exists for automating some portion of the analysis of large sets of texts[9], they typically require a training set in which various words or phrases are mapped or coded by hand. In the case of this thesis, because of the small sample sizes and keyword-rich data used, the datasets were the training sets—all manually coded without any subsequent automation to larger samples.

To generate these codes in content analysis, one uses the keywords and synonyms within the text ("UX" vs "user experience" for instance) or through other groupings that come from a broader perspective of the topic ("Photoshop" and "Sketch" might be grouped under "design tools", for example). It is important however that these categories should not be predefined before the analysis is conducted. Instead, the researcher should allow the data itself to produce both the categories and the names themselves rather than rely on an existing data dictionary of terms (Kondracki and Wellman 2002). In this way, the content remains independent rather than being forced to fit into categories that may represent biases and preconceived notions, or—as in the case of the specific terminology of interaction design—be completely overlooked because they weren't described correctly in a more generalized dictionary source.

Sketching

When it comes to exploring how this content and data can be best organized and subsequently presented in a design, sketching is a fundamental method for designers. With sketching, a designer can create multiple ideas quickly without concern for quality, and then use these concepts for discussion with others and further assessment

[9] for example, ReadMe (http://gking.harvard.edu/readme) and Lexicoder (http://www.lexicoder.com/)

by oneself (Greenberg et al. 2011). While the level of detail may vary depending on what is intended to be conveyed, a sketch is about capturing an idea, not producing an accurate representation of the final design or product.

Prototyping

To further understand and explore possibilities without investing large amounts of effort, prototyping embodies the conceptual model of a designer as he or she attempts to explain "future conditions of use" of a proposed design:

> "Quite simply, these techniques re-create the various parts of this situation that do not yet exist. To make interactive cognition work well, the designer has to create her own working materials; before the world can become a part of cognition, the designer has to create it." (Gedenryd 1998 p.157)

A prototype then is used as an intermediate step to unify the differing and complicating thoughts of a researcher through iterations of design, be they new ideas, ways to convey an existing idea to others, or to explore possible approaches quickly (Benyon, Turner & Turner 2005) (see also Figure 12).

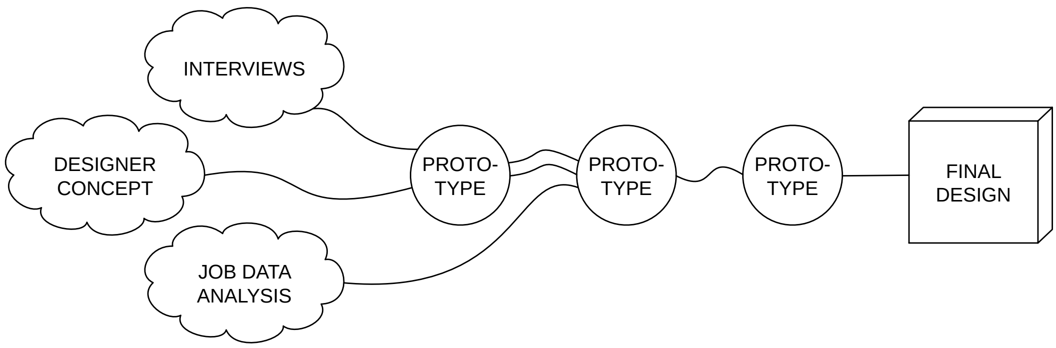

Figure 12: Different elements of understanding iteratively contribute to a prototype

Methods of prototyping range from sketches to paper prototypes to higher fidelity wireframes and design comps—all of which were used in this project to sketch out possible ways of presenting the framework and for mocking up how the survey website and corresponding visualizations would appear. However, rather than use these prototyping methods sequentially, from less detailed to more complete, this project followed a more effective approach to first consider the "most important open design questions" and then choose a prototyping method that would best answer those questions (Houde and Hill 1997 p.368).

Information Visualization

With quantitative information (like what this thesis produced) using a graphical or visualized representation of that data is much more easily and quickly understood than a table or textual description (Shneiderman 1996). Information visualizations (infovis) can include anything from data-derived bar charts and scatter plots to more conceptual representations like flow charts and affinity diagrams, yet the best infovis follows a multistep process in which a designer determines first *what* to present and then *how* to present it in a way that reveals the intent of the design.

Fry (2004) breaks down this process into seven steps—acquire, parse, filter, mine, represent, refine and interact—yet points out that this is not necessarily a linear process. Often the results of a later stage may uncover a shortcoming of an earlier stage that then needs to be revisited to produce a worthwhile result. For example, in the *represent* step when a designer decides how to display data in a chart or graph, she may realize the dataset is too limited to convey anything worthwhile. So she returns to the *filter* step, selects different data to interpret, and continues through the process (Figure 13). This back-and-forth is the core of creating visualizations.

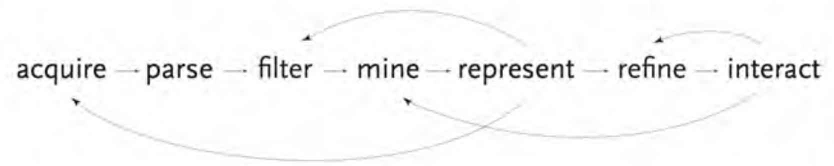

Figure 13: Fry's Computational Information Design process involves moving back and forth between steps to answer the underlying design question (2004)

While the following chapter explains the specifics of how this thesis achieved those steps, more can be offered here to describe the elements of an effective information visualization.

The first element is deciding what question is being asked. According to Fry (2004), too often the start of a visualization effort is simply having gathered large amounts of data and then wondering what to do with it. Instead, the approach should be to start with a question to be answered and then, in each stage, reflecting back to see whether any answers emerge.

The second element is determining what Tufte (2001) calls the user's "cognitive tasks." These are the activities a user needs to do to arrive at a relevant answer to the proposed question. For instance, if a user's cognitive task is to make comparisons between different job listings then the interface should be biased toward making comparisons easier. Tufte considers infovis good when it allows for comparison, ensures causality, integrates text and graphics seamlessly, and demonstrates the underlying data's quality and integrity (Cooper, et al. 2014; Tufte 2001).

The third element for an effective visualization is applying the principles of pattern perception, commonly known as Gestalt laws. Gestalt—which means "pattern" in German—describes how our minds organize perceptual information (Ware 2012). By utilizing these organizational laws, including principles such as proximity, similarity, connectedness, and closure (see Figure 14), one can influence a visualization to indicate relationships beyond just using labels, color, shapes, or other signifiers.

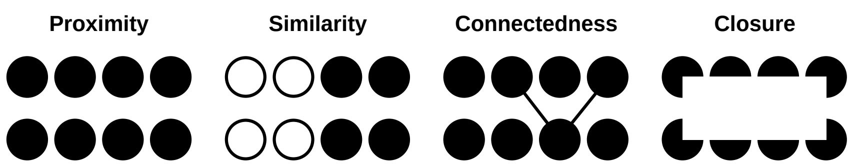

Figure 14: Examples of Gestalt principles demonstrating how visual perception creates patterns

The fourth element to note is that a good visualization allows users to explore the dataset to find additional information they might be interested in. Shneiderman has summarized this infovis feature with the adage, “Overview first, zoom and filter, then details on demand” (1996 p.336), although Ware (2012) points out that users are more likely to move between different views of detail and overview as they explore the dataset, and thus the visualization interface needs to support multiple scenarios of use to be most effective.

Utilized in concert, these elements help to make an information visualization an effective part of any data-driven design.

Evaluations

To gauge how well a given design artifact achieves its intended goals, it must be evaluated, and this thesis project used a few evaluation methods to provide this insight. The first to mention is subjective evaluation and is performed by designers themselves whenever they stop to assess how a given design conforms to their own plans and expectations. This is the fastest method because it only involves the designers themselves and can be conducted in the context of the design process.

The next fastest method is known as a “quick and dirty” evaluation—so named because it can be conducted rapidly yet doesn’t involve detailed documentation to record the findings (hence the “dirty”). In these evaluations, the designers involve other people to provide feedback on designs to see whether they are aligned with what the users are expecting (Sharp, Rogers, & Preece 2015).

The next two evaluation methods to mention may take more time, yet also produce results that can strongly indicate further direction for a design. The first, heuristic evaluations, involves experts who use design heuristics—or rules of thumb—drawn from their own experiences to evaluate a solution. Such heuristics could include whether a design is implemented consistently, whether it uses clear language, or whether it conforms to the users’ mental model, among others (LUMA Institute 2012). The second, user evaluations, gives the perspective furthest removed from the designer, by having users of a given design provide feedback, they provide potentially unique insight and raise additional questions that can then be subjected to the action research process of research through design (Wadsworth 2011).

Usability Testing

Unlike general evaluations which may cover any number of website design elements, usability tests focus particularly on how well a website user performs specific tasks. By measuring the performance of these tasks against Nielsen’s base metrics—success rate, completion time, error rate, and satisfaction—one can understand precisely how a given feature or function on a website performs (Nielsen 2001). These results can then be used over time to determine whether changes to a site improve the site’s usability. Usability tests were originally planned as part of this thesis project, yet were not performed due to delays in implementing website functionality, so the project relied on quick-and-dirty testing and heuristic evaluations instead.

5. Execution Process

This chapter of the thesis describes how various methods (described above) were applied in the execution of the thesis project. These methods produced three different results: a collection of guiding factors that describe how industry approaches interaction design education; a framework for understanding interaction design needs and expectations; and a survey website to collect further information and present the results.

Divergence: Exploring the Industry-Academia Gap

The thesis project commenced in first exploring the problem space, understanding and describing the problems that emerged. The main areas of interest were in understanding how industry thinks of interaction design, how academia thinks of it, and how industry and academia think of each other. The expectation was not to find definitive answers, but to describe problems and find possible areas of investigation.

Literature Review

The literature review began with targeted searches using Google Scholar[10] and ResearchGate[11], examining academic literature for information relating to interaction design education and its effectiveness in industry. As most of the literature pointed to HCI research as opposed to interaction design, this led to further exploration into the history of HCI itself and how interaction design differed. This was the first hint that perhaps one of the reasons interaction design professionals in the industry had issues with interaction (or HCI) education. Research professionals within academia couldn't agree themselves.

Additional exploration included IxD curriculum development and evaluation, pedagogical methods (such as studio work), educational and learning frameworks, and research into student-job readiness. This process revealed a slight bias toward the perspectives and approaches of academia itself, with an emphasis on methods for pedagogical improvement and not as much on practitioner understanding.

To compensate for this bias and get more practitioner- and industry-oriented perspectives, the literature review was expanded to include non-academic sources,

[10] https://scholar.google.com/

[11] https://www.researchgate.net/

such as articles in industry magazines and blog posts from individual practitioners in the field. This effort proved invaluable in uncovering more concrete examples of the disciplines of interaction design, along with the first seeds of how to consider interaction design in a contextual framework. The major results of this literature review can be found in the Introduction, Background, and Theory chapters of this thesis, while also helping to establish the kinds of questions to ask in the expert interviews.

However, a few points of information should be highlighted here as they impacted the latter work and results.

- Interaction design education emerged as different disciplines independently determined certain skillsets they deemed necessary. As time progressed, educators and researchers came together to find commonalities among their various practices to describe a core set of learning areas for students. However, interaction design education at most schools has remained under the influence of the various “parent” disciplines from which it developed.
- Interaction design does not have a commonly agreed upon definition, with some even questioning whether it is a discipline of its own.
- Unlike many other professional disciplines, there are no accreditation organizations specifically for interaction design that could potentially decide what an IxD curriculum should include.

Expert Interviews

This thesis focuses on the experiences of industry, and thus practitioners could be considered the primary interview subjects. However just as in the literature review, the insight and perspective of educators was also important, because their viewpoints offer a frame of reference to which the practitioners can respond, either in agreement or in opposition.

A series of questions were created beforehand, chosen to elicit their opinions on what was important for students to learn in school, what skills they needed to be successful, and where they saw the gaps for recent graduates entering the workforce. Additionally, certain questions were added that addressed either practitioners or educators to specifically uncover their points of view. Appendix B: Interview Questionnaire presents the complete list of questions prepared.

As luck would have it, an opportunity for face-to-face interaction with interaction design educators and professionals from around the world was taking place in Finland around the commencement of the thesis work: Interactions 16, the annual week-long conference for the aforementioned Interaction Design Association (IxDA). IxDA is a non-profit organization for interaction design professionals with more than 80,000 members worldwide, and their annual conference includes a special two-day summit specifically focused on interaction design education.

It was at this conference that seven educators from academia and eleven designers, managers, and recruiters from industry participated in interviews that asked what they considered to be the most important skills and concepts for an interaction designer to know and for IxD programs to teach. They were found through convenience sampling in informal individual or small group conversations (i.e. They were at the conference and available to speak face-to-face). However, not all contacts were asked to be interviewed. Instead, the author relied on purposive, expert sampling—they were selected because of their specific experiences related to interaction design. Because this kind of sampling can lead to a skewed result, a concerted effort was made so that respondents would be as heterogeneous as practical, representing different genders, countries, sizes of companies or schools, different industries, and different organizational roles.

To make the interviews most effective as well as respectful of the interviewees limited time, the questions were asked in a semi-structured manner, meaning they were adapted to each interview and not all questions were asked. Most notably, instead of being asked how important the interviewees judged a defined list of skills, they were invited to offer their own suggestions for which were most important. Their responses offered a greater variety of responses than were on the predefined list—an unintended yet welcome side-effect of semi-structured interviewing.

Degree Program Data Collection

After the literature review and interviews, it was clear that more information needed to be gathered to understand what, exactly was being taught. by considering the details of various degree programs, one could determine whether schools did teach what practitioners said they wanted or whether the problems lay elsewhere.

The first step was selecting schools to investigate. As there is no centralized accrediting body for interaction design, a series of web searches found multiple overlapping lists of interaction design schools and programs (Woelwer 2011; IxDA Map 2016; others). To reduce the potential confusion of comparing undergraduate, graduate, vocational, and professional development programs with one other and to make it easier to understand what they offer, the decision was made to focus solely on currently available master's degrees with English language websites. This resulted in a dataset of 176 programs, against which certain high-level examinations could be conducted, such as what the degree is called ("HCI" vs "interaction design"), what degree type they are (MS vs MA vs MDes), and what kind of school or department manages the program (for an example, see Table 2).

Table 2: Example of the High-Level Data Collected for Each Degree Program

School	Harbour.Space
Location	Barcelona, Spain
Degree Awarded	Masters, Interaction Design
College/Department	n/a
Website	http://www.harbour.space/courses/interaction-design#Master
Length	1 year (3 semesters)
ECTs/Credits	90 ECTs

However, to explore program elements in more detail, such as what prerequisites they have, what kind of final capstone project or thesis they require, or the organization of the courses themselves, a sampling would need to be taken. Following the principles of multi-stage sampling, it was decided to first use only those programs that had “interaction design” in the name of the degree. This reduced the sample to 42 degree programs, which was then further reduced in a random selection to 24 programs, weighted to be geographically reflective of all interaction design programs.

Each of these degrees were then examined in detail to gather additional information about program prerequisites, type of final project (capstone or thesis), and the content and organization of the courses within each (for an example, see Table 3).

Table 3: Example of the Detailed Data Collected for Select Degree Programs

School	Harbour.Space
PREREQUISITES	
Degree?	Bachelors (any discipline)
Transcript	yes
GRE?	no
Letter of Intent?	not sure
Resume/CV?	no
Portfolio?	no
Design Exercise?	no
Skills?	no
Interview?	yes
Other?	none
REQUIREMENTS FOR GRADUATION	
Portfolio Development?	no mention
Internship required?	Yes
Final Project (Capstone or Thesis)?	2 projects: personal and client
Other?	none
CURRICULUM	
URL	http://www.harbour.space/courses/interaction-design?curriculum-Master
Required Courses	Intro to Interaction Design (Art History + History of Design) Introduction to User Experience Design (Schematics) Sketching Design Ideas & Creating Concepts Content Strategy Research Methods Designing Interactive Layouts Interactive Art Direction Photography and Photo Manipulation Introduction to 3D

	Instruments of Interactivity Introduction to Motion Graphics (Video+ Audio) Creating and Applying Interactivity Rapid Prototyping Programming I Working with Data (Data Visualization) Selling & Presenting Design (Business, Entrepreneurship & Self Promotion)
Compulsory Electives	none
Optional Electives	Audio & Video Cybernetics Data Visualization Design Management Emerging Technologies for Physical Spaces Entrepreneurial Design Future Wearables Innovation in Service Design Interfaces for Disabled People Mobile Motion Graphics Physical Computing Projection Mapping Seminars & Workshops Smart Objects Storytelling, Narrative and Interactivity User Experience Design

Job Listing Data Collection

The next activity focused purely on industry: understanding what companies want from interaction designers by exploring the keywords, terms, and phrases used in job listings.

To find jobs suitable for analysis, a simple web search from a job listing aggregation site returned so many listings for the term “interaction designer” and even more for “interaction design” [12] that a complete census of interaction design jobs was impractical and random sampling was deployed to capture a smaller subset of jobs. As with the degree program data collection, it was decided to focus on job listings available in English, while at the same time covering as many countries as possible. This involved searching across 63 country-specific job boards[13] of which 51 returned results for “interaction designer”. However, because not all those search results pointed to jobs that are primarily focused on design (“visual designer” perhaps; “C# developer” probably not), additional multi-stage sampling work was performed to be sure that the data was actually relevant, primarily by removing jobs whose titles were design-related if they didn’t use “interaction” or “interactive” in the title (see Table 4). This resulted in a dataset of 850 job listings.

[12] On Indeed.com, accessed 24 February 2016, a search for “interaction designer” returned 8,330 results (http://www.indeed.com/q-interaction-designer-jobs.html) while “interaction design” returned 38,998 (http://www.indeed.com/jobs?q=interaction%20design)

[13] Indeed.com country-specific websites (http://www.indeed.com/worldwide)

Table 4: Example of the High-Level Data Collected for Each Job Listing

Job Title	Interaction Designer
Company	Ziba Design, Inc.
Location	Portland, OR, United States
Description URL	http://www.coroflot.com/jobs/72092/Interaction-Designer

For the deeper analysis and comparison of specific jobs, the decision was made to perform the detailed job listing analysis using only jobs from a job board with “interaction design” as a given category. Because these categorizations are assigned by the companies that post jobs to the board, this ensures that those companies intend to consider their listing as compatible with interaction design, regardless of job title. While examining several different specialty job boards for designers[14], only one of them[15] listed “interaction design” as its own specialty area. It was from this board that 24 jobs were gathered for more detailed information about job requirements, expected skills and responsibilities, and qualifications, presented in a single, open-ended text area with whatever level of detail the employer chose (see Figure 15).

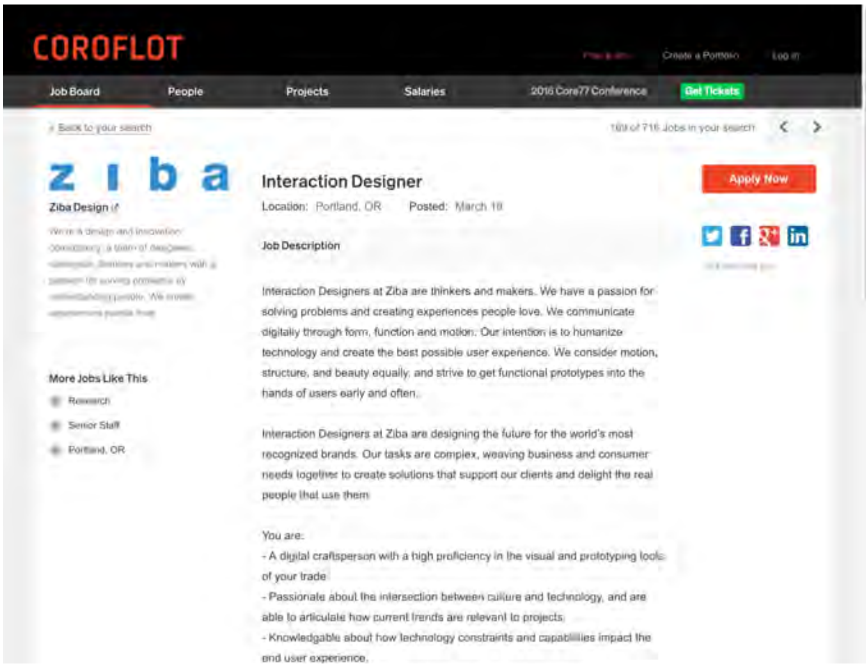

Figure 15: Example of a job listing from a job website (Coroflot 2016)

[14] Including Authentic Jobs (https://authenticjobs.com), Panda Jobs (http://panda.jobs/), Just UX Jobs (http://justuxjobs.com/), and the IxDA job board (http://www.ixda.org/page/job-board)

[15] Coroflot (http://www.coroflot.com/jobs#specialties=15)

Transformation: Uncovering Relationships & Conceiving a Framework

While the activities of the Divergence phase were concerned with expanding the design space and gathering as much data as possible, the next stage of Transformation focused on reviewing the data collected to see what could be understood about industry needs and expectations of interaction design education.

Although each set of data (interviews, degree programs, and job listings) was predominantly qualitative in nature, that did not mean that each would be reviewed and analyzed in the same way. Intentionally, each would be examined as independently as practical, meaning that the labels, categories, and analysis results of each data set would not be used to inform or populate the next data set. To make this even more concrete, different methods and tools were deliberately applied to more clearly open avenues to additional insight than what would have resulted if each dataset were subjected to identical methods and approaches.

Interview Analysis

The analysis began with the interview data, from 11 practitioners in industry and 7 instructors from academia (Table 5).

Table 5: Interview Participants Overview
(with gender, job title & locale)

11 Industry Participants	
P1	Female, experience designer and researcher, United States
P2	Male, CEO of small design studio, England
P3	Male, director of user experience & design, United States
P4	Male, recruiter for large design agency, England
P5	Male, senior UX designer for consultancy, Finland
P6	Female, senior UX&D designer for TV network, England
P7	Male, vice president of design and user experience, United States
P8	Female, recruiter for large technical services firm, United States
P9	Female, vice president of product & user experience, United States
P10	Male, director of UX for small consultancy, Ireland
P11	Male, interaction design for large web services company (and recent graduate), Germany
7 Academic Participants	
P12	Male, university professor in informatics, United States
P13	Male, university department chair of new media design, United States
P14	Male, university professor of visual communications, United States

P15	Male, university professor of interaction design, United States
P16	Female, university department chair of interaction design, Norway
P17	Female, university professor of industrial design, United States
P18	Female, lead IxD instructor for design masters, Scotland

The interview results were organized into two affinity diagrams using a digital mind-mapping tool[16]. This result differed from traditional pen-and-paper affinity diagrams because having an electronic version made the content easier to search, store and review later in the thesis as needed (although it also differed in appearance from the box labels conventional to affinity diagrams).

The first affinity diagram (Figure 16) organized and summarized the interviewees' responses into general areas of what they considered the role of IxD education, what qualifications they felt were important for a job, and how they felt industry could better work with schools in improving outcomes. For example, when talking about recent graduates with design degrees, the interviewees described how they don't have expected skills in software tools (like Photoshop), coding (such as HTML/CSS), or aesthetics (such as color theory).

Overall, their responses matched the literature review, in that there were many differing views as to what schools should emphasize in their education and a general feeling among practitioners that IxD education was inadequate in providing the right kind of skills necessary for good design. Interestingly, the educators conceded some of those same points, and in a few cases suggested industry was to blame for expecting immediate productivity from graduates rather than providing on-the-job training and nurturing raw talent.

Figure 16: Excerpt from affinity diagram of interviewee responses (a complete version is available in Appendix C: Interviewee Responses)

[16] Coggle (https://coggle.it/)

The second affinity diagram (Figure 17) was created specifically from the lists of skills and attributes the interviewees considered important for an interaction designer to have. Because very few specific competencies were mentioned more than once, the answers were aggregated using the categories created by Blevis & Stolterman (2009): **mind-set**, **knowledge set**, **skill set**, and **tool set**.

As can be seen in, nearly as many capabilities (15) were grouped into **skill set** as were grouped into the other three categories combined (20). Additionally, the kinds of skills that the interviewees emphasized most were not necessarily those most commonly mentioned when thinking of interaction design, such as prototyping or brainstorming; instead, they focused on the interpersonal and communicative elements of design in making sense of and conveying to others the designs that are produced.

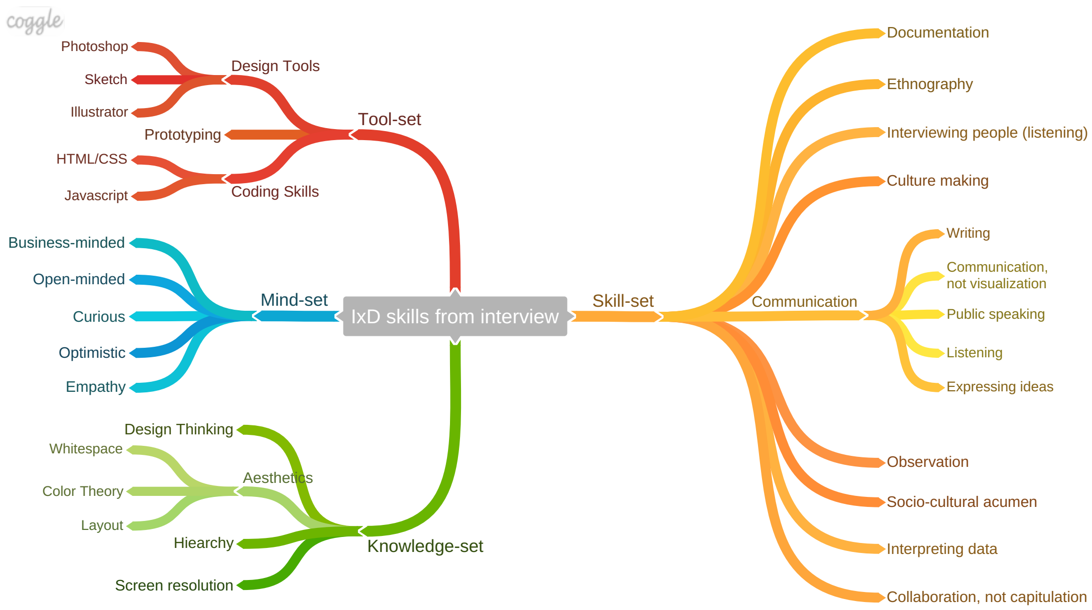

Figure 17: Affinity diagram of IxD competencies, per interviews with practitioners & educators

Degree Program Analysis

The degree program data was analyzed next, in two different rounds. The first, a high-level overview of 176 master's degree programs, examined whether there were any relationships between degree name, school or department type, and locality. The second, a deeper exploration within 24 specific degree programs, compared prerequisites, final projects, and course organization and makeup.

With so many different data points, content analysis was employed instead of affinity diagrams to make comparisons and uncover relationships between the various degree programs, and to do so, the raw data itself had to be cleaned and standardized manually. This involved finding synonyms or a most common term used to describe similar fields and then using that consensus term to describe it. For example, programs with slightly different degree titles such as "Digital Media Arts", "Digital Media Design", and "Digital Media Production" couldn't not be directly compared until they were all categorized as "Digital Media" degrees.

This process was performed for degree titles, school type (liberal arts vs tech vs design), and supervising department type (computer science, psychology, etc.). While very time consuming, this made it possible to perform detailed analysis of the various degrees, comparing degree names to locations, degree types (MA, MS, etc.) to school types, and so forth, using Excel.

High-Level Degree Program Analysis

176 master's degree programs in interaction design were gathered and analyzed for comparisons between degree type (e.g. MA vs MS), location, school type (e.g. liberal arts vs technology school), department type (e.g. computer science vs design), and degree title (e.g. interaction design vs HCI) (see Table 6).

Table 6: Degree Programs Overview

Degree Type	36 Masters of Art (MA), 70 Masters of Science (MS), 19 Masters of Design (MDes), 18 Masters, 15 Masters of Fine Arts (MFA), and 18 other masters (MAS, MPS, etc.)
Locale	94 in Europe, 60 in North America, 10 in Asia, 7 in Oceania, 1 in Africa, and 4 online
School Type	109 Liberal Arts, 30 Technology, 15 Design, 11 Art, 8 Art & Design, and 3 Art & Technology

When it comes to actual degree title, it was notable that across 176 degree programs, there were 101 unique names for the degree awarded. In addition to expected titles such as "Interaction Design", "Human Factors" and "Human-Computer Interaction", the titles ranged from simple ("Design") to complex ("ICT Innovation – Human Computer Interaction & Design (HCID)"), making it difficult to compare one degree to another. However, when cleaned and coded, the titles could be grouped into the following main categories (along with the number of degrees associated with each), as seen in Table 7:

Table 7: Cleaned Degree Titles, ordered by frequency

Interaction Design	42	**Human Factors**	4
HCI	37	**Product Design**	4
Interactive Design	19	**Service Design**	4
Design	14	**Information Technology**	3
User Experience	12	**Interface Design**	3
Human-Centered Design	7	**Computer Science**	2
Information Science	7	**Experience Design**	2
Media Design	7	**Web Design**	2
Digital Media	6	**Communication**	1

Although "Interaction Design" was the most common title used, it was nevertheless used only 24% of the time, which conformed with the literature in the variety of programs that teach interaction design.

Comparing these titles with the types of schools that offer them, no noteworthy findings emerged. However, when looking at the specific departments that oversaw these degrees within these schools (Table 8), a more noticeable result appeared: most IxD degree programs were managed by Design or Art departments, either solo or in partnership with another department, accounting for 57% of all programs.

Table 8: School Departments that Manage IxD Degrees, ordered by frequency

Design	70	**Architecture**	9
Art	30	**Mathematics**	8
Computer Science	30	**Industrial Design**	6
Information Science	26	**Business**	2
Technology	24	**Professional Studies**	2
Communication	22	**dedicated IxD department**	3
Engineering	18	**multidisciplinary**	6
Media	12	**no department listed**	3
Psychology	12		

Comparing these administering departments against the degrees they administer (Table 9), one can see that although most degree titles were managed under a Design department, it was noteworthy that Computer Science disproportionally oversaw programs in HCI and Human-Centered Design, while Psychology oversaw Human Factors, reflecting the historical origins of those programs.

Table 9: Comparison between Degree Titles and Administering Departments

Degree Title vs. Administering Department	Architecture	Art	Business	Communication	Computer Science	Design	Engineering	Industrial Design	Information Science	Mathematics	Media	Professional Studies	Psychology	Technology	dedicated dept.	multidisciplinary	none
Communication	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Computer Science	-	-	-	-	1	-	1	-	2	-	-	-	-	-	-	-	-
Design	-	4	-	2	-	8	1	-	1	-	1	-	-	2	-	1	-
Digital Media	-	3	-	2	1	3	2	-	-	1	-	-	-	1	-	-	-
Experience Design	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HCI	-	-	-	6	14	1	4	1	13	2	6	-	7	5	-	3	-
Human Factors	-	-	-	-	1	-	1	-	-	-	-	-	2	1	-	-	-
Human-Centered Design	-	-	1	-	3	1	2	-	1	1	-	1	-	1	-	-	-
Information Science	-	1	-	2	-	2	-	-	3	1	-	-	1	-	-	1	-
Information Technology	1	-	-	1	1	-	-	-	1	-	-	-	-	2	-	-	-
Interaction Design	6	10	-	1	1	26	3	3	4	-	3	-	-	7	-	-	1
Interactive Design	-	2	-	6	3	8	1	-	1	-	1	1	1	4	-	-	-
Interface Design	-	1	-	-	-	3	-	1	-	-	-	-	-	-	-	-	-
Media Design	2	6	-	1	-	5	-	-	-	-	1	-	-	-	-	-	-
Product Design	-	1	-	-	-	3	1	1	-	-	-	-	-	-	-	-	-
Service Design	-	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-
User Experience	-	1	-	1	4	5	2	-	-	3	-	-	1	1	-	1	1
Web Design	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Totals	**9**	**30**	**2**	**22**	**30**	**70**	**18**	**6**	**26**	**8**	**12**	**2**	**12**	**24**	**0**	**6**	**3**

The final analysis of the degree programs was by geography, from which there were only minor findings (Table 10):

- **Type of degree offered:** MAs were more frequent in Europe, MFAs were more frequent in North America, MSes and other degrees were evenly distributed, and none of those were used in Asia and Oceania, which used MDes and the generic "Masters" exclusively to describe these degrees.
- **School offering the degree:** While all degrees were most likely to be offered in liberal arts schools around the world, technology schools in Europe and Asia had a much higher proportion than in other places.
- **Title of degree offered:** European programs used the titles "Interaction Design" and "User Experience" more frequently to describe their degrees than North America programs, while North American programs used "Interactive Design" and plain "Design" proportionally more often than the rest of the world. Incidentally, North America was also the only place that used "Human Factors" as a name for the master's program.

Table 10: Popularity of Degree Titles, by School Location

(ordered by total count)

Degree Title	Africa	Asia	Europe	N. Amer.	Oceania	Online	Total
Interaction Design		3	22	12	3	2	42
HCI			21	15	1		37
Interactive Design	1		7	8	2	1	19
Design		3	4	6	1		14
User Experience		1	8	2		1	12
Media Design			6	1			7
Human-Centered Design		1	3	3			7
Information Science			5	2			7
Digital Media		1	2	3			6
Service Design			3	1			4
Product Design			4				4
Human Factors				4			4
Interface Design			3				3
Information Technology			3				3
Web Design			1	1			2
Computer Science			2				2
Experience Design				2			2
Communication		1					1
Total	**1**	**10**	**94**	**60**	**7**	**4**	**176**

Detailed Degree Program Analysis

After the high-level review, a deeper exploration of 24 degree programs began. These programs, as described previously, were randomly selected based on geography and limited to those with "interaction design" in the name of the degree. To gather information about prerequisites and course curricula, the program websites needed to be reviewed, and in some cases, was very difficult to locate (if posted at all). With the sites found, each of these degrees were then examined in detail to gather additional information about program prerequisites, type of final project (capstone or thesis), and the content and organization of the courses within each (see Table 11).

Table 11: Degree Programs Overview

(with degree type, degree name, locale & length of program)

D1	MA, Interaction Design, England, 1 year
D2	MA, Interaction Design, Estonia, 2 years
D3	MA, Interaction Design, Germany, 2 years
D4	MA, Interaction Design, Ireland, 1 year
D5	MA, Interaction Design, Online (US), 2 years
D6	MA, Interaction Design, Sweden, 2 years
D7	MA, Interaction Design, United States, 2 years
D8	MA/MDes/MFA, Media & Interaction Design, Canada, 2 years (degree type changes depending on final project or thesis)
D9	MAS, Human Computer Interaction Design, Switzerland, 3 years
D10	Masters, Interaction Design & Electronic Arts, Australia, 18 months
D11	Masters, Interaction Design, France, 28 months
D12	Masters, Interaction Design, Norway, 2 years
D13	Masters, Interaction Design, Spain, 1 year
D14	MDes, Interaction Design, Australia, 2 years
D15	MDes, Interaction Design, China, 1 year
D16	MDes, Interaction Design, United States, 1 year
D17	MFA, Interaction Design, Sweden, 2 years
D18	MFA, Interaction Design, United States, 2 years
D19	MRes, Interaction Design, England, 1 year
D20	MS, Human Computer Interaction Design, United States, 2 years
D21	MS, Interaction Design & Information Architecture, United States, 2 years
D22	MS, Interaction Design & Technologies, Sweden, 2 years
D23	MS, Interactive Media Technology, Interaction Design specialization, Sweden, 2 years
D24	MS, User Experience & Interaction Design, United States, 18 months

The first notable finding was how different the programs were in terms of time to complete. While most programs were 2 years long (14 programs or 58%), 25 percent were only a year long, and one of them was a 3-year program. Additional differences included what they required from those applying to the program (see Table 12). While nearly all expected a bachelor's degree of some kind (22 programs or 92%), less than half (10 or 42%) required a portfolio of prior work, and nearly a third (7 or 29%)

asked for proof of specific skills, mostly in prior experience with programming languages. This suggested that even before a program in interaction design begins, the expectations of student skills and experience differed among schools.

Table 12: IxD Graduate Degree Program Qualifications

Undergraduate Degree	22 required a Bachelor's, 2 required only experience
Transcript	21 required a transcript
Portfolio	15 required a portfolio
Résumé/CV	10 required a résumé/CV
Interview	10 conducted an applicant interview
GRE Test (USA only)	5 (of 7) required a GRE test score
Skills	7 required additional skills, mostly programming
Design Exercise	1 conducted a design exercise

Similar differences emerged with how the programs approached the final project of a degree program (see Table 13). A third of programs administered a thesis, another third ran a design or capstone project, and the final third were split between requiring either a thesis or a capstone project, or requiring neither.

Table 13: Degree Program Final Projects

Thesis	9 required a thesis
Final Project	8 required a capstone or final project
Either	3 allowed either a thesis or a capstone project
Neither	4 did not include a final project or thesis

And while many of the schools emphasized portfolios on admission to the program, only 4 programs (17%) had any indication that they helped students develop their portfolios for after-graduation employment.

With all of that said, the greatest differences between the programs were in the type of courses that they offer. As in the high-level review with degree titles, course titles needed to be standardized to find relationships (so “Research Methods” included “Research & Design Process Methods”, “Design-based research” and “Research Methods in Interactive Media Technology”). These were then grouped into more abstract course categories through an affinity diagramming process as a means of surfacing required competencies (see Figure 18).

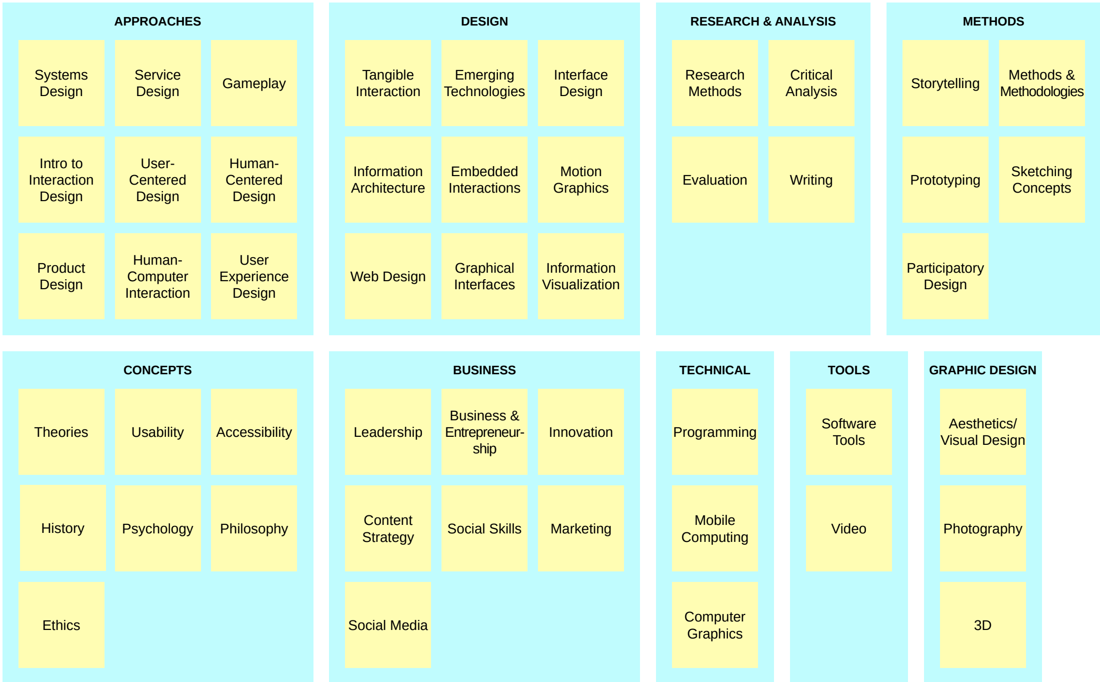

Figure 18: Affinity diagram of IxD courses, grouped into higher-level competency areas

Based on compulsory courses alone, the 24 degree programs collectively required 49 different classes as part of the core curriculum (and that was with the course titles normalized according to the content analysis). Not one of these courses was referenced even 50 percent of the time across all programs, not even presumably universal offerings such as "Introduction to Interaction Design", "Methods & Methodologies", or "Aesthetics" (see Table 14).

Table 14: IxD Program Required Courses

(limited to those with 25% or greater penetration across degree programs)

Class	Count	Category
Research Methods	11	Research & Analysis
Intro to Interaction Design	9	Approaches
Methods & Methodologies	9	Methods
Prototyping	9	Methods
Aesthetics/Visual Design	7	Graphic Design
Business & Entrepreneurship	7	Business
Theories	7	Concepts
Innovation	6	Business
User Experience Design	6	Approaches

Worth observing as well was that even after including so-called "compulsory electives" to the mix—meaning courses from a which a student makes their own selections to fulfill specialization requirements or personalize their educations—this did not increase the frequency of courses across all degrees (see Table 15). (It should be noted that the effect of compulsory electives may have been muted in part because ten of the programs or nearly 40 percent did not offer electives at all but had a core set of common classes for their entire program).

Table 15: Required and Compulsory Elective Courses
(limited to those with 25% or greater penetration across degree programs)

`	Count	Learning Category
Aesthetics/Visual Design	11	Graphic Design
Research Methods	11	Research & Analysis
Business & Entrepreneurship	10	Business
Methods & Methodologies	10	Methods
Mobile Computing	10	Technical
Tangible Interaction	10	Design
Innovation	9	Business
Intro to Interaction Design	9	Approaches
Prototyping	9	Methods
Emerging Technologies	8	Design
Programming	8	Technical
User Experience Design	8	Approaches
Critical Analysis	7	Research & Analysis
Gameplay	7	Approaches
Service Design	7	Approaches
Theories	7	Concepts
User-Centered Design	7	Approaches
Embedded Interactions	6	Design
History	6	Concepts
Information Visualization	6	Design
Interface Design	6	Design

Because so few courses were shared by a large percentage of programs, they were aggregated into higher-level categories of knowledge using an affinity diagram to see whether any patterns emerged (Figure 19). When doing so, one could see how certain areas simply had more breadth to them, which may explain why no particular course was taught more frequently—one school may have been emphasizing product design while another focused on service design, yet both were teaching design approaches.

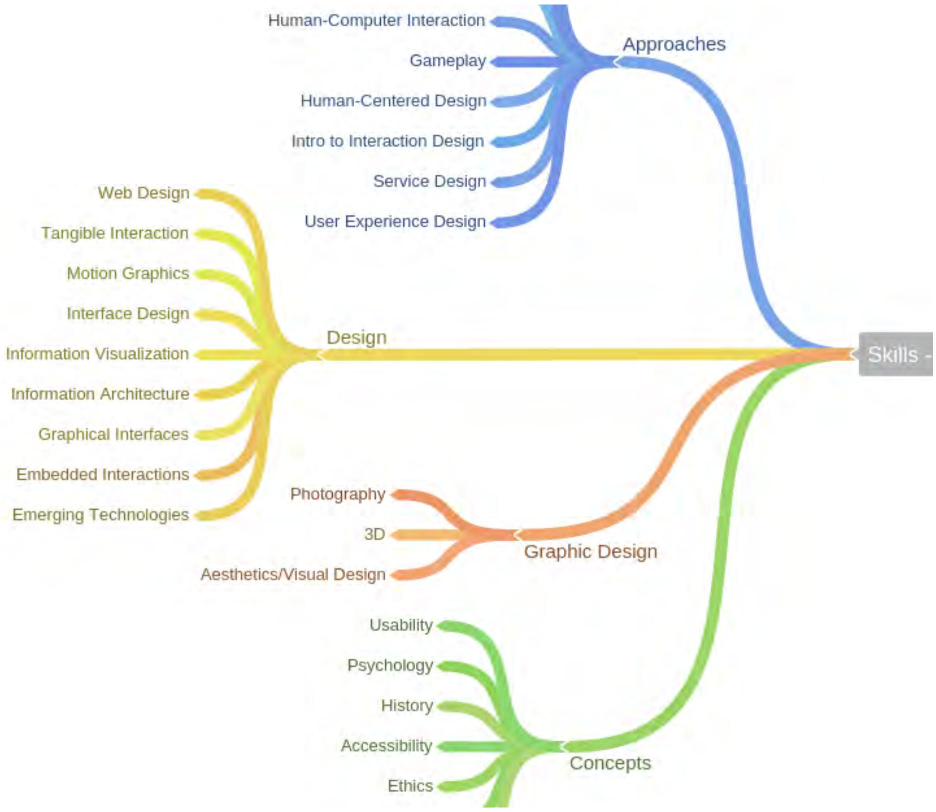

Figure 19: Excerpt from affinity diagram of IxD competencies, according to the curricula of degree programs (a complete version is available in Appendix D: Degree Program Competencies)

However, when these higher-level categories were evaluated on a school-by-school basis, it appeared that different programs not only chose different courses to teach but also different knowledge areas entirely. For example, in comparing two different degree programs that offered a similar number of courses (Nos. 4 and 11 in Table 16), one can see that the first offered classes in categories that the second didn't—namely, Business, Graphic Design, and Design Tools—while the second offered classes in categories that the first didn't—Design Approaches and Technical Skills. Between the two, the only course categories in common were Design Activities and Methods, and similar mismatches appear across all degree programs.

Table 16: Number of Courses within High-Level Categories

per degree program

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Design Approaches	2	3	2	-	-	-	3	3	3	1	2	2	-	2	3	3	2	3	4	2	2	3	2	4
Business	3	-	1	2	-	-	1	3	1	1	-	1	-	2	2	4	2	1	2	2	-	1	1	1
Concepts	2	1	3	-	2	-	2	1	2	3	1	2	-	1	-	2	-	1	-	2	-	1	-	-
Design Activities	5	4	1	1	3	-	1	5	2	4	2	3	2	-	3	2	-	-	-	1	-	2	1	4
Graphic Design	1	-	-	2	-	-	1	3	1	2	-	1	-	-	1	1	-	1	-	-	1	-	-	-
Methods	1	3	-	1	1	-	2	3	1	-	1	1	-	-	1	1	2	3	2	2	2	1	1	1
Research & Analysis	2	1	1	1	-	-	1	1	-	-	-	3	2	1	2	2	1	-	-	-	1	3	1	1
Technical	-	2	-	-	-	-	1	2	-	2	2	2	-	-	1	1	2	-	-	-	-	3	-	2
Tools	-	-	-	2	-	-	-	1	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Totals	**16**	**14**	**8**	**9**	**6**	**0**	**12**	**22**	**10**	**14**	**8**	**15**	**4**	**6**	**14**	**16**	**9**	**9**	**8**	**9**	**6**	**14**	**6**	**13**

Taken in the aggregate, the information gathered from the degree analysis provided very little toward answering the question of what industry wants and expects from interaction design education. The programs touched on so many different aspects of practicing interaction design that it was difficult to conclude that any one program or even group of programs could be considered representative of industry needs. Instead, they merely reinforced the findings from the literature, that interaction design is a very broad collection of activities and encompass many related disciplines, giving degree programs broad latitude to develop independent programs that produce potentially very different interaction design graduates and practitioners.

Job Listing Analysis

The next area of transformation occurred while researching and analyzing the details of job listings related to interaction design. Like the expert interviews of practitioners and educators, the job listings data indicated what skills, attitudes and behaviors industry looks for from interaction designers. Two levels of content analysis were conducted, with the first examining 850 job listings to find whether there were any relationships between job title and locality of the position. The second analysis was within 24 specific job listings, to compare needed skills, expected responsibilities, and required education (if any).

High-Level Job Listing Overview

As with degree titles, job titles are abundant in their variety, with more than 332 unique job names listed. Thus the job listing data and content went through a cleaning process similar to that of the school data. The job titles for the 850 listings were standardized based on common synonyms (e.g. The title “Digital Designer” was applied to listings for jobs such as “Senior Digital Designer”, “Digital Designer (Intermediate)” and “Digital Lead”). Quite a few of the job titles were dual-titled, such as “Interaction Designer/User Experience Designer” or “User Interface Designer /Researcher”, which required a further effort to separate the two sub-titles, clean and standardize those, and then reassemble them for purposes of filtering and analysis. Even with that cleaning and filtering, 75 exclusive categories remained for a job title in interaction design. Interestingly, more than half (39) of those job titles were “dual titles”, and in fact, if one examines the total count of all jobs listed, nearly 20 percent of the them were for these kinds of positions.

Looking at that list of design titles overall, there were some clear differences between North America and the rest of the world (see Table 17). While North Americans preferred to use “Interaction Designer” or a dual title, Europeans and Asians used “User Experience Designer”, “UI/UX Designer” or “User Interface Designer” with proportionally greater frequency. This difference led to the later inclusion of geographic information for the web survey of practitioners to see whether they had similar biases for or against certain designer titles.

Table 17: Popularity of Interaction Design Job Titles, by Location
(ordered by total count)

Job Title	Africa	Asia	Europe	Mid. East	N. Amer.	Oceania	S. Amer.	Total
Interaction Designer	2	6	51	4	144	3	4	214
User Experience Designer	4	17	100	5	24	6	7	163
"Dual Titles" (e.g. Designer / Developer)	2	12	53	5	85	2	3	162
UI/UX Designer	2	28	38	8	6	8	4	94
User Interface Designer	4	17	24	2	4			51
Other Designer (Game, Instructional, Motion, etc.)	3	5	13	1	11	2		35
Visual Designer	1	2	13		2	3	4	25
Product Designer		3	9	3	6		2	23
Director, Manager, Strategist	1		10	3	3		2	19
Graphic Designer	1	12	1	2	1			17
Web Designer	1	5	3	3	1			13
Service Designer	1		5			2	2	10
Developer, Engineer	1		3	1	1		3	9
Designer			6		2			8
Researcher	1		2		2	1	1	7
Total	**24**	**107**	**331**	**37**	**292**	**27**	**32**	**850**

Detailed Job Listing Analysis

The analysis shifted next to 24 job listings, a collection of all jobs in from the only job board found with a specific category for interaction design. They were explored in further detail to determine what common characteristics they shared. As a point of comparison to see whether there was any relationship between job title and required skills, 19 of the designer job listings had "interaction" or "interactive" in their titles, while five did not (see Table 18).
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Table 18: Job Listing Overview & Degree Requirements
(with job title, location & degree requirement, if any)

Job Listings for Interaction or Interactive Designer	
J1	Lead Interaction Designer, Saint Paul, MN BA or higher in HCI, interaction design, design, graphic design, industrial design, and/or design research discipline
J2	Junior Interaction Designer, Philadelphia, PA BA or higher in design-related field
J3	Interaction Designer, Cambridge, UK BA in HCI, Design or relevant experience
J4	Interaction Designer, Pittsburgh, PA BA in CS, web dev, HCI, mobile computing, graphic design, software engineering or a related field of study

J5	Graphic Designer **-** Interactive, McLean, VA BFA/MFA in Graphic Design
J6	Visual / Interaction Designer, Washington, DC Degree in a design-oriented specialization
J7	Interaction Designer, New York, NY no degree listed
J8	Senior Interactive Designer, New York, NY no degree listed
J9	Senior Interaction Designer, Irvine, CA BA in HCI or related experience
J10	User Interaction Designer, Vancouver, WA BA or higher in User Interface Design, Graphic Design or equivalent
J11	Senior Interaction Designer, Berlin, Germany no degree listed
J12	Interaction Designer, San Francisco, CA no degree listed
J13	Interaction Designer, Sunnyvale, CA BA or higher in interaction design, HCI, human factors or an engineering discipline
J14	Lead or Principal Interaction Designer, Sunnyvale, CA BA or higher in interaction design, HCI, human factors or an engineering discipline
J15	Interaction Design Lead, Des Moines, IA BA or higher in HCI, HCID, web design, visual design, information science, CS, or equivalent experience
J16	Interaction Designer, Munich, Germany BA or higher in communication/interaction design or similar field
J17	Senior Interaction Designer, Monroeville, PA BA or higher in graphic, interaction design and/or new media design
J18	Interactive Designer, Washington, DC BA or higher in interactive design, industrial design, graphic design, or visual communication design
J19	Interaction Designer, Portland, OR no degree listed
Job Listings without “interact-” in the title	
J20	Senior Experience Designer, Lead, San Francisco, CA no degree listed
J21	Head of Product Design, San Francisco, CA no degree listed
J22	Principal UX Designer, New York, NY no degree listed
J23	UI Designer, Costa Mesa, CA BA (any) or 4+ years’ experience
J24	Front End Designer/Developer, San Francisco, CA no degree listed

Because of how much emphasis the interviews put on portfolios, it was interesting to note that 14 of the job listings (58%) specifically requested a portfolio, while only 7 (29%) mentioned a CV or résumé. Similarly supporting another conclusion of the interviews, 9 of the job listings did not mention any need for a degree[17] and an additional 4 requested a degree but also allowed for “equivalent experience” as a substitute. And even those that asked for an interaction design degree also accepted other degree types, such as graphic/visual design or even engineering (see Table 18).

When it came to the content of the 24 detailed job descriptions themselves, there were no common fields to be standardized and so the effort turned to qualitative data analysis. A number of analysis tools[18] were reviewed for their ability to tag and group content as well as perform statistical analysis of text, and MAXQDA was selected. Because this tool was new to the author—in fact the whole world of quantitative data analysis was unfamiliar—it took some time to learn the functionality and process of adding job listings, creating keywords/codes, assigning codes to text, and then organizing and grouping codes into higher-level areas of interest and categorization.

While the coding for the degree programs took some time, it paled in comparison to the effort required for each job listing. Because each job listing was written by the company that posted it, the organization of elements were each unique. As might be expected (and as can be seen in Figure 20), the listings were very keyword-dense, coded on average 54 different times. MAXQDA includes some tools for semi-automating some of this work, but it required a paid add-on dictionary which was not purchased. However, because much of the coding involved terminology specific to interaction design, it is doubtful whether that tool could have been used to extract and organize terminology such as “user flow”, “interactive prototype,” and so forth.

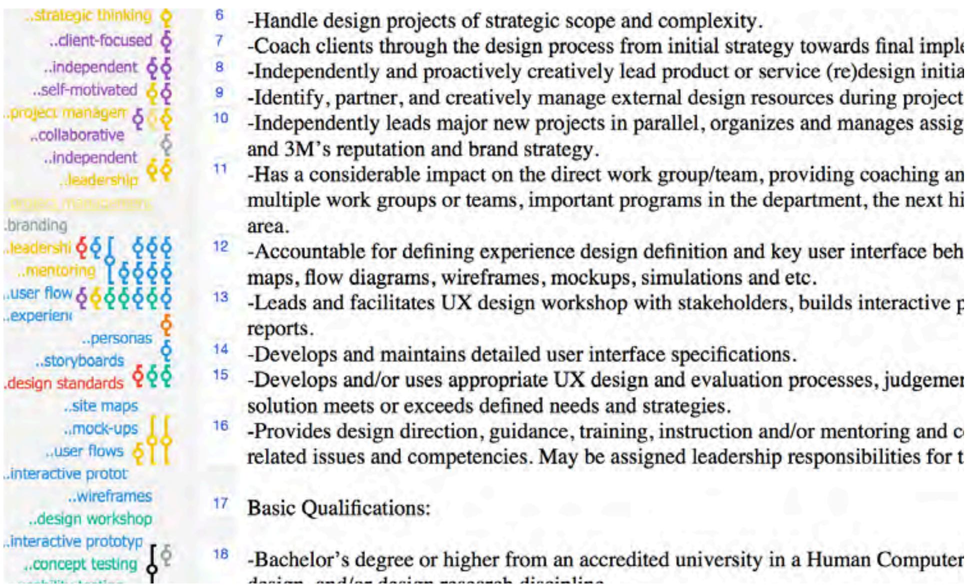

Figure 20: Screenshot from MAXQDA demonstrating how text passages can be assigned codes

[17] It is perhaps instructive to note that for those job listings that said a degree was not required, 8 of the 9 were for jobs in either San Francisco or New York, both highly competitive job markets.

[18] Including Atlas.ti (http://atlasti.com/), MAXQDA (http://www.maxqda.com/), RapidMiner (https://rapidminer.com/), and TAMS Analyzer (http://tamsys.sourceforge.net/)

After the initial set of 326 codes were entered, they were further refined and combined—for example, consolidating similar terms like "HTML" and "HTML5"—and then grouped into higher-level competency areas within the tool itself, resulting in 203 categories and subcategories of codes to describe the job listings. At this point, it was clear that MAXQDA wasn't designed to handle that number of codes and the tools it offered to analyze data were difficult to grasp, so the data was exported out of MAXQDA and imported into a spreadsheet so that further analysis could be made.

From there, it was much easier to perform further analysis in Excel. However, before going into the specific skills, requirements, and knowledge expected in each of the jobs, one must call attention to the sheer breadth of coded items overall, as seen in Figure 21 (a full-size version is available in Appendix E: Job Listing Competencies):

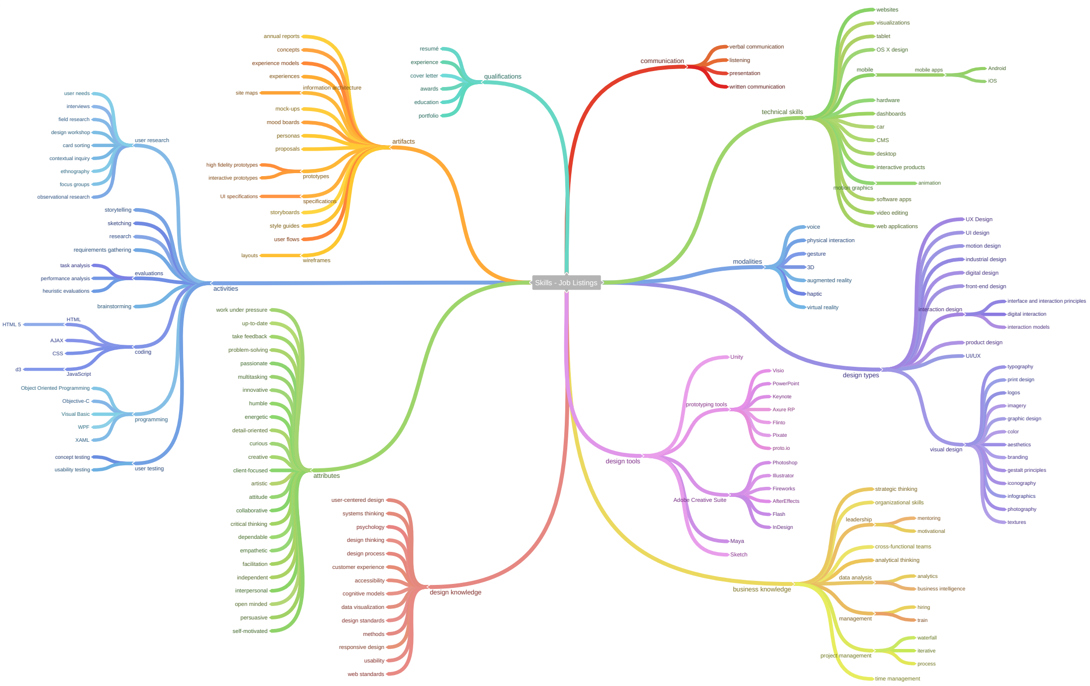

Figure 21: IxD competencies, according to job listings (full-size is in Appendix E: Job Listing Competencies)

These different skills were sorted and categorized into 11 high-level areas with 124 competencies, 71 sub-competencies and 8 sub-sub-competencies. Based on the competencies themselves (see Table 19), 10 percent of them were mentioned in 50 percent or more of the listings—finally, a source that seemed to begin to answer the question of what industry expects from interaction design education (in contrast to degree programs where no course appeared in even 50 percent of the curricula). Interestingly, the skill or aspect with the most mentions across all job listings was "collaborative" or the ability of the employee to cooperate and work with others, an attribute or personality trait rather than some knowledge or concrete skill that could be tested against. Additionally, the other highly mentioned competencies were less about specific tools and more about approaches and resulting artifacts.

Table 19: Most Common Skills in Job Listings
(limited to those mentioned 50% or more often)

Competency	Mentions	Frequency	Category
Collaborative	22	92%	Attributes
Prototypes	21	88%	Artifacts
Visual Design	19	79%	Design Types
Interaction Design	18	75%	Design Types
User Research	18	75%	Activities
UX Design	18	75%	Design Types
Passionate	17	71%	Attributes
Experience	16	67%	Qualifications
Wireframes	16	67%	Artifacts
Cross-functional Teams	15	63%	Business Knowledge
Education	15	63%	Qualifications
Mobile	15	63%	Technical Skills
User Testing	14	58%	Activities
Concepts	13	54%	Artifacts
Design Standards	13	54%	Design Knowledge
Information Architecture	13	54%	Artifacts
Leadership	13	54%	Business Knowledge
Portfolio	13	54%	Qualifications
Project Management	13	54%	Business Knowledge
User Flows	13	54%	Artifacts
Adobe Creative Suite	12	50%	Design Tools
Innovative	12	50%	Attributes
User-Centered Design	12	50%	Design Knowledge
Written Communication	12	50%	Communication

When looking at the high-level categories (Table 20), one can see that each job listings (save two[19]) included competencies from 9 or more of the 11 categories, suggesting that most interaction design jobs expect a diverse set of skills. Yet that's not to say that each category was evenly represented in each job; where one listing (No. 2) did not mention any competencies within Design Activities, another (No. 7) had more than one third of its listed competencies in Design Activities. However, in general, one can say that interaction design jobs emphasize Attributes, Artifacts, and Design Types, and understate Qualifications, Modalities, and Design Tools needs.

[19] the job listings in question (Nos. 8 and 24) only had 20 and 17 competencies respectively while the average job listing had 36 unique competencies, suggesting that the descriptions were less detailed rather than suggesting that those positions were less oriented toward interaction design.

Table 20: Number of Job Competencies within High-Level Categories
per detailed job listing

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Activities	12	-	2	6	2	1	17	1	4	3	2	7	6	3	5	2	4	3	3	2	1	8	6	2
Artifacts	10	9	1	8	6	4	5	5	6	6	2	6	3	3	8	7	8	3	3	1	6	6	9	3
Attributes	9	14	9	4	4	1	4	3	3	5	7	6	2	3	11	7	6	8	5	10	10	5	10	3
Business Knowledge	7	1	2	4	5	1	2	5	2	3	2	1	2	4	4	3	3	6	2	6	8	7	5	3
Communication	2	2	1	3	2	3	2	1	3	1	2	1	-	-	2	1	1	1	3	1	3	3	1	-
Design Knowledge	3	1	3	6	2	2	3	-	1	3	2	2	3	3	7	-	6	3	3	2	2	4	4	1
Design Tools	4	3	1	-	6	-	6	-	3	-	1	6	1	1	5	2	-	4	-	6	6	2	1	-
Design Types	3	7	6	8	4	3	4	5	2	6	2	4	5	4	5	6	6	10	3	1	3	2	8	2
Modalities	-	3	1	-	2	-	-	-	-	2	-	-	2	3	-	-	-	-	-	5	-	-	-	-
Qualifications	2	2	4	3	2	5	2	-	2	2	2	4	2	2	3	1	4	5	3	1	-	2	2	-
Technical Skills	5	3	1	4	1	6	2	-	1	2	1	2	1	1	1	2	3	9	1	-	5	1	7	3
Totals	**57**	**45**	**31**	**46**	**36**	**26**	**47**	**20**	**27**	**33**	**23**	**39**	**27**	**27**	**51**	**31**	**41**	**52**	**26**	**35**	**44**	**40**	**53**	**17**

In comparing the jobs that specifically had “interaction” or “interactive” in their titles versus those that did not, no obvious competencies emerged as unique for a given title, apart from a slightly greater emphasis on business knowledge for those jobs without “interaction” in the title. That said, it was difficult to make too many comparisons due to such a small sample size (19 vs. 5 job listings). Perhaps with more non-interaction design job listings, those numbers might change. Still, it is important to remember those listings were categorized under “Interaction Design” on the web site to begin with, so perhaps there wouldn’t be as much of a difference even if the sample size were larger. Comparisons with other “non-interaction” design jobs, such as visual designer or web designer, might uncover larger differences.

Framework Conceptualization

While analyzing the three datasets (interviews, degree programs, and job listings), it became clear that there were relatively few unifying skills or abilities that could adequately describe an interaction designer, and the ad hoc categorizations also failed to succinctly express what IxD education could or should provide by way of courses or knowledge areas to encompass all possible job needs. However, to bridge the gap between academia and industry, it was important to figure out a way to unite these different elements, and the idea of a matrix of skills and abilities emerged.

Rather than a list of specific competencies required for an interaction designer to know or do, a framework representing a range of capabilities could be used to evaluate and situate a job listing or degree program within the expected competency areas. Using some set of standard descriptions, one interaction design job could be considered more “research-oriented” because it required skills like ethnography, interviewing and user testing, while another interaction design job could be considered more “design-oriented” because it emphasized graphic tools or visual artifacts. The task then was to determine how to best categorize this information in a way that would uncover differences between job listings and IxD degrees in a way that reflected the real distinctions.

Survey Conceptualization

While the job listings analysis provided the most detailed information up to that point of what industry expects from interaction design education, it didn’t necessarily reflect the perspective of the designers themselves, the way the interviews did.

Additionally, the job listings covered the breadth of what a designer would need to be able to do in the given position but gave very little indication of which skills or abilities were most important. From the author’s personal experience as a designer himself and one who has hired other designers, often a job listing is intended to gather a wide swath of potential candidates and then, depending on the competencies of the person who is hired, the actual requirements of the job change to use those competencies most effectively. Thus a designer who is hired for a visual design position may end up doing more front-end work if they turn out to have that skill or develop that skill while on the job. Over time, as that secondary skill becomes more valuable or as new methods, tools, or artifacts emerge and become widely adopted, they are subsequently adopted into job listings for future positions.

As such, an additional method was conceptualized to gather information about what industry expects from interaction design while it emerges: an online survey from those in the field. The survey would be sent to design practitioners, students and academics to find out what competencies they feel are most important right now. These results could further confirm whether the framework concept appropriately organizes these areas of importance. Additional demographic information would potentially uncover regional differences as found in the degree and job data, and possibly demonstrate how what industry expects from education may differ based on locality. And having it be survey-based would allow the results to scale more rapidly and broadly than conducting and analyzing interviews and job listings in the manual and time-consuming process of the earlier stages of the thesis project.

Because the overall thesis project plan was to develop an online visualization tool in which people could interact with the thesis research findings, the decision was made to use that same platform for hosting the survey instrument as well. The idea then developed that perhaps the survey participants could enter their answers and, after submitting, be able to see those results in aggregate with the responses from others, presented in the proposed skills framework.

Convergence: Designing the Survey Tool, Visualizations & Competency Framework

With the path to completion clear, the thesis effort shifted to two semi-parallel tracks: determining how to design the proposed skills framework so that it appropriately captured all relevant interaction design skills and abilities required from industry, and implementing the survey tool and visualization platform so the framework could be tested and displayed for public consumption. While work on one informed the other, for ease of describing the process, the two efforts will be described separately.

Survey Design, Implementation & Analysis

In designing the survey instrument, the primary goals were: 1) to quickly gather the main skills and knowledge an interaction designer should know; and 2) to gather minimal demographic information from participants for further analysis and comparison. From the job listing and degree program analyses, it was clear that the terms people used for titles, activities and skills were not standardized, so the survey needed to support users entering their own terms. On the results pages, the system needed to integrate with a charting app of some kind for real-time survey results. Finally, the survey design and subsequent results pages needed to work well on mobile browsers, with their smaller screen sizes and touch interface.

A hand-drawn sketch shown to designer colleagues in a quick-and-dirty review validated the basic concept, followed by a subsequent wireframe of the survey tool layout for further feedback (Figure 22).

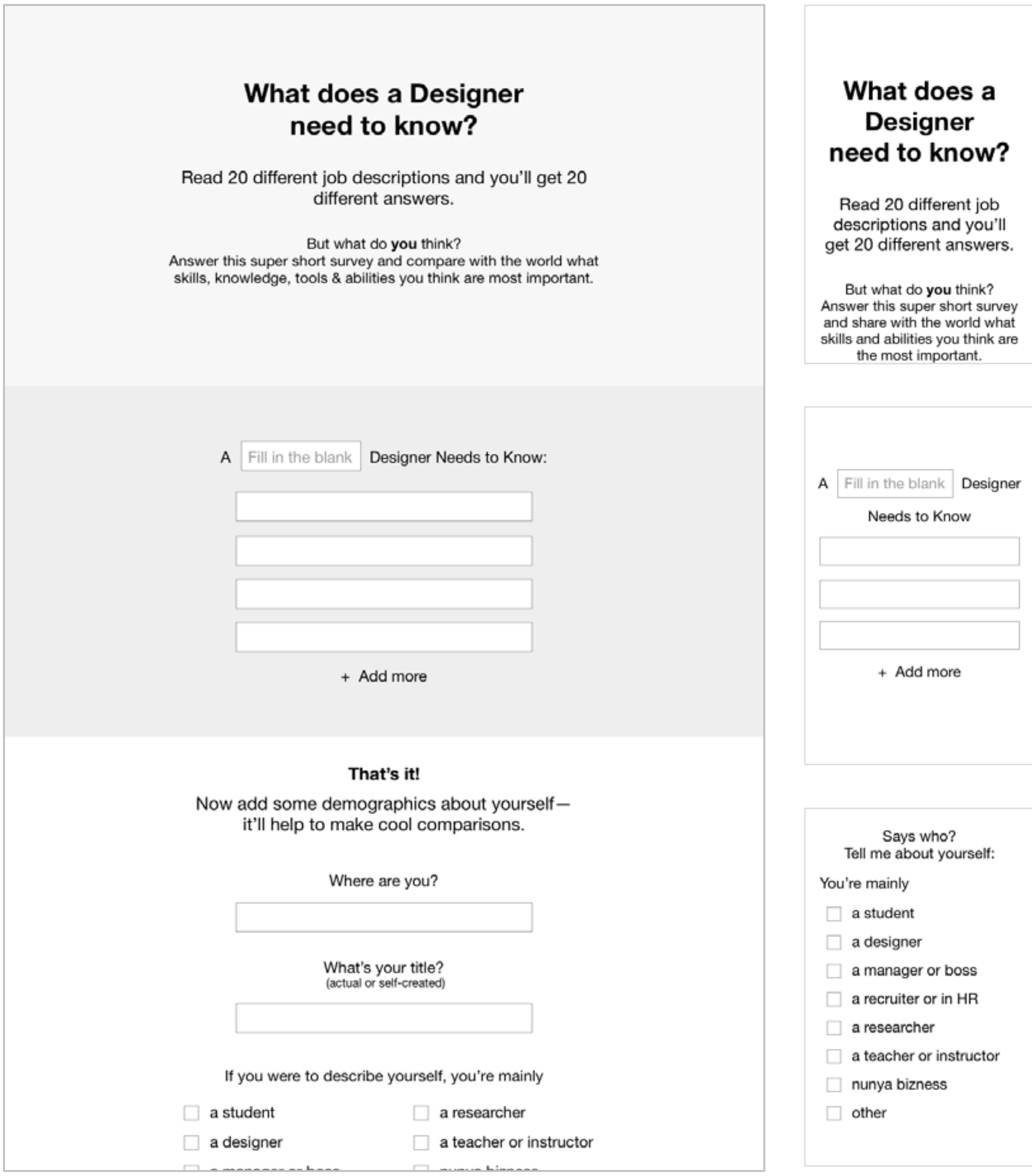

Figure 22: Excerpts from the wireframe for the survey tool, in desktop and mobile layouts

From the testers (3 interaction design students, 1 director of a web development company), the primary area of feedback came from how, exactly, the designer type and skills would be entered. To them, it was better to limit the type of designer being described (such as Interaction Designer or UX Designer) and restrict the skill fields to a predefined list as well. Doing so would make it possible to indicate whether there are, indeed, different skills across designer types and help to reduce post-survey coding and hopefully support real-time results in a visualization. To populate the form data list, 160 knowledge areas, tools, characteristics and so forth were gathered from the literature review, competency frameworks, interviews, degree programs, job listings, and the author's own experience as a designer (a full list can be found in Appendix F: WhatsaDesigner.com Competency List).

A design comp (Figure 23) was then created to capture the general color scheme, typeface and aesthetics. After that was finalized, work on the design comp was stopped and work began in coding the design in HTML and CSS.

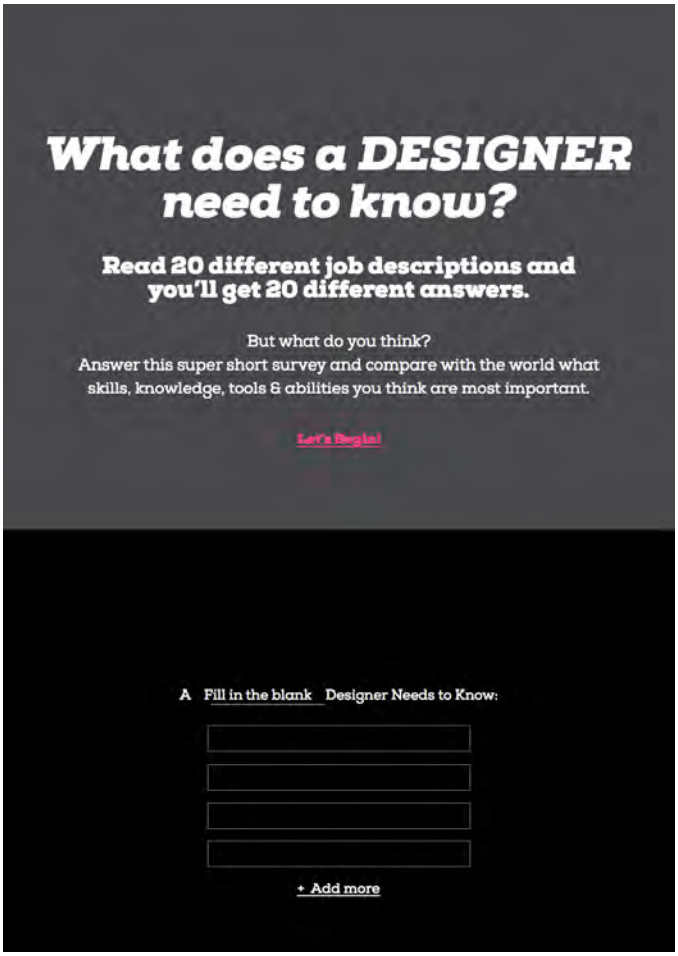

Figure 23: Design comp of survey tool

The choice was made to use an off-the-shelf solution for the form submission so that the survey could be up and running quickly (particularly while the author can design in HTML/CSS, he is only moderately skilled in programming). Supporting the aforementioned functionality and requirements provided to be difficult from hosted survey tools and open-source, self-hosted ones too[20]. After reviewing a number of tools, the decision was made to use Gravity Forms[21], a form plugin for WordPress, a platform which the author is very familiar. However, after some beta testing, it was determined that having the users just select from a predefined list of competencies

[20] Including SurveyMonkey (https://www.surveymonkey.com/), Typeform (https://www.typeform.com/) and Wufoo (http://www.wufoo.com/)

[21] Gravity Forms (http://www.gravityforms.com/)

was overly restrictive. Rather than go back to open-ended answers, the decision was made to provide an auto-completion tool with the option to provide one's own entry as well. After spending multiple attempts to get it to work successfully according to those requirements, those efforts were abandoned and the survey was rebuilt from scratch in HTML/CSS and supported by a third-party hosted backend, Getform[22].

To visualize survey results in real-time, efforts were made in exploring how to integrate the 3rd-party survey storage tool with various Javascript-based infovis tools (such as chart.js and d3js). Although initial efforts looked promising, due to project delays this work was aborted and the decision was made to launch the survey iteratively, with the first version collecting the data, and subsequent versions presenting the visualizations.

This made particular sense because another problem emerged: how to handle user-entered survey results. It was important not to limit the responses so that users could provide skills, tools, and abilities that were not in the original list or that were emerging in the field. Yet efforts to understand how machine learning could be used to interpret the survey takers' open-ended responses through automated content analysis led to the conclusion that the time to implement such a solution would delay the project even further, and the decision was made to abandon that feature as well.

Instead, the survey data would be stored in a database and then interpreted and cleaned manually before being formatted and subsequently published to the website. Further technical work was thus aborted and the first iteration of the site was built and launched to https://whatsadesigner.com/ (screenshots of the completed tool can be found in the Results chapter of this thesis).

As far as who to invite to take the survey, it could not be the general public as participants needed to have some context for design and methods. As such, they were hand-selected by the author as individuals with some exposure to design, such as through work, as an educator, or as one who was themselves a designer. After the survey was tested successfully, a list of some 120 colleagues were invited to participate via targeted messages via LinkedIn, Twitter, and email.

After the first day, the survey data site was checked, uncovering a glaring problem: all 20 of the first responses were missing answers to the most important question of designer skills and abilities. This problem was resolved quickly, but because the survey was anonymous, there was no way to know which of the previous invitees had taken it and who hadn't. A second announcement was sent, resulting in 35 total responses to the survey over the next two weeks.

Survey Data Analysis

For the 35 survey responses, more than two-thirds of the respondents (24 or 69%) considered themselves designers and 15 of them had "design" or "designer" in their job titles, yet only three (8.5%) of the respondents indicated that their job title or self-description included "interaction," compared to the seven (20%) who used "UX" instead and the three (8.5%) who used "graphic design". While the clear majority of

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[22] Getform (https://getform.org/)

the respondents were situated in North America (23 or 66%), there was still a credible number from Europe (8 or 23%) and Asia (4 or 11%)

Little more than half of the respondents described the skills for interaction designers, with the rest split between visual/graphic, UX, UI, and web designers (see Table 21). The survey limited respondents to add up to 10 skills, selected either from the pre-defined options or added manually. While the small sample size perhaps skews the results slightly, it is interesting to note that the web designer entries had nearly twice as many skills added as those for visual designers.

Table 21: Survey Responses for Each Designer Type

Title	Entries	Avg. # of Skills Submitted	Avg. # (%) of New Skills Added
Interaction (IxD) Designer	18	6.1	2.6 (42%)
Visual/Graphic Designer	6	5.0	3.0 (31%)
User Experience (UX) Designer	3	8.0	0.3 (4%)
User Interface (UI) Designer	3	5.7	3.3 (59%)
Web Designer	3	9.7	3.0 (31%)
Product Designer	1	6.0	4.0 (67%)
Service Designer	1	7.0	7.0 (100%)
Average		6.3	2.5 (40%)

With nearly half the responses typed in by participants, a similar cleaning and coding process as from the other datasets was used to standardize and group the survey results as well. From them, 90 different competencies emerged, with very little overlap across all design types: only five were mentioned 20% of the time or more often and 53 (59%) were mentioned only once (see Table 22).

Table 22: Survey Competency Counts and Percentages for All Designer Types
(limited to those mentioned 10% or more often)

Competency	Mentions	Frequency
Graphic Design / Visual Design	11	31.4%
User Research	10	28.6%
Prototyping	8	22.9%
Aesthetics	7	20.0%
User-Centered Design (UCD)	7	20.0%
Cognitive Psychology	6	17.1%
User Testing	6	17.1%
Communication	6	17.1%
Tools for Design (Illustrator, Photoshop, Sketch, etc.)	6	17.1%
Color Theory	5	14.3%
Sketching	5	14.3%

Tools for Wireframing, Prototyping (Axure, Balsamiq, Invision, OmniGraffle, UXPin, etc.)	5	14.3%
Adobe Creative Suite (Adobe CS)	4	11.4%
CSS	4	11.4%
Design Thinking	4	11.4%
HTML	4	11.4%
Print & Layout Design	4	11.4%
Strategy	4	11.4%
Typography (fonts, typefaces)	4	11.4%
Usability	4	11.4%
User Experience (UX) Design	4	11.4%
Wireframing	4	11.4%

Examining the 57 competencies mentioned in the 18 interaction designer entries alone (Table 23), a few are mentioned proportionally more frequently, with 8 mentioned 20% of the time or more often, including skills in visual design and many references to users, whether in research, testing, or design approach. Also of note, a large number (25 or 43%) are mentioned only once, again suggesting the wide spread of skills and knowledge that an interaction designer must have.

Table 23: Survey Competency Counts and Percentages for Interaction Designers
(limited to those mentioned 10% or more often)

Competency	Mentions	Frequency
Graphic Design / Visual Design	7	38.9%
User Research	7	38.9%
Prototyping	6	33.3%
Cognitive Psychology	5	27.8%
User-Centered Design (UCD)	5	27.8%
Communication	4	22.2%
Usability	4	22.2%
User Testing	4	22.2%
Programming & Coding	3	16.7%
Strategy	3	16.7%
Tools for Design (Illustrator, Photoshop, Sketch, etc.)	3	16.7%
Tools for Wireframing, Prototyping (Axure, Balsamiq, Invision, OmniGraffle, UXPin, etc.)	3	16.7%
Aesthetics	2	11.1%
Collaborative	2	11.1%
Critical Analysis	2	11.1%
Design Thinking	2	11.1%

Emerging Trends	2	11.1%
Ethnography	2	11.1%
Hierarchy	2	11.1%
Listening	2	11.1%
Tools for Diagrams, Flowcharts (Coggle.it, ConceptDraw, Visio, OmniGraffle, etc.)	2	11.1%
User Experience (UX) Design	2	11.1%

Data Visualizations

While waiting for results from the survey, attention shifted to the question of how, exactly, to organize and present the various skills and competencies that were captured from the three—soon to be four—datasets (interviews, degree programs, job listings, and web surveys). In all four cases, qualitative information would be coded and summarized into some kind of quantitative body of data. However, organizing that into a data visualization would be much more easily and quickly understood than a data table or textual description (Shneiderman 1996).

As a starting point, some time was spent trying to match the Venn diagram of disciplines shown previously in this thesis (Theories & Concepts, Defining Interaction Design, (IxD), Figure 3). However, after a few attempts to compare overlapping degree titles (such as ones that included “design”, “interact”, or “human” in the title), it was soon apparent that little actionable information could be gathered. Additionally, due to the proportional nature of a true Venn diagram (technically, a Euler diagram), one cannot programmatically create a diagram with more than 4 factors unless those factors can be guaranteed not to overlap (something that was not the case with the data at hand) (see Figure 24).

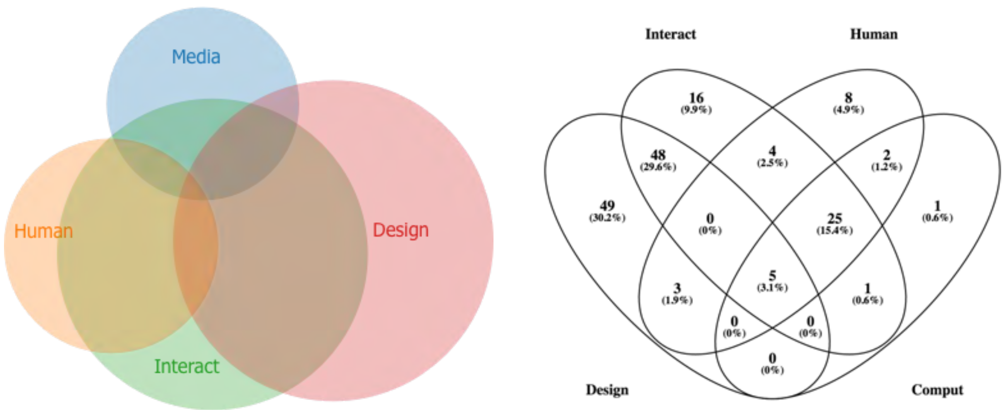


Figure 24: Attempts to visualize relationships between degree names using Venn diagrams

The next efforts involved using Cluster Diagrams, grouping competencies into colored categories and presenting the results where the area of a circle represents its frequency (Figure 25). This possible would work with small groups of results, however with the hundreds of factors and nested categories that emerged from the job listing data, Circle Packing made more sense. While a Cluster Diagram certainly looked appealing and a Circle Packing diagram made it easier to see a hierarchy, neither did a particularly effective job of presenting information proportionately (a weakness of circle-based visualizations). This led to a shift away from circles to squares, visualizing the factors as plot areas in a Tree View. And while the tree view was perhaps the best way to present the detailed results as a whole, it still wasn't clear what, if anything, the visualizations actually said about interaction design education.

Figure 25: Attempts to visualize relationships using force cluster, circle packing, and tree view diagrams

One of the points of the visualization was to make it easier to make comparisons between two different results, so the exploration shifted toward how the data and results would be compared against other sources, such as comparing two job listings or degree programs. The previously designed affinity diagrams used throughout the execution process were too large and difficult to use with hundreds of results, nor would it be easy to make comparisons using such an unstructured view. A handful of sketches suggested directions to go in (Figure 26), but because they were not based on actual groupings or data sources, they didn't necessarily lead confidently in one path to pursue. An actual framework was needed in which to situate the data before the results could be visualized in an intuitive way for users.

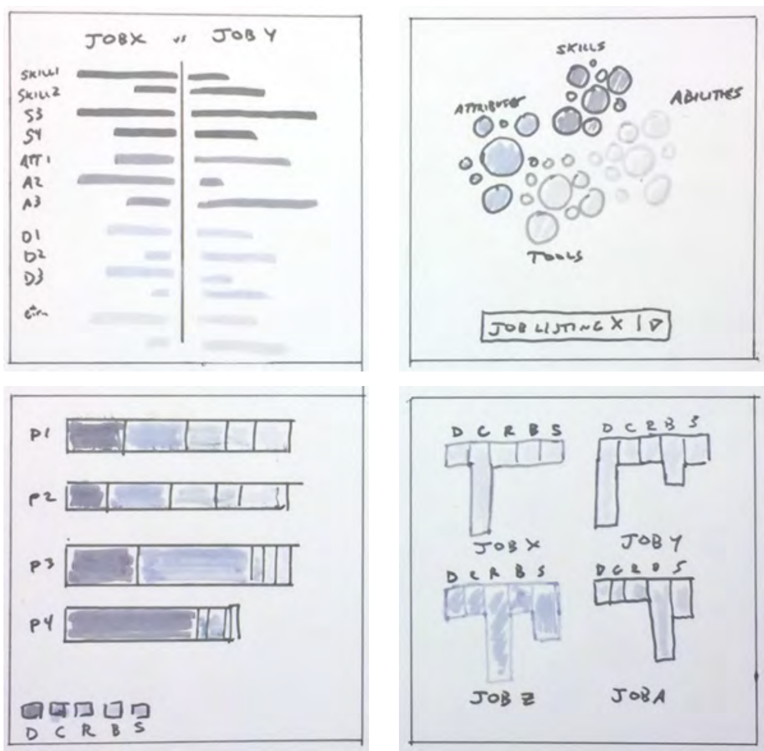


Figure 26: Visualization sketches to explore how to compare data sources

Competency Framework

Indeed, the idea of having a framework made sense, yet designing the specifics was something else. Preliminary efforts to combine categories did not prove effective, as there was little overlap between them (Table 24). That's not to say that there were completely different factors between the datasets; on the contrary, many items appeared across all three. Rather, because of the aforementioned effort to segregate the analyses, there wasn't a common view that emerged. Additionally, the categories selected didn't necessarily offer ways to distinguish different jobs or degree programs in an effective way. For example, while the job listing categories of "Business Knowledge" and "Design Knowledge" might show which jobs emphasized the one or the other, most other categories weren't specific enough—two jobs with an equal number of items in the "Activities" category, for instance, wouldn't necessarily help someone to know that one job focused on programming and coding while another concentrated on graphic design.

Table 24: Categories in Interviews, Degree Programs and Job Listings

Interview Categories	Degree Categories	Job Listing Categories
Knowledge-Set Mind-Set Skill-Set Tool-Set	Business Concepts Design Activities Design Approaches Graphic Design Methods Research & Analysis Technical Tools	Activities Artifacts Attributes Business Knowledge Communication Design Knowledge Design Tools Design Types Modalities Qualifications Technical Skills

Yet having more categories didn't seem like the ideal path to go down either—an important factor for the framework was having something easy to understand and use. The four categories from Blevis and Stolterman were perhaps too simple, yet they led to reexamining the literature and finding ways in which the frameworks overlapped or could be applied to the datasets in some way (see Table 25).

Table 25: Job Competency Models Comparison

B&S	DEM	KSA	O*NET	SFIA
Mind-set			Worker Characteristics	Behavioral Skills
Knowledge-set	Knowledge: Theory	Knowledge	Worker Requirements	Knowledge
Skill-set	Knowledge: Application	Skills	Experience Requirements	Professional Skills
Tool-set			Occupation-Specific	
	Knowledge: Administration	Abilities	Worker Characteristics	

While the SFIA had the greatest specificity by breaking the competencies down into skill categories (e.g. Strategy and Architecture, Delivery and Operation, etc.), it completely ignored any aspect of tools or experience requirements, both of which featured prominently in the job listing data. And Faiola's Design Enterprise Model (DEM)—with its matrix of knowledge areas—was organized so differently from the others that it couldn't even be compared directly to the others. Yet it was that very difference that made it appealing, in that it introduced the idea of separate knowledge domains in addition to areas of applying knowledge. Perhaps a similar grouping of domain disciplines could be used for the thesis data as well?

The first step was reconsidering those domain categories from the DEM—Social, Design, Business, and Computing—not as purely areas of knowledge or learning but rather areas of work within interaction design. To quickly validate this line of thinking, the domains were applied to the raw list of 160 competencies, knowledge, and tools used in the online survey. While most of the capabilities fit into one or another category, a number of them fit into a new category: Research. The activities of understanding users and performing user testing and analysis seemed to differ enough from the others that placing them under Design or Social didn't make sense. At the same time, the term "Social" with its modern association with social media (such as Facebook and Twitter) didn't seem to fit a category that now included cognitive psychology, among other competencies. It was renamed "People" instead.

While these five domains made sense as the "horizontal" groupings for the framework, the DEM's vertical knowledge categorizations of Theory (Foundation), Application (Processes), and Management (Administration) were too focused on an academic learning environment and did not apply well to the same list of competencies from the online survey. Instead, the author applied a sorting process like that performed with the affinity diagrams, with 11 facets emerging for organizing the capabilities: Abilities, Activities, Attributes, Business Skills, Contextual Fluency, Core Skills, Design Methods, Knowledge Areas, Languages, Software Tools, and Technical Skills.

Melding these facets into a matrix view with the five high-level domains, it made sense that some of these facets would only apply to one domain (e.g. Design Methods to Design, Business Skills to Business, Languages to Computing). Additionally, while sketching potential ideas for how to display this information (Figure 27), it was clear that 11, and even 8 facets were too many to view and understand at one time.

Figure 27: the competency framework emerged as domains and facets were sketched

Further efforts to combine the remaining facets found resonance in the sets described by Blevis and Stolterman: knowledge-set, mind-set, skill-set and tool-set, with the change that mind-set (or more correctly "mindset") seemed to not capture the combination of both mentality and specific feelings that the word "attitude" did. However, this re-grouping left a few categories out—Abilities and Activities could span any of the other four new categories (see Table 26)—and so a re-evaluation of the competencies was needed, using the job listings and the survey results.

Table 26: Consolidating the Competency Facets into 4 Main Groupings

Knowledge	Skills	Tools	Attitudes
Knowledge Areas Contextual Fluency Design Methods	Core Skills Business Skills Technical Skills	Software Tools Languages	Attributes
Abilities, Activities			

Within this new evaluation, it turned out that the coded competencies from the survey fit logically into the four facets (with those from Abilities and Activities spreading out in the facets), which suggested these groupings made sense. However, re-evaluating the job listings in this same way revealed an additional area of competencies that didn't match: qualifications. Although the interviews had established that a job applicant's educational degree wasn't necessarily a factor, nevertheless the job data indicated that it was being asked for, so there needed to be some way of representing that to a user. Additionally, because some of the job listings suggested that an engineering degree could be used to qualify an applicant while others mentioned a graphic design degree instead, the thinking was that those could then be applied to either Design or Computing accordingly and thereby showing those relative biases within the context of the framework.

Furthermore, because of the analysis work done with the degree program data, it seemed that this same framework could be used not just to describe a job listing, but also to describe an interaction design school program as well. In that way, a potential student could understand what a school emphasized and see that some programs required computing qualifications while others did not, and thereby get a sense of the type of program it is (and for hiring managers, the potential skills and abilities of students who graduate from such a school). Thus, Qualifications was added as the fifth and final facet for the framework.

A more detailed explanation of the elements of the framework, how they come together, and the representative competencies that belong within each can be found in the Results section of the thesis.

Competency Visualization

While the elements of the framework fit into a compact matrix of domains and facets, there was still the question of how to actually show which were more common or more important and which were not. Using some sort of visualization of the data would be more visually interesting, as well as allow others to quickly scan the information. Not only that, if the visualization could represent a range of responses rather than single values (e.g. 10-20% vs 14%), it would better reflect the inexact, qualitative nature of the source content rather than some artificially precise number that the underlying data didn't reflect.

Many iterations were made, exploring how to present the specific domain facets using different visualization principles such as brightness, size, and shape to distinguish between the different domain facets (see Figure 28 for a sampling). Along the way, various additional factors presented themselves, including a desire for the resulting visualization to be reproducible in black-and-white, easily distinguishable at small sizes, and self-contained—meaning that a value could be understood on its own rather than relative to another shape (one can only know a shape is half the size of another or half the brightness if the larger or brighter shape is present). This meant that shading, area, and length wouldn't work, leaving counts, fills, and shapes.

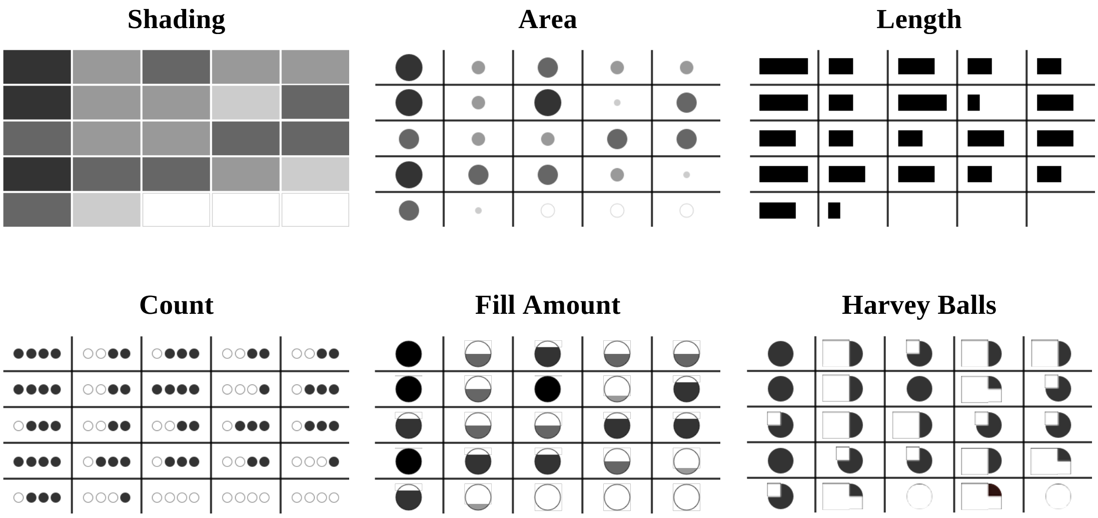


Figure 28: Possible visualizations for IxD Competency Framework counts

Reviewing these options, the final decision was to go with circular visualizations known as Harvey balls. Harvey balls (named after their founder) are representational glyphs often used as a form of comparison for scenarios in which ranges apply rather than exact values (Albert and Tullis, 2013). Although there are different variations for how Harvey balls are presented, the most common is with five different balls, with varying levels of completion, from empty to full. An important aspect of Harvey balls, is that they do not represent total values the way that a pie chart does (which might lead to some confusion). Instead, Harvey balls are often used to represent only a relatively small range of values, as shown in Figure 29 (all values below 60% are represented by one ball, while the rest are evenly divided above that point).

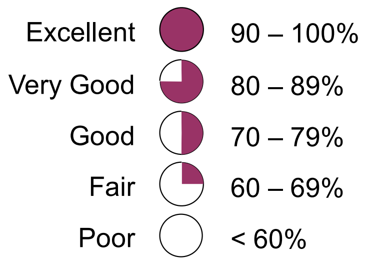
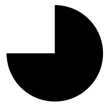
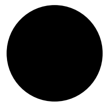


Figure 29: Harvey Balls pictograms represent a small range of values (Albert and Tullis 2013)

This last aspect made Harvey balls particularly useful for the competency values, especially when a given job listing might have 30-40 different competencies. In these scenarios, no single domain facet may ever rise above 25% of the total, yet being able to nevertheless represent differences in small intervals helps one understand the relative importance a given area is for a job (Table 27).

Table 27: Harvey Icons Representing Domain Facets

Not Expected 0%	**Rarely Expected** >0-6%	**Occasionally Expected** 7-12%	**Frequently Expected** 13-18%	**Likely Expected** >18%
				

To arrive at these values, each keyword in a job listing was mapped to one of the competencies, and the associated domain facet then aggregated the resulting totals. However, because the number of competencies associated with different listings may differ wildly—for example in the original job listings, the smallest competency total was 23, the largest was 57—the counts for each domain facet were averaged by the total count of competencies, resulting in percentage values that could be used to compare between different entries, regardless of the competency counts.

The percentage threshold for each icon (the ranges of 0-6%, 7-12%, etc.) was based on overall competency distributions from the 24 job listings, with the idea being that none of the “higher” thresholds would exceed the count of a “lower” threshold (i.e. the counts for more “frequently” would be less than “likely” responses). Through trial and error using whole number percentages, it was decided that 6% would be used as the cut-off to break apart each threshold, resulting in evenly separated thresholds that nevertheless demonstrated differences between different job listings. With more responses, these thresholds could likely shift.

Framework & Survey Data Evaluation

The final step in the Convergence process was evaluating the framework itself, to see whether it actually could be applied to specific design titles, job listings, and even degree programs and thereby support the thesis effort in uncovering what industry needs and expects from interaction design education. Thus, two levels of testing were performed: the first against individual job listings and the second against the collected survey data as part of the visualization platform.

Job Listing Comparison

From the job listings, a random selection of four jobs was analyzed using the competencies and domain facets of the IxD Competency Framework. From the resulting views using Excel spreadsheets (Figure 30), one can see how the jobs differ, with, for example both senior design jobs involving more orientation to business and people and less in pure design.

Job Listing #1: Lead Interaction Designer

	Design	Computing	Research	Business	People
Knowledge	9%	2%	5%	7%	4%
Skills	19%	9%	5%	4%	4%
Attitudes	4%	2%	0%	5%	5%
Tools	9%	0%	5%	0%	0%
Qualifications	4%	0%	0%	0%	0%

Job Listing #7: Interaction Designer

	Design	Computing	Research	Business	People
Knowledge	15%	4%	9%	4%	0%
Skills	15%	15%	0%	2%	4%
Attitudes	2%	0%	0%	2%	4%
Tools	13%	0%	4%	2%	0%
Qualifications	4%	0%	0%	0%	0%

Job Listing #11: Senior Interaction Designer

	Design	Computing	Research	Business	People
Knowledge	17%	0%	4%	4%	0%
Skills	9%	0%	0%	9%	9%
Attitudes	4%	9%	0%	9%	9%
Tools	9%	0%	0%	0%	0%
Qualifications	9%	0%	0%	0%	0%

Job Listing #13: Interaction Designer

	Design	Computing	Research	Business	People
Knowledge	37%	4%	15%	4%	0%
Skills	11%	4%	0%	4%	0%
Attitudes	4%	0%	0%	0%	4%
Tools	7%	0%	0%	0%	0%
Qualifications	7%	0%	0%	0%	0%

Figure 30: Representative job listings, organized into the IxD Competency Framework

Of course, this spreadsheet layout is still visually noisy, so although the web visualization interface was not implemented in time for this thesis, nevertheless one can apply its style. Looking at two job listings with the style applied, one can see even more quickly that one position requires more computing and business skills while another is more of a pure design job with research needs (see Figure 31).

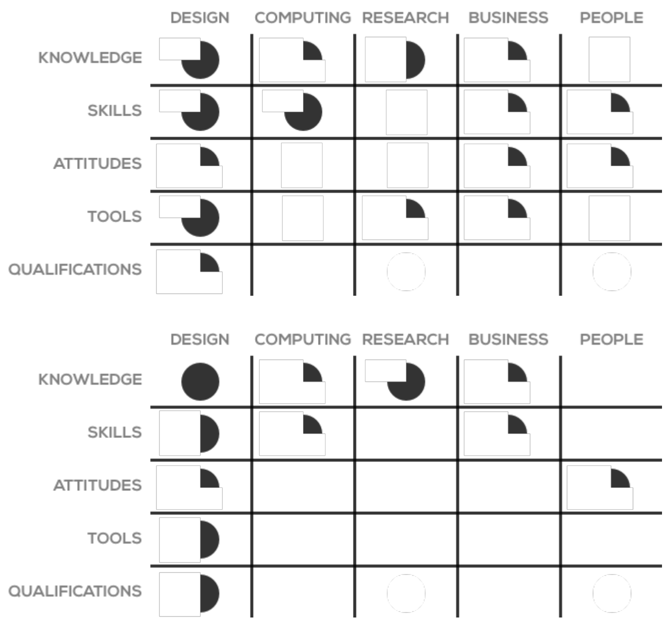


Figure 31: Two job listings (Nos. 7 and 13), compared using the IxD Competency Framework

Survey Findings Comparison

While the collected survey data was limited to 35 responses and thus any extrapolation is weak, there is nevertheless a small set of comparative information that can be shared here (Figure 32). The primary takeaway is that, indeed, the various job titles do reflect different competency focuses within domain facets, which could be further refined with more data.

All Designers

	Design	Computing	Research	Business	People
Knowledge	34%	3%	9%	4%	4%
Skills	11%	5%	1%	3%	5%
Attitudes	2%	1%	2%	0%	3%
Tools	11%	0%	2%	0%	0%
Qualifications	0%	0%	0%	0%	0%

(n = 35)

Interaction (IxD) Designer

	Design	Computing	Research	Business	People
Knowledge	33%	3%	13%	5%	6%
Skills	7%	0%	3%	4%	6%
Attitudes	4%	2%	1%	0%	5%
Tools	8%	0%	2%	0%	0%
Qualifications	0%	0%	0%	0%	0%

(n = 18)

Visual/Graphic Designer

	Design	Computing	Research	Business	People
Knowledge	50%	3%	0%	0%	0%
Skills	7%	0%	0%	7%	7%
Attitudes	0%	0%	3%	3%	3%
Tools	17%	0%	0%	0%	0%
Qualifications	0%	0%	0%	0%	0%

(n = 6)

User Experience (UX) Designer

	Design	Computing	Research	Business	People
Knowledge	21%	0%	8%	4%	0%
Skills	38%	0%	0%	4%	4%
Attitudes	0%	0%	0%	0%	0%
Tools	13%	0%	8%	0%	0%
Qualifications	0%	0%	0%	0%	0%

(n = 3)

Figure 32: Survey results for various designer titles, organized into the IxD Competency Framework

One additional point to notice is the complete absence of any responses under qualifications. While future survey results may include responses that relate to a qualification competency, this aspect of a job may not ever appear in user-generated results, and is more reflective of what a formal job listing might require.

Hopefully with more responses (and the time to build the visualization interface), an even stronger picture could be created for what industry wants and expects from interaction design education.

6. Results

With the research and design completed, the subsequent outcomes can be described under the following main sections: guiding factors for what industry expects from interaction designers and IxD education; a competency framework that organizes, describes and compares the skills an interaction designer needs to know; and a website that incorporates both a survey tool that updates the framework as industry needs develop and an interactive visualization that allows others to review and explore those needs.

Guiding Factors

Based upon the research efforts of this thesis, several insights have been gathered that are critical to understanding what industry needs and expects from interaction design education. These factors, covered in detail below, can be summarized as follows:

- Interaction design lacks a unifying disciplinary core
- Industry disagrees on what interaction designers should know
- Academia disagrees on what interaction designers should be taught
- Both practitioners and academics agree that interaction design education is inadequate (although they don't always agree why)
- The skills and knowledge required to practice interaction design exceeds what can taught
- Interaction design degrees are unimportant in evaluating job candidates
- The portfolio has the most influence in choosing who to interview
- The portfolio is a poor predictor of employee quality
- Job competency models offer a potential tool for standardizing and evaluating skills

Interaction design lacks a unifying disciplinary core

The principles and concepts of interaction design developed concurrently and separately across other existing fields of practice and research, such as human factors, engineering, computing and library management (Shackel 1997, Grudin 2008). Yet even as researchers and professionals from these separate fields recognized their common interests and affinities under the umbrella term "human-computer interaction" (in the 1980's) and "interaction design" (1990's), they considered themselves more of a loose collection of like-minded thinkers than a part of a wholly separate and new discipline of their own (Churchill, Bowser, and Preece 2013). This independent sentiment remained in the decades following, with one researcher concluding that, “there is no commonly agreed definition of interaction design” and instead is more of a “general orientation” towards digital products and an emphasis on how users experience them (Löwgren 2002 p.186).

Without a clear disciplinary focus, there are few objections to suggestions that interaction design should include additional practice areas, such as business, economics and humanities (Culén 2015; Faiola 2007; Norman and Klemmer 2014), and for practitioners themselves to become more multi-disciplinary or trans-disciplinary (Adamczyk and Twidale 2007; Blevis and Stolterman 2009; Churchill, Bowser & Preece 2013). This broad embrace in the practice side of interaction design is also reflected in the eclecticism of research on the academic side, where some have argued that interaction design might be better treated as an “inter-discipline” (Reeves 2015) or “not even as a scientific field, but as a professional association, oriented toward practitioners as much as researchers” (Blackwell 2015 p.504).

Yet despite this lack of a core, those within the field do want a common connection, a shared thread that “‘people can hang their hats on’” (Churchill, Bowser, and Preece 2013 p.49). This was also supported by the interaction design conference where the interviews were conducted. The 18 interviewees came from many different backgrounds and used titles like “senior UX designer” and “vice president of product & user experience” or taught within school departments such as “informatics”, “visual communications”, and “industrial design”, yet they all shared a common interest in building and improving interaction design education.

Industry disagrees on what interaction designers should know

This lack of a disciplinary core manifests itself in ways beyond just the history and research literature of interaction design. The first to consider is how practitioners within industry interpret what knowledge and skills are expected from interaction designers.

From the high-level review of 850 job listings within interaction design, 332 unique job titles were found, and after standardizing these titles to remove minor differences (ex. “Senior Interaction Designer” vs. “Interaction Design Lead”), 75 exclusive categories for a job title remained. Of these, more than half used a “dual title” such as “Interaction Designer/User Experience Designer” or “User Interface Designer/Researcher” to describe the job role. Diving deeper into the data with an analysis of 24 randomly selected job listings, several findings emerged that show how jobs differ:

- 11 of the listings (46%) asked for an undergraduate degree, 9 of the listings (38%) did not, and the other 4 requested a degree or comparable experience.
- 14 of the jobs (50%) required a portfolio, while seven (29%) asked for a CV or résumé.

- 203 specific skills and knowledge areas were identified, with 24 of them (12%) appearing in 50% or more of the job listings.
- The most commonly requested competency appeared in 22 of the listings (92%) and was less a skill and more a personality attribute (“Collaborative”). Five other competencies were found in 75% or more of the job descriptions: “Prototypes” (88%), “Visual Design” (79%), “Interaction Design” (75%), “User Research” (75%), and “UX Design” (75%).
- Organizing these skills into eleven higher-level categories, such as “Attributes”, “Design Tools”, and “Technical Skills”, showed that nearly all listings (22 or 92%) included competencies from 9 of these 11 categories, although these groupings were not evenly distributed nor similarly emphasized from one job listing to another.

These broad ranges of skills were also found in the expert interviews, in which the participants identified multiple knowledge areas that they considered important for interaction designers to know. The literature as well uncovered multiple facets of an interaction designer’s job requirements, from research methods (Rogers 2004) to usability and user-centered design (Ji and Yun 2006) to ergonomics, agile development, and specific methods such as personas, wireframes, and card sorting (Hussein, Mahmud, and Tap 2014).

Academia disagrees on what interaction designers should be taught

It’s not just industry that lacks consensus on what an interaction designer should know; academia as well interprets interaction design across a broad spectrum of knowledge areas and subsequently teaches it in many different ways.

Interaction design degree programs emerged in the mid-1980’s and early 1990’s from different disciplines and school departments, including engineering and architecture (Grudin 2008; Shackel 1997), and emphasize more of those fields’ areas of focus than a common set of content (Cooper et al. 2014). And although academics have discussed how to standardize education before, this hasn’t resulted in complete agreement. The first widely recommended curriculum for an HCI undergraduate course wasn’t a single curriculum at all; instead, it was designed to be used modularly, with different parts to be taught or not depending on the degree program, be it psychology or computer science (Hewett et al. 1992). And while a recent effort from the ACM SIGCHI Curriculum Development Group to update the curricula acknowledged that a standardized curriculum or degree would make it easier for industry to know what skills students have, they concluded that a “living curriculum” without specific courses was a better approach (Churchill, Bowser & Preece 2013).

Looking more specifically at IxD programs themselves as detailed in Chapter 5: Degree Program Analysis, this thesis examined 176 master’s degrees distributed across 16 different school departments—from design to engineering to architecture—and found 101 unique titles for the degree awarded, from the expected (“Interaction Design”) to the unique (“ICT Innovation – Human Computer Interaction & Design

(HCID)"). And although all indicated they taught interaction design, only 24% of the degrees included "Interaction Design" (or some close derivative) in the title.

Yet the differences weren't only superficial, in the title or the department alone. From a geographically distributed, randomly selected list of 24 master's degree programs titled "Interaction Design," other differences appeared:

- The degree types included masters of arts (MA), science (MS), design (MDes), fine arts (MFA), research (MRes), applied science (MAS), and undesignated ("Masters").
- The program length ranged from 18 months to 3 years, with most (58%) 2 years long.
- For prerequisites, while most programs required a portfolio (63%), many required a résumé or CV (42%), and a sizeable minority required verifiable skills, such as programming (29%), not all required an undergraduate degree (92%).
- For graduation, 38% required a thesis, 33% required a capstone or final project, 13% allowed either, and the remaining 17% did not include either.
- Comparing curricula, 42% had a core set of common classes for their entire program, while the rest included both required and elective courses, allowing students to choose which classes they wanted to take.
- 49 different courses were identified as core classes across the various programs, none of which were taught in more than half the schools. In fact, fewer than half the courses (21 courses or 43%) were shared by at least 25% of the schools, meaning that most schools taught courses unique to their program with little in common between schools.
- Organizing these courses in nine higher-level categories, such as "Tools", "Graphic Design", "Business", and "Research and Analysis", showed that the programs also differed in which of these broader areas their classes were, with no common patterns or groupings across the 24 degree programs.

Academics within interaction design also disagree on what schools should be teaching, with such notables as Jon Kolko requesting more craft skills (2001a) and Don Norman arguing for less (Norman and Klemmer 2014). And while Glushko (2008) argues that all disciplines—from business to medicine—have unique variations dependent on the institutions in which they are taught and the instructors which teach them, he also emphasizes that these differences are small and often countered by accrediting organizations which standardize curricula for the given field. Interaction design has no such standard pedagogical reference or accrediting organization (Thomassen and Ozcan 2010).

Both practitioners and academics agree that interaction design education is inadequate

Despite the lack of consensus within either industry or academia for what an interaction designer should know and what should be taught, both sides of the divide agree that interaction design education is inadequate, although they don't always agree why. Most commonly, they contend that education is not keeping up with the rapid changes in interaction patterns and technologies that emerge, a conclusion that has been repeated for many years (Culén, Mainsah & Finken 2014; Faiola and Matei 2010; Foley et al. 2005; Grudin 2008; Myers 1998). Additionally, they point to the instructors' own interests and biases preventing students from learning industry-relevant knowledge (Winograd 1990) and the difficulties in presenting information in pedagogically effective ways that are also reflective of real-world working conditions (Lian-nan, Yu-long & Jia-xun 2015; Silva, Crosby & Polo 2014; Thomassen and Ozcan 2010).

From the expert interviews, practitioners echoed some of the above critiques while also describing graduates that lacked experience with industry-standard tools such as Photoshop, or knowledge of aesthetics or coding, and were therefore unable to contribute immediately. The educators interviewed agreed with most of these points, although pushed back on the idea that graduates should be immediately productive, citing fields such as architecture and law in which newly hired employees are trained on the job by more senior personnel.

This issue relates to a potential shortcoming in understanding what, exactly, education in general should involve, with vocational education having a more professional focus on expected skills needed in the field while liberal education address more of higher-order thinking processes (Shinn 2014). This has led some to argue that a formal education is not necessarily at all, a poor substitute for dedicated practice and on-the-job experience (Rutledge 2010; Six 2012), a sentiment shared in the interviews too.

The skills and knowledge required to practice interaction design exceeds what can be taught

This may seem obvious, yet it's an important element to remember when considering what interaction design education should do. At its most fundamental, education is about both imparting knowledge and improving a student's ability (Shinn 2014), yet in those two dimensions are two additional problems relating to interaction design education.

The first—imparting knowledge—is not just difficult for the reasons mentioned above. Another reason is the sheer breadth of skills and knowledge expected to be acquired in the short period of time a degree occurs. The analysis of master's degree programs identified 50 different courses across the surveyed schools. From the literature, Marcus (2005) identified 120 educational topics to cover in an interaction design curriculum. The job listing analysis identified 200-plus competencies that were required from across the postings, with an average of 36 unique competencies per job. This makes the likelihood of establishing a single degree program to teach all of these a mathematical impossibility.

The second—a student's ability—is another dimension to what can or can't be taught. From the academic literature, assessing a student's skills can be difficult to evaluate for areas of aesthetics (Yang, You & Chen 2005) as can the teacher's ability to further cultivate or enhance those abilities in the classroom or studio setting (Culén, Mainsah

& Finken 2014; Liu 2009; Thomassen and Ozcan 2010). This problem of talent also emerged in the interviews, with a newly graduated designers' aptitude one of the areas that fell short. Again, a previously referenced quotation from a university professor deserves repeating: "Not everyone will come out as a professional designer, they just don't have the skills. I don't want them to drop out school, but I need to help them see that this field might not be for them" (M Lahey 2016, personal communication, 3 March).

Interaction design degrees are unimportant in evaluating job candidates

When asked about the importance of a design degree, interviewers that had hired designers said it was completely unimportant in their decision, mainly because it was nearly impossible to know what skills the person had, whereas a portfolio could demonstrate skill or ability quickly. While the interviewees agreed that a degree demonstrated a basic level of competency, it wasn't very important what school it came from or whether it was even a specialty degree in interaction design or another design field. Even for a large multinational company like IBM or Google (Bryant 2013), having a degree of any kind was not a requirement if the applicant had the evidence for skills and experience.

The 24 job listings reflected this de-emphasis of any specialized academic interaction design degree, with nine of the listings (37.5%) not requesting any degree, four (16.7%) asking for a degree or comparable experience, and the remaining eleven (45.8%) asking for a degree in a broad variety of fields including HCI, graphic design, engineering, information science, computer science, and visual communications. Interestingly, for those nine job listings that said a degree was not required, eight of them were for jobs in either San Francisco or New York, both highly competitive job markets, suggesting that requiring a degree was perhaps a barrier to finding a qualified applicant. Also of note: none of the job listings required—or even mentioned—a master's degree as a requirement.

As for why degrees aren't important, interviewees said there was no way to know from the degree alone what skills or abilities an applicant had. Research literature also points to the inconsistency between programs to understand what skills a candidate may or may not have (Churchill, Bowser, and Preece 2013), as well as the rapid changes in technology that make taught skills less relevant (Lian-nan, Yu-long & Jia-xun 2015; Shinn 2014) and the fact that current practitioners' own lack of degrees makes them less inclined to consider degrees as a deciding factor (Six 2012).

The portfolio has the most influence in choosing who to interview

All industry interviewees said that the portfolio was the most important tool they use to determine who to interview, even going so far as to ignore the résumé or CV entirely, except perhaps as a keyword filtering tool to find candidates whose portfolios might then be considered. The job listing analysis showed a similar emphasis, with twice as many jobs requesting a portfolio (14 listings or 58.3%) than a

CV or résumé (7 listings or 29.2%). This is supported by outside research in which 63% of managers in creative fields in North America said a portfolio was the most influential element when hiring an employee (The Creative Group 2011).

The best portfolios are more than just a collection of images however; per interviews and literature, diverse portfolios demonstrate an understanding of design principles and process and convey to the reader that the candidate can solve complex problems (Churchill, Bowser, and Preece 2013; Kolko 2011b). The academic interviewees understood this as well, describing how much they worked with students on improving their portfolios so that they would be received well, including one interviewee who taught an undergraduate course entirely on portfolio creation in preparation for graduates to interview for jobs.

Yet from the review of degree programs themselves, only four of the programs (17%) indicated they helped students develop their portfolios for after graduation. This finding is particularly interesting since more than half of the programs (15 or 62.5%) required a portfolio to apply for acceptance to the program themselves.

The portfolio is a poor predictor of employee quality

Although they hire based on the portfolio, interviewees who managed designers admitted that this wasn't the best way to evaluate a candidate. Two interviewees described specific scenarios where they hired strong candidates primarily based on the quality of their portfolios, only to realize six months later that they lacked fundamental business understanding, design thinking, and client communication skills and weren't as effective as they hoped. Notwithstanding that, the interviewees said they would continue to rely on portfolios mainly because they didn't believe there was a better alternative.

This factor presents a promising area of further research, because despite thorough search in the digital libraries for ACM, ResearchGate, and Google Scholar, no literature supporting or refuting this conclusion could be found. The closest support is a meta-analysis of jobs across a variety of fields, which showed that work sample tests (in which a candidate performs specific tasks as part of the job interview process itself) were moderately associated with job performance (r=.54), slightly higher than structured interviews and general mental ability (GMA) scores (both with r=.51) (Schmidt and Hunter 1998). Confirming how well a portfolio or degree predicts designer's job performance is outside the scope of the thesis, yet points to need for having clear measures of a designer's knowledge and skills so that industry can adequately evaluate interaction designers.

Job competency models offer a potential tool for standardizing and evaluating skills

Without accrediting boards to standardize educational programs or licensing bodies to certify ability, and without a consensus on what a degree should entail or what skills are necessary for a designer to know to practice interaction design, one is left with little to understand and compare what industry needs and expects from interaction design education. This lack of standards is not unique to interaction design, and the use of job competency models like KSAs and O*NET are used for many other positions to describe the work activities and knowledge areas they require. Additional models, like the Design Enterprise Model and Blevis and Stolterman’s, don’t describe particular jobs, but instead cluster skills into categories that help to understand the potential areas of competency needed. Others, like SFIA for IT jobs, extend this clustering further, with detailed evaluations for how a person should be able to perform in the skill, depending on the position’s seniority. No such framework or model exists for interaction design

According to an extensive literature review in the field (Ennis 2008), competency frameworks are effective in describing an individual’s skillsets and uncovering gaps, describing a job’s requirements, and helping educational institutions to map curricula to expected job needs in the market. They are less effective in evaluating motivation and personality traits, and can be difficult to address all requirements for job success.

Taken altogether, these factors led to the conclusion that establishing a common curriculum for interaction design would not reflect the breadth and diversity of interaction design within industry and academia. At the same time, one can also conclude that industry itself is not able to clearly describe what is expected of interaction designers when their own methods (primarily portfolios) inadequately assess people for interaction design jobs. Thus, an alternative approach is proposed to evaluate what industry wants: The Interaction Design Competency Framework.

Interaction Design Competency Framework

While each of these guiding factors deserve critical evaluation, the limited timeframe of the thesis necessitated a more limited scope. With that in mind, the area of most interest to the author was addressing the breadth of skills expected within industry, particularly as the portfolio (a visual artifact) is used so consistently to evaluate the skills and abilities of a prospective interaction design employee. The bewildering variety of job titles and job descriptions makes it almost overwhelming for anyone to get an adequate picture of what, exactly, an interaction designer should know and thereby craft a valid educational program to address it.

Yet if greater clarity could be imparted to what industry wants, then that might help academics design more appropriate and responsive educational programs. By the same token, a better understanding of how to think about job competencies might make it easier for directors and hiring managers within industry to evaluate prospective employees more broadly across multiple factors than just a portfolio. And for practicing interaction designers, having a framework within which to situate themselves might improve their ability to understand their own strengths and interests, and position themselves more effectively in the job market. The Interaction Design Competency Framework is the author’s attempt to address those outcomes.

The Interaction Design Competency Framework complements existing job competency models such as SFIA and O*NET, offering an interaction design-specific model for understanding what industry expects from practicing designers. Instead of proposing a single set of skill criteria that will satisfy most job needs, the IxD

Competency Framework provides a mechanism for standardizing how different criteria may manifest themselves across all aspects of interaction design. At its core, the Framework is designed to:

- Present at a glance what are the task and work areas for a given job
- Provide enough high-level information so comparisons can be made between different jobs or degrees
- Allow for deeper exploration of specific competencies
- Flexibly accommodate new criteria so that it can remain relevant even as new technologies, methods, and approaches emerge

To do so, competencies relevant to various aspects of the work of interaction design are organized into groupings relating to work disciplines or domains and activity areas or facets.

Domains of Competency

The IxD Competency Framework consists first of five competency domains. These are distinct areas of practice reflective of formal disciplines that are already present in interaction design. However, these are not the classic domains of human factors, information systems, HCI, etc., from which interaction design emerged. Rather these are the current areas in which an interaction designer may work in industry:

- **Design** – Graphics, Interfaces, Interactions – this domain refers to the conceptualization and design of both visual forms and behaviors encompassing both the static and dynamic nature of design (Faiola 2002). Design includes creating visualized artifacts and the creative and evaluative methods and thinking that accompanying that process.
- **Computing** – Programming, Functionality, Performance – this domain addresses the technical aspects of implementing a design into workable code or interface, whether in front-end development (HTML, CSS, Javascript), programming, or tangible electronic device.
- **Research** – Observing, Interpreting, Evaluating – this domain focuses on the efforts required to understand and respond to external information when creating or implementing a design, such as ethnographic work, user testing, and data analysis.
- **Business** – Managing, Planning, Marketing – this domain concentrates on the practices and methods for introducing a design into the marketplace and how timelines, staffing, and financial resources impact that. It is also concerned with how an organization can effectively use design to provide value through the direct creation of products and services, and how business strategies can inform the direction a design should take as it addresses market needs.
- **People** – Communicating, Empathizing, Motivating – this domain looks into the social and cognitive elements that make up individual and collective human processes, from the perspective of interpersonal interaction and collaboration (rather than research).

Facets of Competency

While the domains of competency organize capabilities into disciplines, the facets of competency organize capabilities by elements of performance. The five facets are:

- **Knowledge** – what you must know to perform a task – the theoretical or practical understanding of a subject
- **Skills** – how you perform a task – the specific practices of applying knowledge to produce design artifacts
- **Attitudes** – how you feel as you perform a task – the affective sentiments and mindsets the individual possesses about the task, themselves, or the people and environment around them
- **Tools** – what you use to perform a task – the external assets utilized to complete a task, be it a physical object (such as pen and paper), digital artifact (such as software), or design artifact being worked on
- **Qualifications** – what indicates you can perform a task – the formal and informal credentials that indicate one's ability, such as a degree, portfolio, certificate, or previous experience

The IxD Competency Framework Matrix

There are 286 competencies identified as part of the IxD Competency Framework and each has been assigned to a domain and facet. A sampling can be seen in Table 28 while a complete list is available in Appendix G: Competencies.

Table 28: Example Competencies within the IxD Competency Framework

	Design	**Computing**	**Research**	**Business**	**People**
Knowledge	Usability	Hardware Programming	Field Research	Project Management	Cognitive Psychology
Skills	User Flows	Javascript	Web Analytics	Hiring	Listening
Attitudes	Creative	Analytical Thinking	Open-Minded	Works under Pressure	Self-motivated
Tools	Sketch App	Git	Eye Tracking	PowerPoint	Social Media
Qualifications	Portfolio	CS Degree	Journalism Degree	PMP	Psychology Degree

Applying the Framework to Find What Industry Wants

To apply the Framework and thereby understand what industry wants from interaction design, let's use it in the context of a job listing. In the case of a given job, keywords and phrases are coded and mapped to 47 different competencies, each with its own associated domain facet (see Table 29).

Table 29: Competencies for a Specific Job Listing for an Interaction Designer

	Design	Computing	Research	Business	People
Knowledge	Design Standards Graphic Design/Visual Design Interaction Design (IxD) Usability User Experience (UX) Design User Interface (UI) Design User-Centered Design (UCD)	Object Oriented Programming	Heuristic Evaluations Task Analysis User Research User Testing	Strategy Time Management	
Skills	Brainstorming Information Architecture Mobile Web Mobile Apps Personas Specifications Wireframing	AJAX CSS HTML JavaScript Visual Basic WPF XAML		Requirements Gathering	Communication Written Communication
Attitudes	Problem-solving			Client-focused	Collaborative Interpersonal
Tools	Axure RP Flash InDesign Prototypes Tools for Wireframing, Prototyping (Axure, Invision, OmniGraffle, UXPin, etc.) Visio		Contextual Inquiry Focus Groups	PowerPoint	
Qualif.	Experience (Design) Portfolio				

One can immediately see that the most of the competencies are in the Design domain; however, it is less obvious which domain facet has the most. The next step is to count the number of competencies for each domain facet and divide by the total number of competencies (see Table 30). Using a percentage rather than a total count allows comparisons to be made between job listings, because the number of competencies associated with different listings may differ.

Table 30: Competency Distribution for an Interaction Designer Job Listing
(percentages reflect competencies in the given domain facet, divided by the total number of competencies for the given job listing)

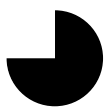
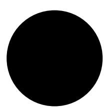
	Design	Computing	Research	Business	People
Knowledge	15%	4%	9%	4%	0%
Skills	15%	15%	0%	2%	4%
Attitudes	2%	0%	0%	2%	4%
Tools	13%	0%	4%	2%	0%
Qualifications	4%	0%	0%	0%	0%

To further simplify the results and improve ease of communication, the framework replaces these percentages with circular visualizations known as Harvey balls. Each Harvey ball icon represents a range of percentages and indicates the percentage threshold for each domain facet, showing in a “semi-numeric” way whether a given domain facet is likely to be part of a job’s tasks. This abstraction is intentional, because it would be inappropriate to apply a numerical or statistical level of scrutiny to something that is somewhat imprecise to begin with: the proportion of a job spent in each task or area of competence.

Again, although they look like pie charts, Harvey balls are not quantitative visualizations. They do not represent an exact quarterly percentage with the solid ball representing 100% of all values. Rather they display qualitative differences within a small range to emphasize dissimilarities that wouldn’t be immediately apparent if the larger total was used. For example, when looking at the sample job listing in Table 30, one can see that not one domain facet has more than 15% of the total. If these were presented by a standard quarter pie (for 25% or less), all those 15 domain facets would have the same icon, which doesn’t reflect the large differences between domain facets, for example between Design Knowledge and Business Tools.

To represent these differences between domain facets, a smaller frequency range of 6% was chosen for each Harvey ball visualization (see Table 31). This interval was based on an analysis of the detailed job listings to evenly distribute the responses. Thus for a sample job with 52 competencies, one might find 8 of 52 competencies (or 15.4%) in the Design Knowledge domain facet and 2 of 52 (3.8%) in Research Tools.

Table 31: Harvey Icons Representing Domain Facets

Not Expected 0%	**Rarely Expected** >0-6%	**Occasionally Expected** 7-12%	**Frequently Expected** 13-18%	**Likely Expected** >18%
				

Replacing the percentage values in the IxD Competency Framework for the job listing (see Figure 33), one can see even more quickly which domain facets the job focuses and which it does not, namely a strong bias toward Design yet with some specific skills in Computing, knowledge in Research, and overall familiarity with Business.

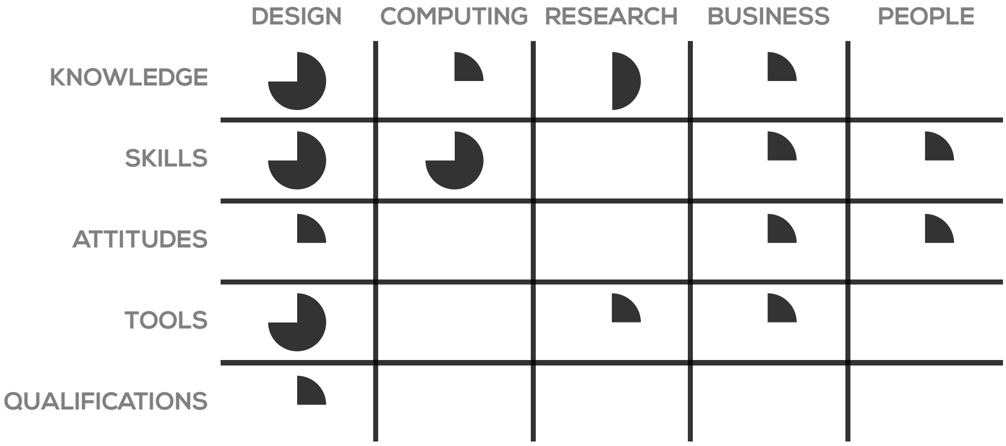


Figure 33: An example of the IxD Competency Framework for a job listing

Continuing this summary framework further, two different job listings can then be compared (Figure 34), and one can quickly see that the first position requires more computing and business skills while the second is more of a pure design job with research needs as well.

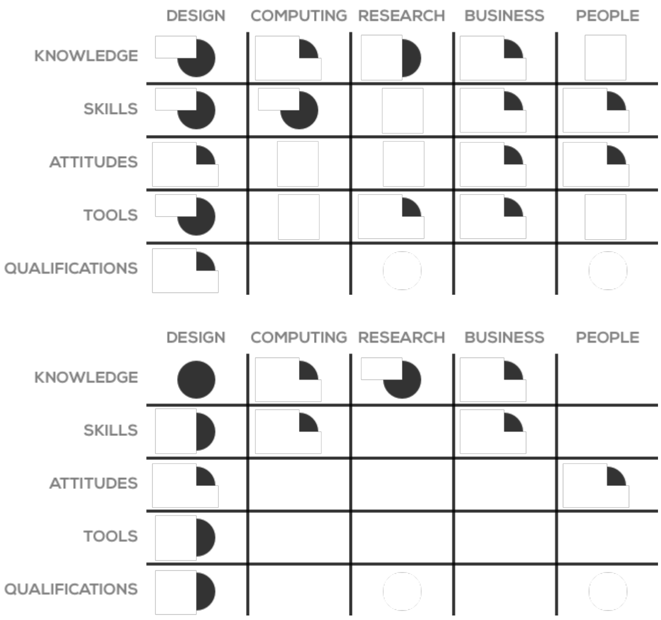


Figure 34: Two job listings, compared using the IxD Competency Framework

The framework doesn't just apply to individual job listings either, but can be used to summarize competencies across multiple job listings to show the general state of industry needs from interaction design practitioners (Figure 35), demonstrating that while the strongest emphasis is on design knowledge and skills, there are also expectations for both strong design tools and strong people attitudes (in addition to broad prospects across computing, research, and business).

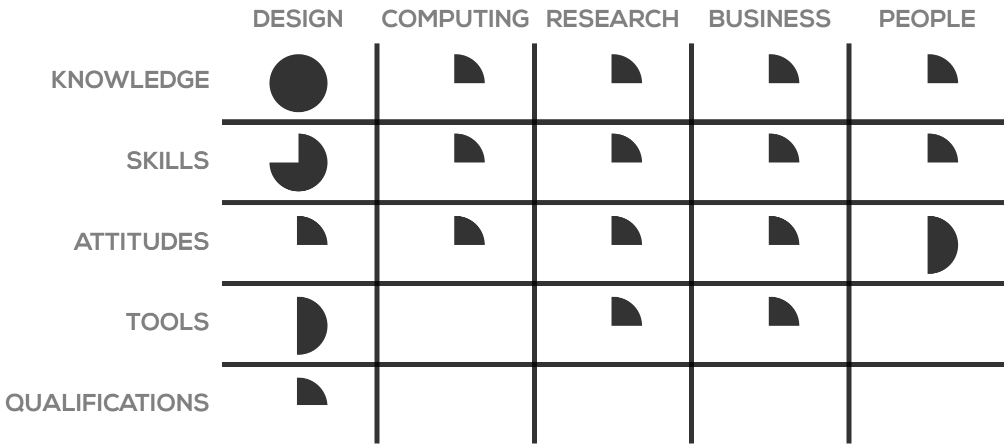


Figure 35: Aggregate domain facets for all sampled job listings for interaction designers

Diving into the domain facets uncovers specific elements that can better show what industry wants interaction designers to know, and where perhaps IxD education is not responding to that need. For example, looking at the top skills a designer should have within the Design domain, 63% of the jobs required mobile design skills and 50% required information architecture skills. Compared to interaction design curricula, those two skills were taught in only 42% and 13% of the school programs, which hints to a place of improvement. (A complete list of these totals as organized by domain facets can be found in Appendix H: Competency Counts for Job Listings).

WhatsaDesigner.com

While the Interaction Design Competency Framework provides a context for organizing competencies from job listings in a standardized way, the author wanted to further work to popularize the framework beyond the thesis document. At the same time, although the Framework is based on the collected data from 24 job listings, the author wanted to also evaluate expected design skills and knowledge by engaging directly with those in the industry. To that end, WhatsaDesigner.com was created, an ancillary product to explore and extend the space within understanding interaction design education from the perspective of industry.

WhatsaDesigner.com is a website with two main functions:

1. an online survey that asks participants what competencies they think are most important for a designer to know; and
2. an interactive visualization that allows visitors to see how competencies compare across different designer titles and locations.

The survey tool was successfully built and deployed as part of this thesis project[23], and the data it collected can be seen earlier, in the Survey Data Analysis section

[23] https://whatsadesigner.com/ [18 August 2016]

within the Execution Process chapter. The visualization interface was not built and implemented before the conclusion of the thesis project; nevertheless, its proposed functionality is described herein.

WhatsaDesigner.com Survey

The WhatsaDesigner.com survey collects visitors' opinions about what they think an interaction designer should know in a simple web form. It uses a pre-filled list of competencies from which the visitor can choose an option, or they can include their own if they are unable to find one they feel is suitable. It also asks for demographic information to capture how industry expectations may differ based on locality.

The website front-end was built using standard HTML/CSS with a responsive design for support on mobile browsers, and incorporates webfonts (for aesthetics) and a small Javascript library for handling the filtering and manual selection of competencies. The form data is submitted to a third-party form management tool, Getform[24], which provides the data in a downloadable csv for further interpretation.

The following pages describe the specific functionality of the website, along with motivations for design decisions.

[24] Getform (https://getform.org/)

Landing Page

The landing page of the site presents the purpose clearly and cleanly without distraction (Figure 36). To give appropriate focus to the questions at hand, each portion of the survey is split into separate pages. However, to provide a fast, seamless experience, the actual pages of the survey are not separate HTML pages, but sections of a single page. The page design utilizes responsive design techniques to resize for mobile and tablet screens, optimizing the site experience accordingly.

When the user is ready to begin the survey, clicking the “Begin” button scrolls the page down to the next view, the Designer Type and Competencies page.

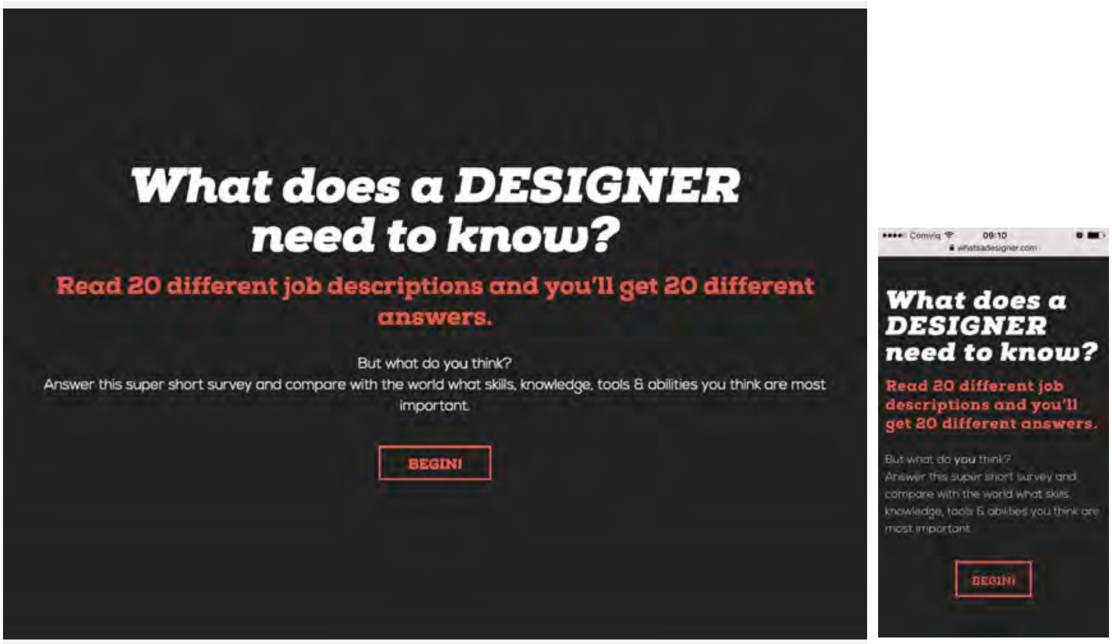


Figure 36: The Landing Page, in desktop and mobile layouts

Choosing the Designer Type

The first step that a user takes is to select the type of designer they will be describing (Figure 37 and Figure 38). Although the purpose of this thesis is to understand the competencies specific for interaction design, one finding was that the actual term "interaction designer" doesn't have the same meaning to all people. In fact, because so many interpret what it means to be interaction designer so differently (as evidenced by the different datasets), it can be helpful to understand what skills and knowledge people attribute to other designer types and use as a point of comparison to determine whether there are unique qualities for one type of designer versus another, such as a web designer versus a UX designer.

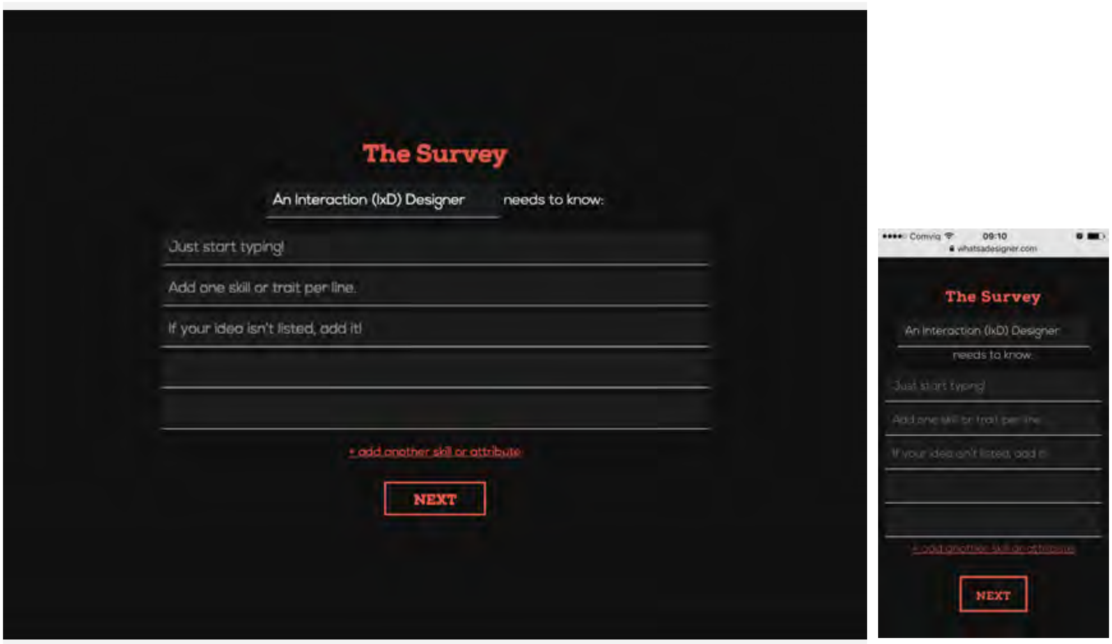


Figure 37: Designer Type & Competencies Page, in desktop and mobile layouts

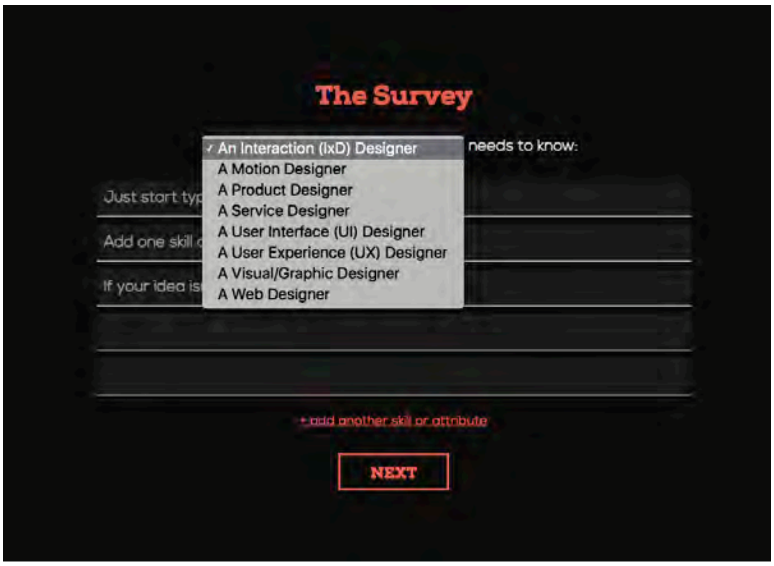


Figure 38: Choosing the designer type

Entering Competencies & Auto-Complete

As mentioned previously, the survey uses a pre-filled list of competencies as a base from which the user can select the competencies they believe are most appropriate for the designer type they are evaluating. However, a traditional dropdown <select> does not scale when there are dozens (or hundreds) of options to choose from. A technique known as autocomplete allows the user to begin typing a possible component name, and the list returns only those items that contain the letters the user has begun typing in the string (Figure 39).

At the same time, because practitioners themselves may think of competencies not in this list, the user should also be allowed to enter their own answers and suggestions. The HTML5 <datalist> input controller provides this functionality, but has limited browser support, so to extend this functionality to more web browsers, a Javascript-based fallback[25] is used.

Figure 39: The Autocomplete in action, in desktop and mobile layouts

[25] Awesomplete - https://leaverou.github.io/awesomplete/

Survey End: Demographics

In order to give appropriate focus to the questions at hand, each portion of the survey is split into separate pages. However, so that this content load quickly, they aren't actually separate web pages at all, but full-screen views for each section of the site. Thus the second "page" of the survey is actually on the same webpage as the first "page" (as is the start screen too). The second section of the survey asks demographic questions such as location and respondent type (Figure 40). While these fields are not required, the information may provide insight into whether differences in designer responsibilities are due to location or based on perception of the respondent (the idea being that, for instance, a manager might believe certain competencies are more important than a designer might due to a more business-focused point of view).

Upon clicking the submit button, the data entered in the form is collected and stored in the database for retrieval later and a notification is sent to the site owner (the author).

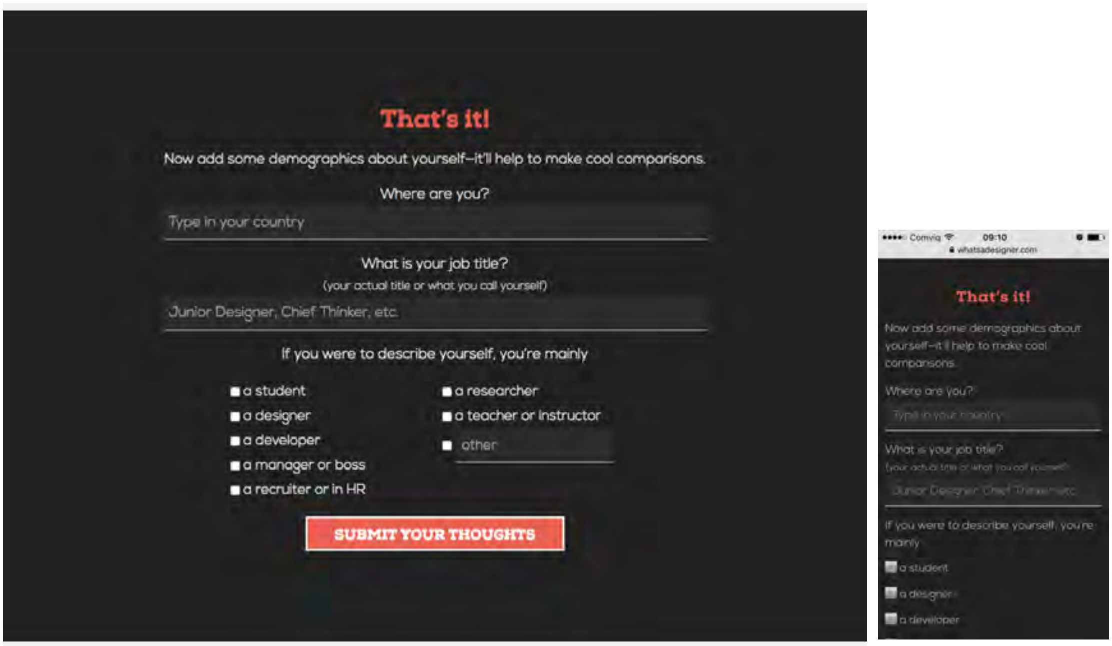


Figure 40: The Demographic Detail Page, in desktop and mobile layouts

Results Page, current live version

While the intent of the results page is to display the resultant data from survey submissions, it does not do so currently. This is due to technical limitations of what was implemented in code, as well as the need to clean-up and code manually-entered values so they match existing competencies. As such, the current version of the live page contains a thank you page and a request for participants to share the survey with other friends and colleagues (Figure 41). And for the time when data is collected and cleaned and an interface is available to view the results, a sign-up form to subscribe to updates is also available on this page.

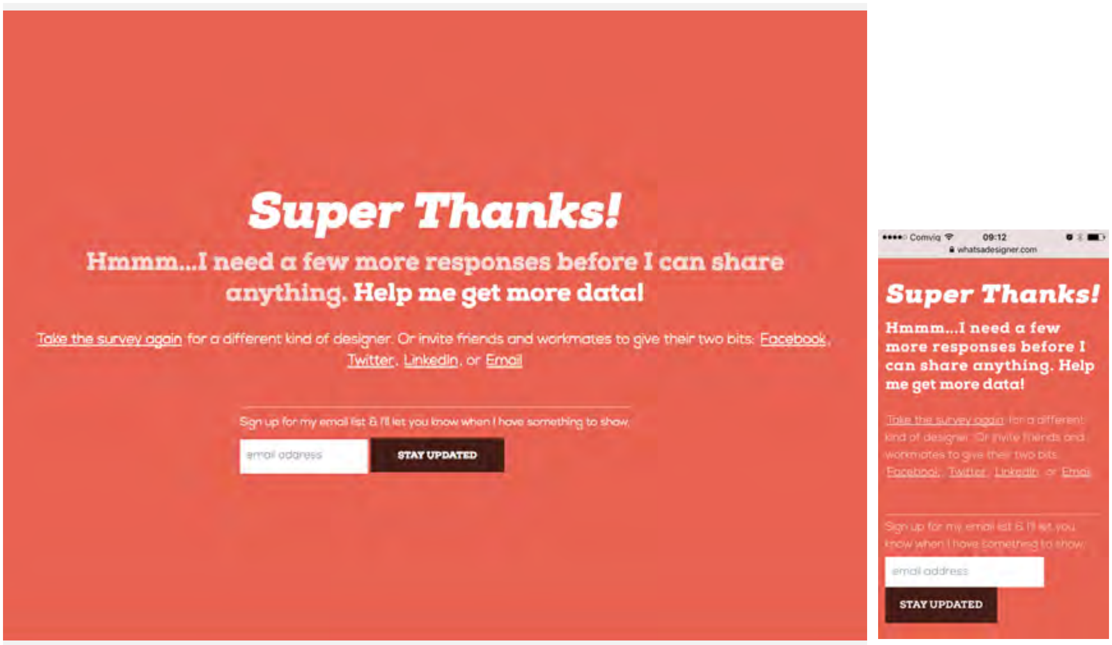


Figure 41: Thank You page, in desktop and mobile layouts

WhatsaDesigner.com Competency Data Visualization

Although the previous screenshots are directly taken from the live website, the following are high-fidelity mockups that show what results could look like if enough data were collected and the functionality were in place to demonstrate how the Interaction Design Competency Framework could further uncover what interaction designers should know in an interactive interface supported by regularly updated data.

Default Results View

After the user has completed the survey, the website takes them to the Results page, where they can see the competency framework for the designer title they provided information for (Figure 42). They can scroll down the page and view all competencies ordered by most frequently mentioned, or they can click on a domain facet and see only those competencies which apply. Using the top filters, they can also view the results for another designer title or the same designer title but for a different locality. They can also compare the given title to another title and/or locality. And they can share the survey with friends or colleagues.

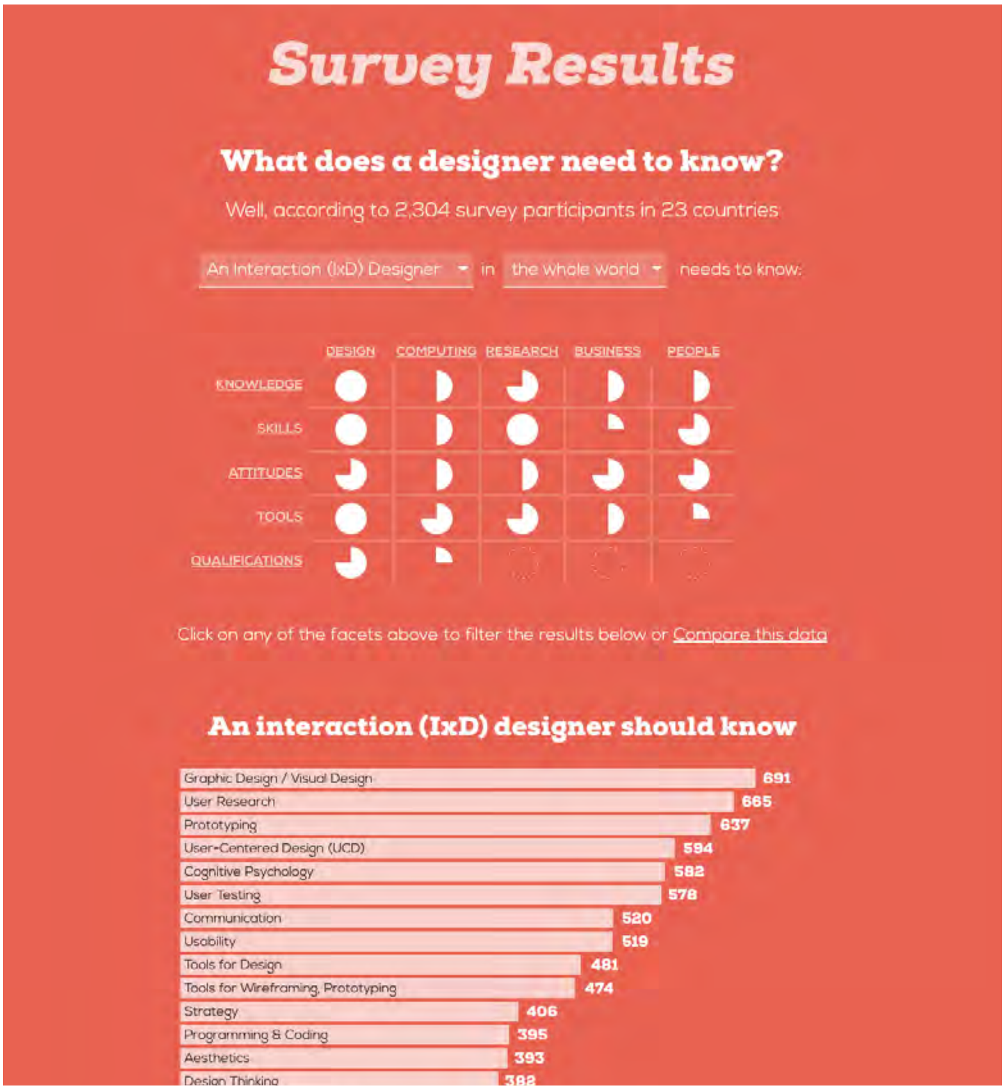


Figure 42: Results page, with data visualizations

Filtered View

When the site visitor clicks on a specific domain facet (or a domain or facet title itself), the domain faceted is highlight and the list of competencies below the framework are filtered to show only those that apply, ordered by popularity (Figure 43). Clicking on another domain facet changes the filter to those relevant competencies instead, while "Clear" restores the view to the its default appearance, with all competencies listed.

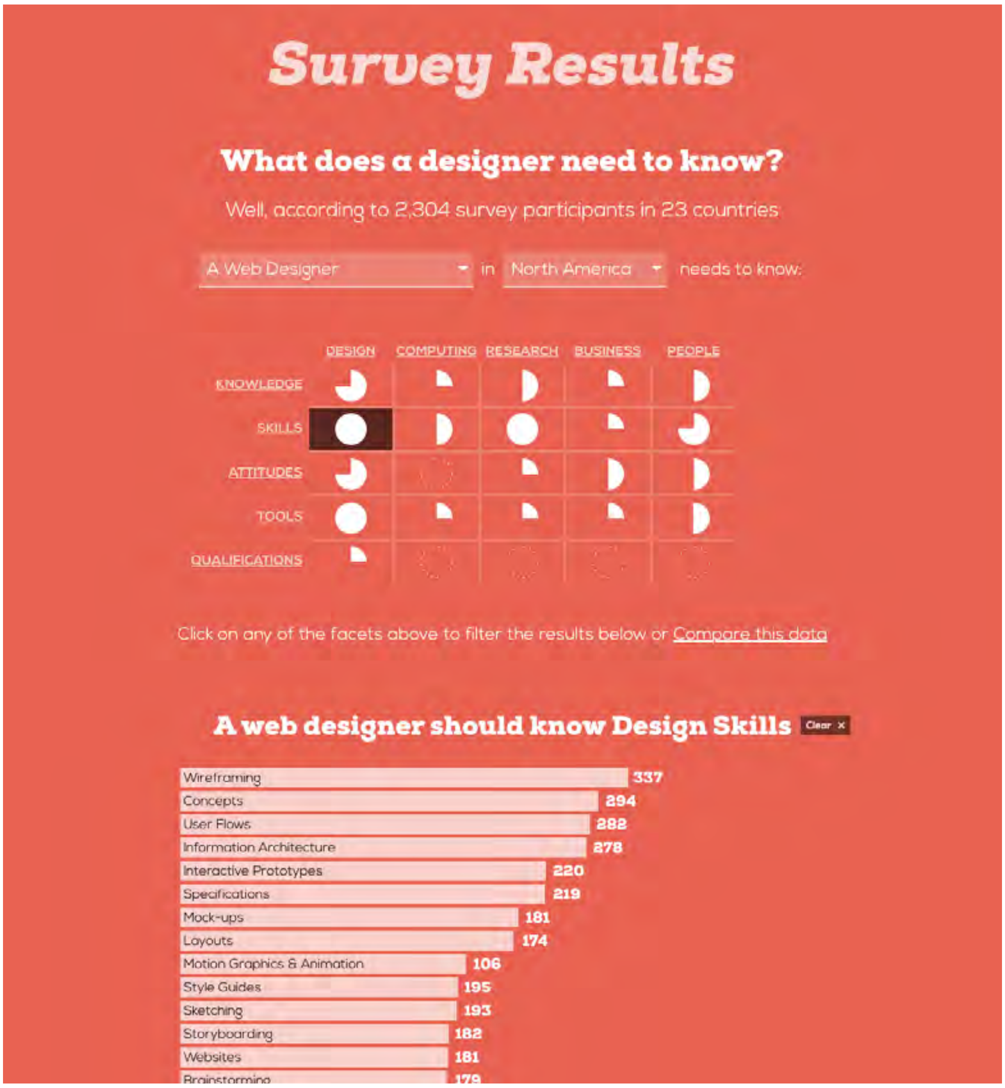


Figure 43: Filtered view of Results page

Comparison View

When the user chooses to compare two different design titles or localities, they are given the same type of interface as the main results page, but can view the two side-by-side (Figure 44). Additionally, while the detailed list of competencies is presented in order of most frequently mentioned across both titles, the competency labels themselves are placed under the title in which they are more preferred. All other functionality remains the same, including clicking on a domain facet to filter competencies and selecting a different comparison to make or going back to the default view.

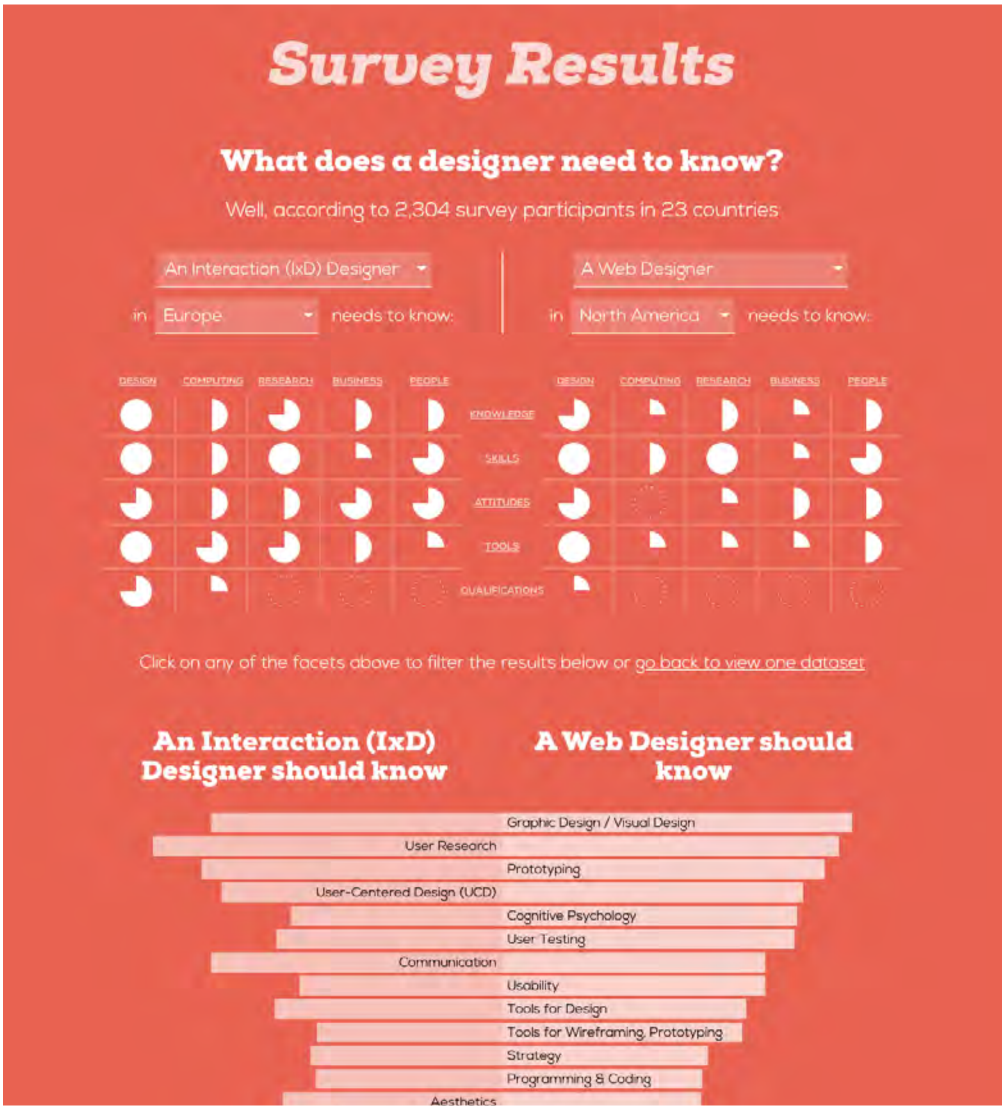


Figure 44: Comparison view of two different designer titles

7. Discussion

With the project complete, it is now time to consider the results of those efforts and address what worked, what didn't, and what could be enhanced through further work.

Overview

The focus of this thesis was to understand what industry needs and expects from interaction design education. The underlying motivation for this desire was to provide some sort of standard or optimal curriculum that could produce qualified interaction designers into the field of practice. However, it became apparent quickly that not only was there no single solution, but that even trying to comprehend clearly the complexity of the overall design space was an almost insurmountable task.

In a very real sense, I had come full circle back to the circumstances of the SIDeR student conference described in the introduction of this thesis: I was approaching the challenge from an industry mindset rather than an academic one. From the raw data I had collected, I expected to see a clear result that pointed out the knowledge, skills, attitudes, and tools from which to create a model interaction design education. Instead, try as I might, there really was no obvious outcome, no distinct solution that could be gleaned.

As it turns out, the challenge of interaction design education isn't that there is some sort of ideal "one size fits all" degree program, if only it could be discovered. The guiding factors developed to describe this problem space, explaining how and why an ideal interaction design education is a wicked problem, with contradictory perspectives on what is important and to whom. The challenge is that there are multiple ways to interpret what it means to be an interaction designer, and multiple ways to educate an interaction designer, and before now, there hasn't been a clear way to visualize these differences.

As a possible solution to address some of this factors, the Interaction Design Competency Framework offers a visualization tool to understand and recognize the ways one job may emphasize development skills while another may require more research knowledge, and both are legitimate descriptions of what an interaction designer should know.

Findings & Outcomes

In comparing the methods to answer the question of how we can know what industry needs and expects from interaction design education, the following generalized assessments can be made:

- **Literature Review** – provided a thorough grounding of the nature of interaction design education and established that there were wide gaps of disagreement between and within industry and academia, however it provided very little information for what competencies are most important.
- **Interviews with Industry & Academia** – gave great insight into the hiring process and the limitations in general of determining someone's skill levels, with the most insightful points being the general unimportance of a degree and the high importance of a portfolio. As for specific competencies, they offered a few, but the amount of time to get them made interviews an inefficient data gathering tool.
- **Degree Programs** – provided solid numbers for what is being taught, but very little for what industry wants, either as feedback or via empirical statistics of how many graduates have jobs, for example. Also, because the information is at a course level, it would require much more work to go into individual courses to find more specific competencies that would associate with specific job skills.
- **Job Listings** – provided the most detail by far, with the average job listing containing more than 36 uniquely identifiable competencies across knowledge, skill, attribute, tool, and qualification. The coding process, however, is time consuming, and finding job listings relevant to interaction design risks the possibility of bias.
- **Online Surveys** – gave much fewer answers per entry than the job listings (6.3 per survey vs. 36.4 per job) and still required some manual cleaning. However, it has the greatest future potential, because of how easy it is to distribute, and also how many of the responses included competencies not part of the original list, suggesting the survey respondents have the pulse of what is most relevant and applicable in industry.

In every scenario, for the findings to be useful, manual intervention was required—in seeking out, gathering, cleaning, coding, and then loading this data. The WhatsaDesigner.com website was intended to offer a less onerous method to collect larger streams of data, yet it never reached that potential and so it is difficult to place too much emphasis on those results.

The Guiding Factors Effectiveness

Considering the thesis results, this project answers the question of "what is the ideal interaction design education" with the somewhat ineffectual answer of "it doesn't exist." While this is frustrating on a personal level, the guiding factors provide a way of thinking about the problem in broader terms, describing not only why such an answer doesn't exist, but also why such a question is fraught with problems itself.

And while the guiding factors may not cover every issue influencing how industry thinks about interaction design education, they do surface certain attitudes or behavior that provide further avenues of inquiry. For example, even if one were to codify a common curriculum or describe job titles and descriptions through a common standard, there's no guarantee that would change industry's disinterest in using an interaction design degree as a measure of knowledge and their continuing reliance on the inadequate portfolio.

As such, perhaps the true challenge—one only briefly alluded to in this thesis project—is less about educational preparedness and fit for jobs as it is for industry to assume a greater role in the post-educational transition into the workforce, akin to residencies in medicine, hiring a law school graduate before they take the bar exam, or apprenticeships in other fields. Yet that is another thesis altogether.

IxD Competency Framework Effectiveness

Placing competencies in the context of the IxD Competency Framework does indeed make it easier to understand and compare different job listings, job titles, and degree programs. by having higher level categories, one can quickly see what are the particular emphases of a given job, and then be able to drill down and see more specific information. And standardized labels for the competencies themselves, one can get a better sense of what is expected rather than be uncertain when two different jobs describe a responsibility in different language. As an unintended side effect, having standardized domains, facets, and competencies also makes it possible to compare jobs to degrees and thereby assess the suitability of a design program against a specific job or job category.

That said, the specifics of the framework and the groupings of knowledge, skills and abilities are somewhat unpolished and could use more review and analysis. From the foundation, the process of assigning competencies didn't always result in a clear designation to a particular domain or facet, and there are multiple cases where a particular competency might be considered either a knowledge area, skill, tool or attitude depending on the original reference. For example, "Research Methods" is a form of knowledge, while "Research" itself (as in performing research) is a skill. or a job listing might include specific reference to Photoshop (which is a tool) while another might more generally refer to photo editing, which is a skill.

Similarly, while the matrix of domain-facet quadrants makes for a visually appealing presentation of competencies, it doesn't necessarily uncover specific enough areas of differentiation in all domains, primarily Design. The Design domain contains three times the number of competencies as the other domains and should logically be split into more domains. What those domains should be is unclear, however, because of how much overlap there is between say, graphic design and interface design in regards to knowledge, required skills, tools, and so forth.

By the same token, Attitude competencies are not assigned to a particular domain because they are not uniquely specific to any given domain. Unlike most skills—for instance prototyping which has a clear connection to Design—attitudes such as "energetic", "passionate", and "self-motivated" are not particularly aligned to one of the main domains of the framework. Future Work (listed below) suggests a possible way to resolve this problem, yet it is one way in which the results of the IxD Competency Framework have not been completely explored, conveying again how much the skills and knowledge of interaction design education is a wicked problem.

And frankly, the results of this thesis project suggest that it's not really about IxD education either, just what is expected from designers in general. If the goal of this work is to help interaction designers know what to learn to be attractive to industry, then I answered this from the first interviews: add a bunch of keywords and create a good portfolio. However, if the goal is about helping improve interaction design as a whole, then a larger thrust should be to help industry distinguish the skills that cause a candidate to be interviewed and hired versus the competencies they ultimately want in their prospective employee. The depth of that disconnect would require a much deeper dive into the work of which this thesis only scratches the surface.

Visualization & Website Effectiveness

Apart from the effectiveness of the IxD Competency Framework, additional discussion should be made around its glyph-based visualization and subsequent implementation in the website. While using Harvey balls is not a completely uncommon visualization within business consulting (and readers of the US-based *Consumer Reports* magazine, which uses a modified version for its rating system), it may not be the most effective for audiences unfamiliar with its implementation. Including a legend (like that found in Table 27) describing the icon meanings would help.

Additionally, because little testing was done of the visualized results for the website, there are certain elements in its presentation that are somewhat unrefined. Some of this is a limitation of using static images to represent a dynamic interface—seeing a filter in action might make certain design elements more obvious. Yet others are simply shortcomings in the interface itself. For instance, in the comparison view, it is somewhat unclear how the detailed competency comparison chart (the two-way histogram or pyramid graph) is ordered. In addition to adding more explanatory text, it might be helpful to include more functionality such as the ability to sort not just by most popular between both but by most popular for one or the other, or even alphabetically.

Data Limitations

It should be noted that these results gloss over some potential weaknesses in the underlying data itself, inherent shortcomings that impact the effectiveness of the IxD Competency Framework in describing what is needed in a given job listing or degree program. Apart from general weaknesses in limiting the research to English-language sources, the relatively small sample size, and the need for frequent manual intervention to clean and conform the date, two more prominent issues should be addressed here:

- just because a competency isn't listed doesn't mean it's not needed
- just because a competency is listed doesn't mean it's required frequently

The first shortcoming refers to the fact that some of the data sources are not written to the same level of details as others are. Thus a job listing that consists of 400 words will likely not have as many competencies associated with it as a job listing with 800 words. And because it has fewer competencies, the shorter job listing may display less strongly for different aspects of the IxD Competency Framework, making it appear less relevant.

The second shortcoming refers to the opposite scenario, in which a job listing or other data source includes a competency, but that given competency is not particularly substantial compared to other competencies. For example, a job listing may include “user research” and “mentoring” as job responsibilities, yet the reality is that user research is only conducted twice a year while mentoring is a daily task. If presented proportionality in the IxD Competency Framework, the People-Skills quadrant would have much greater emphasis while Research-Knowledge would not, yet this is not how the framework currently works.

Incidentally, this is an issue for any job listing, regardless of whether there is some sort of visualization like the IxD Competency Framework to break down what one does each day. In fact, only one of the 24 jobs analyzed in detail shared any explanation of how much time would be spent on which tasks, and in that case, it was at a fairly abstract level of detail[26]. School data fares somewhat better, by way of hours per course, but as courses are indicators of knowledge and not necessarily actions within them, course hours don’t give an accurate enough breakdown of how much time is actually spent in lectures vs. lab activities or in specific skills that could then be used to better populate the IxD Competency Framework.

Process

In considering how these results were achieved, certain methods and activities worked better than others. A few areas of particular note:

Literature Review

As a research-oriented project, the time spent reviewing existing literature was vital in establishing a contextual understanding of both the academic and the industry perspectives on interaction design education, as well as the reality that the gap was not just between industry and academia but within them as well. Additionally, it was the thorough investigation around accreditation that led to the discovery of multiple existing frameworks (KSAs, SFIA, etc.) for organizing competencies, an integral step to imagining the creation of the Interaction Design Competency Framework.

[26] Kuder, Interaction Design Lead: “80% UI, 20% visual”

Data Collection, Coding, & Analysis

The data collection and coding process, while much more intense and time-consuming than expected, was also worthwhile in that it provided the raw foundation upon which the elements of the framework could be tested against. Without coding and how it surfaced uniquely relevant information, it wouldn't have been obvious to include the People dimension of the framework, with its emphasis on social interaction, communication and collaboration.

However, relying on coding to empower the conclusions of the framework ultimately was the single biggest problem with this project. The sheer amount of time it took to tag relevant keywords and phrases in the job listings, and then clean up and standardize the responses, only to then export the data back to Excel due to shortcomings with the software (and/or the inexperience of the author with the software tools), meant that much less time could be spent on designing, building out, and testing the framework and corresponding website.

Could fewer pieces of content have been analyzed? Certainly. Yet in my desire to create as accurate a picture as possible (as well as my worry that there was not enough rigor to the process), there never felt like there was enough.

Overall Design Process

Speaking of process, the Jones model—with its phases of divergence, transformation, and convergence—was ideal for the kind of scenario this thesis work is situated in in which there are no defined, determinate boundaries nor clear, optimal solutions. Because these so-called wicked problems typically lead to resolutions that are "good enough" rather than ideal (if they even lead to that), the fact that the result does not definitively answer the question of what specific skills industry needs from IxD education is not an indication of failure.

The Jones model then provides a path through just such scenarios, encouraging the adjustment and reevaluation of design activity based on new information rather than completely stopping work effort. Thus, when faced with the results from interviews that employers use the CV/résumé as a screening tool for specific keywords and rarely (if ever) use an interaction design degree as a way to evaluate job candidates, instead relying heavily on the candidate's portfolio, the decision was made to shift the focus away from the creation of a defined product (an archetypal interaction design education) and toward a more broadly conceived framework tool to understand the variety of forms interaction designers take.

However, because the Jones model is so flexible and open-ended, it was difficult to know when one effort logically should end and another begin. It often felt as though there was always one more article to read or one more keyword to code that would shed greater light on the problem and thereby resolve it. This is not a problem with Jones, *per se*. Rather, my bias as a designer in industry working under strict budget and close scrutiny by a client has been to iterate through designs rapidly, closing avenues of exploration as soon as there appears to be a promising result. But because there were no immediate answers and instead more questions during this thesis work, I continued my divergent efforts rather than accept those new questions as a finding of themselves. In literature and in research, having a result that leads to more questions is considered a good consequence, whereas for me as a designer it only meant that I didn't understand the scope or problem space well enough.

Perhaps rather than consider all the data gathering efforts (literature, interviews, schools, and jobs) as one large divergent phase and then all the analysis (affinity diagrams, content analysis, framework sketching, prototyping) as a large transformation phase before creating convergent designs for testing, a better approach would have been to have each dataset be its own diverge-transform-converge cycle.

In this iterative approach, each dataset would be gathered, analyzed, implemented into a robustly defined artifact, and then tested before proceeding to the next dataset. This would have satisfied the requirements of the project and resulted in more testable designs than what occurred. Instead, the transformation/content analysis of all data took much more time than expected, other elements of the thesis project suffered.

Tools

As much as this research effort has been a largely unfamiliar process for me, several tools and technologies within this thesis have been equally unexplored. New methods (quantitative data analysis), new software (MAXQDA) and new coding platforms (chart.js) all presented additional roadblocks to completing the project in a timely fashion. From an overly optimistic plan to create a working interaction with real-time data updates, I subsequently spent too much time trying to learn and use tools that ultimately could not be implemented successfully, and thus was unable to perform the necessary work to thoroughly validate results by other means.

Impact

Despite these shortcomings in the process, the overall results—guiding factors describing the problem space of interaction design education, a descriptive framework for interaction design competency, and a website for popularizing that framework—have broad application. The guiding factors identify underlying barriers in trying to improve the effectiveness of education. The framework not only categorizes various tasks a job requires and highlights the relative focuses of different IxD degree programs, it also could be used by interaction designers themselves to assess their own alignment within the discipline. With this self-assessment in hand, they could pursue jobs that better reflect their competencies; and the employer could also use that candidates' framework results as a more thorough predictor of fit and success, perhaps even freeing them from the tyranny of hiring by portfolio alone.

Additionally, while the framework uses facets specific to design, there is no reason why it couldn't be more generalizable to any other field where there is a strong split between industry and academia. One could simply determine the facets appropriate to that given field or discipline and use them to replace those that are specific to interaction design. The resulting competency framework could likely shed light into just where the disconnects are in those disciplines as well.

Future Work

While each of the guiding factors could benefit from further research, the dual findings that the portfolio has the most influence on who to interview, yet is a poor predictor of employee quality, deserves more attention. As noted in the results, neither of these has received much (or any) consideration in the existing research literature and yet seem to be strong dependent factors for why industry is dissatisfied with interaction design education.

The Interaction Design Competency Framework could also receive a more vigorous review by those responsible for hiring employees and those directly related to curriculum development to test whether it accurately capture their needs and could indeed reflect what an interaction designer needs to know. Additionally, the survey tool received only basic user evaluation, and future work would be to give it a more thorough vetting by more users.

Relatedly, subsequent effort would be to implement the visualization in code on the site for real-time data gathering and updates, powered by a database back-end that could record results over time and possibly permit insight into how the definitions and job requirements for designers is changing over time.

As more results are gathered, this might in turn help resolve the issue with Attitude competencies being uncoupled from any particular domain. Just as previous researchers found a significant association between specific HCI roles and empathy (Putnam and Kolko 2012), the survey tool might show that certain attributes appear more frequently with other domain-specific competencies, so and attitude like “Open-Minded” may be a Design attitude rather than a Research attitude.

Experimenting with giving certain facets more weight than others might in turn alleviate the aforementioned concerns about whether the competencies listed all have the same level of importance relative to one another.

A final area of future endeavor would be to provide more visualizations and interactivity on the website, including the ability to compare one job or degree program to another or compare one type of designer to another, thereby allowing users even further insight into how differently industry and academia think about interaction design.

8. Conclusion

The focus of this thesis project was to understand what industry needs and wants from interaction design education. To answer that question, I explored available literature, interviewed experts from both academia and industry, examined both school curricula and job listings, and surveyed practitioners, managers, and educators directly to gather what the key skills and abilities are for a successful interaction designer to know and use.

Although the underlying hope of this thesis was to synthesize a standard curriculum for interaction design education that could match what industry expects, the results of research and data analysis suggest that such an outcome is unrealistic. It fails to reflect the disparate nature of different degree programs and the wide variety of needs from different businesses and design firms. We can thus conclude that there is no common description or list of criteria for what industry needs and expects from interaction design education, just as there is no common description for an ideal interaction designer.

Instead, a series of guiding factors materialized to better understand the reasons why these degree programs are so different, why industry job titles and descriptions disagree with one another, why companies emphasize portfolios and deemphasize degrees when hiring designers, and why interaction design education may never fully incorporate the breadth of what could be known about interaction design.

To address these factors, a framework was created which better situates competency areas, domains of expertise, and facets of activity across a continuum of specialization within interaction design. The Interaction Design Competency Framework presents focus areas which one can use to interpret what a job listing requires or a school program emphasizes. Intersecting the domains of Design, Computing, Research, Business, and People, with the facets of Knowledge, Skills, Attitudes, and Tools, the IxD Competency Framework organizes individual competencies at these nodes.

To further test the validity of the competency assignments as well as a mechanism to gauge how the needs of industry changes over time, Whatsadesigner.com elicits feedback from anyone who has a relationship to design. On this site, a user enters the skills and abilities they feel are most important for a designer to know, and these responses are then used to populate visualizations within the IxD Competency Framework visualization for the particular design position indicated. While the website and survey are successfully operating, due to technical shortcomings the visualization functionality failed to be completed by the conclusion of this thesis. Future work needs to be performed to implement this infovis functionality and research its effectiveness in conveying to both instructors and practitioners the various ways interaction design can be understood in both industry and in education.

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11. Appendices

Appendix A: SFIA Framework Overview

Levels: 1 Follow; 2 Assist; 3 Apply; 4 Enable; 5 Ensure, advise; 6 Initiate, influence; 7 Set strategy, inspire, mobilise

Category	Subcategory	Skill	Levels
Strategy and architecture	Information strategy	IT governance GOVN	5–7
		IT strategy and planning ITSP	5–7
		Information management IRMG	4–7
		Information systems coordination ISCO	6–7
		Information security SCTY	3–7
		Information assurance INAS	5–7
		Analytics INAN	3–7
		Information content publishing ICPM	1–6
	Advice and guidance	Consultancy CNSL	5–7
		Technical specialism TECH	4–6
	Business strategy and planning	Research RSCH	2–6
		IT management ITMG	5–7
		Financial management FMIT	4–6
		Innovation INOV	5–6
		Business process improvement BPRE	5–7
		Enterprise and business architecture STPL	5–7
		Business risk management BURM	4–7
		Sustainability strategy SUST	4–6
	Technical strategy and planning	Emerging technology monitoring EMRG	4–6
		Continuity management COPL	4–6
		Sustainability management SUMI	5–6
		Network planning NTPL	5–6
		Solution architecture ARCH	5–6
		Data management DATM	2–6
		Methods and tools METL	4–6
Change and transformation	Business change implementation	Portfolio management POMG	5–7
		Programme management PGMG	6–7
		Project management PRMG	4–7
		Portfolio, programme and project support PROF	2–6
	Business change management	Business analysis BUAN	3–6
		Requirements definition and management REQM	2–6
		Business process testing BPTS	4–6
		Change implementation planning and management CIPM	5–6
		Organisation design and implementation ORDI	5–6
		Benefits management BENM	5–6
		Business modelling BSMO	2–6
		Sustainability assessment SUAS	4–6
Development and implementation	Systems development	Systems development management DLMG	5–7
		Data analysis DTAN	2–5
		Systems design DESN	2–6
		Network design NTDS	5–6
		Database design DBDS	2–6
		Programming/software development PROG	2–5
		Animation development ADEV	3–6
		Safety engineering SFEN	3–6
		Sustainability engineering SUEN	4–6
		Information content authoring INCA	1–6
		Testing TEST	1–6
	User experience	User experience analysis UNAN	3–5
		User experience design HCEV	2–6
		User experience evaluation USEV	2–6
	Installation and integration	Systems integration SINT	2–6
		Porting/software configuration PORT	3–6
		Hardware design HWDE	4–6
		Systems installation/decommissioning HSIN	1–5
Delivery and operation	Service design	Availability management AVMT	4–6
		Service level management SLMO	2–7
	Service transition	Service acceptance SEAC	4–6
		Configuration management CFMG	2–6
		Asset management ASMG	4–6
		Change management CHMG	2–6
		Release and deployment RELM	3–6
	Service operation	System software SYSP	3–5
		Capacity management CPMG	4–6
		Security administration SCAD	1–6
		Penetration testing PENT	4–6
		Radio frequency engineering RFEN	2–6
		Application support ASUP	2–5
		IT infrastructure ITOP	1–4
		Database administration DBAD	2–5
		Storage management STMG	3–6
		Network support NTAS	2–5
		Problem management PBMG	3–5
		Incident management USUP	2–5
		Facilities management DCMA	3–6
Skills and quality	Skill management	Learning and development management ETMG	3–7
		Learning assessment and evaluation LEDA	3–6
		Learning design and development TMCR	4–6
		Learning delivery ETDL	3–5
		Teaching and subject formation TEAC	5–6
	People management	Performance management PEMT	4–6
		Resourcing RESC	4–6
		Professional development PDSV	4–6
	Quality and conformance	Quality management QUMG	4–7
		Quality assurance QUAS	3–6
		Quality standards QUST	2–5
		Conformance review CORE	3–6
		Safety assessment SFAS	5–6
		Digital forensics DGFS	4–6
Relationships and engagement	Stakeholder management	Sourcing SORC	2–7
		Contract management ITCM	4–6
		Relationship management RLMT	4–7
		Customer service support CSMG	1–6
	Sales and marketing	Digital marketing MKTG	2–6
		Selling SALE	4–6
		Sales support SSUP	1–6
		Product management PROD	3–6

Appendix B: Interview Questionnaire

Demographics

- Name
- Age
- Years in the industry
- Job title, level, role
- Company size, industry
- Schools attended, degrees attained
- Path into interaction design (if not school)

About Education

- Think about the role of education in gaining employment in the industry. What does education do well?
- What does it do poorly?
- What do you think of degree programs vs certifications vs online courses?

- From your perspective, what subject areas would be best for students to pursue in school?
- What skills would be best for them to learn in school?
- What activities should be available in school?

- What can't be learned in school? What must the job teach?
- What should students learn to do on their own?
- Where are the gaps?
- [If applicable] as someone who has worked in both academia and industry, what do you see as the differences?

Skill Rating

[The following would be best done via survey or maybe a printout sheet. For each, we should find out:]

- How important is each skill or area to learn or know, as a practitioner?
- How would you rank the candidates you interview (or employees you hire)?
- What differences, if any, have you noticed about any particular candidates or hires, depending on their education?

- Knowledge Areas
  - Mobile Interaction
  - User Interface
  - User Experience
  - User Testing
  - Emerging trends
  - Etc.
- Activities
  - Design studio
  - Group work
  - Crit sessions
  - “real” clients
  - prototyping
  - Building a portfolio
- Languages
  - HTML
  - CSS
  - LESS/SASS
  - Javascript
- Software tools
  - Git
  - Preprocessors (grunt)
  - Photoshop
  - Sketch
  - OmniGraffle
  - Flinto
- Abilities
  - Attitude/disposition
  - Communication skills
  - Interpersonal skills
  - Leadership
  - Organization/time management
  - Problem-solving abilities
  - Work ethic
- Design Methods
  - Sketching
  - Storyboarding
  - Paper prototypes
  - Rapid prototypes
- Contextual Fluency
  - Usability
  - Accessibility
  - Responsiveness
  - Aesthetics
  - Privacy
  - Gamification

Questions to ask managers, supervisors, recruiters

- What are the biggest complaints you have about the people you hire?
- What are the biggest weaknesses of the people you vet and interview?
- What are the skills you hire for the most?
- What skills do you need the most of?
- How do you rate in importance the following:
  - CV
  - Portfolio
  - Design activity
  - Interview
  - Recommendation from others
  - Degree or accreditation
  - Thesis project

- How important is a degree in interaction design/HCI/UX vs others?

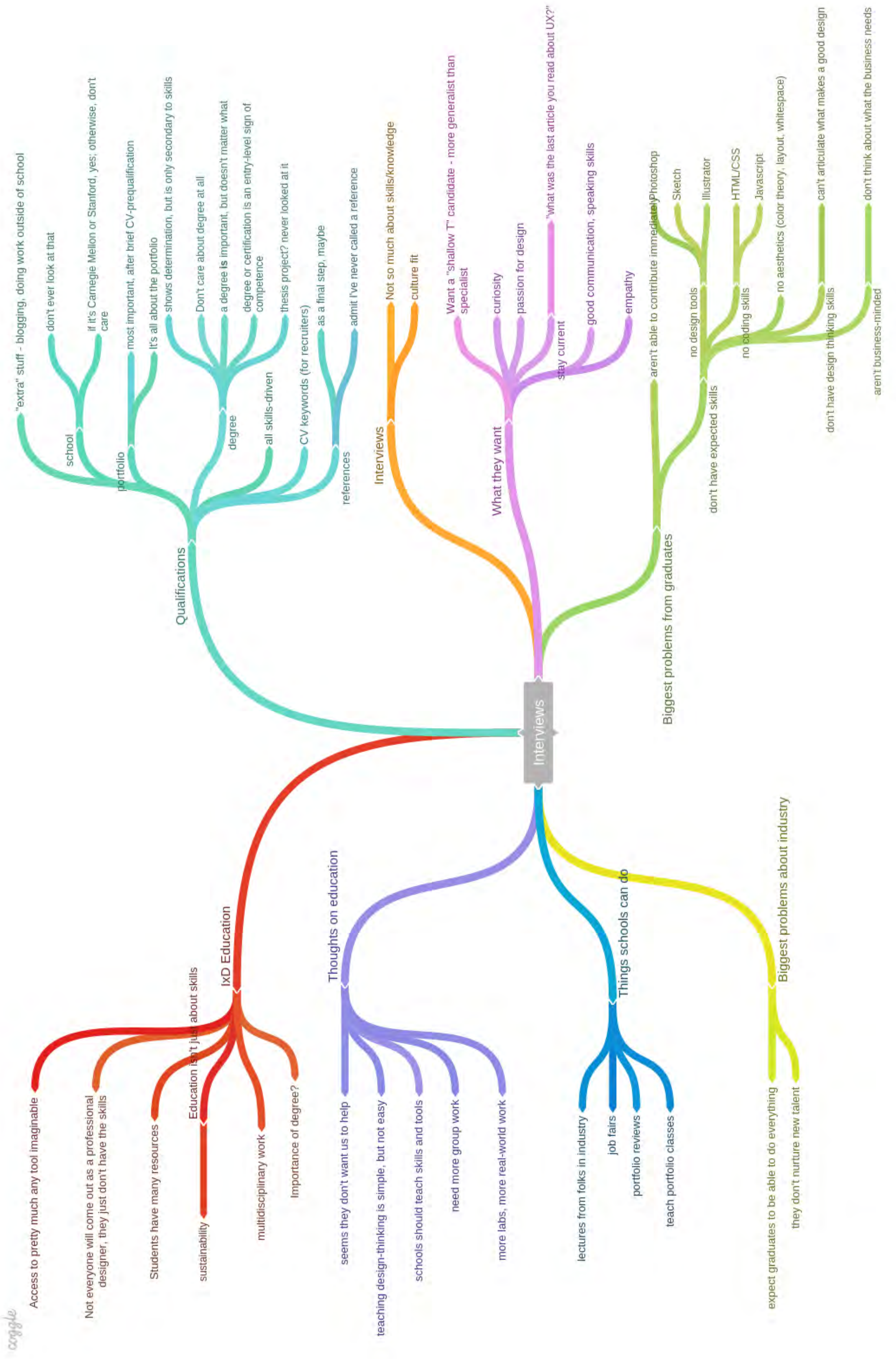
About the Future

- What do you think designers in 10 years will spend most of their time doing? 5 years?
- Is interaction design the future? or is service design? or something else?
- What are the skills that a future interaction designer has?
- What does the future of interaction design education look like?

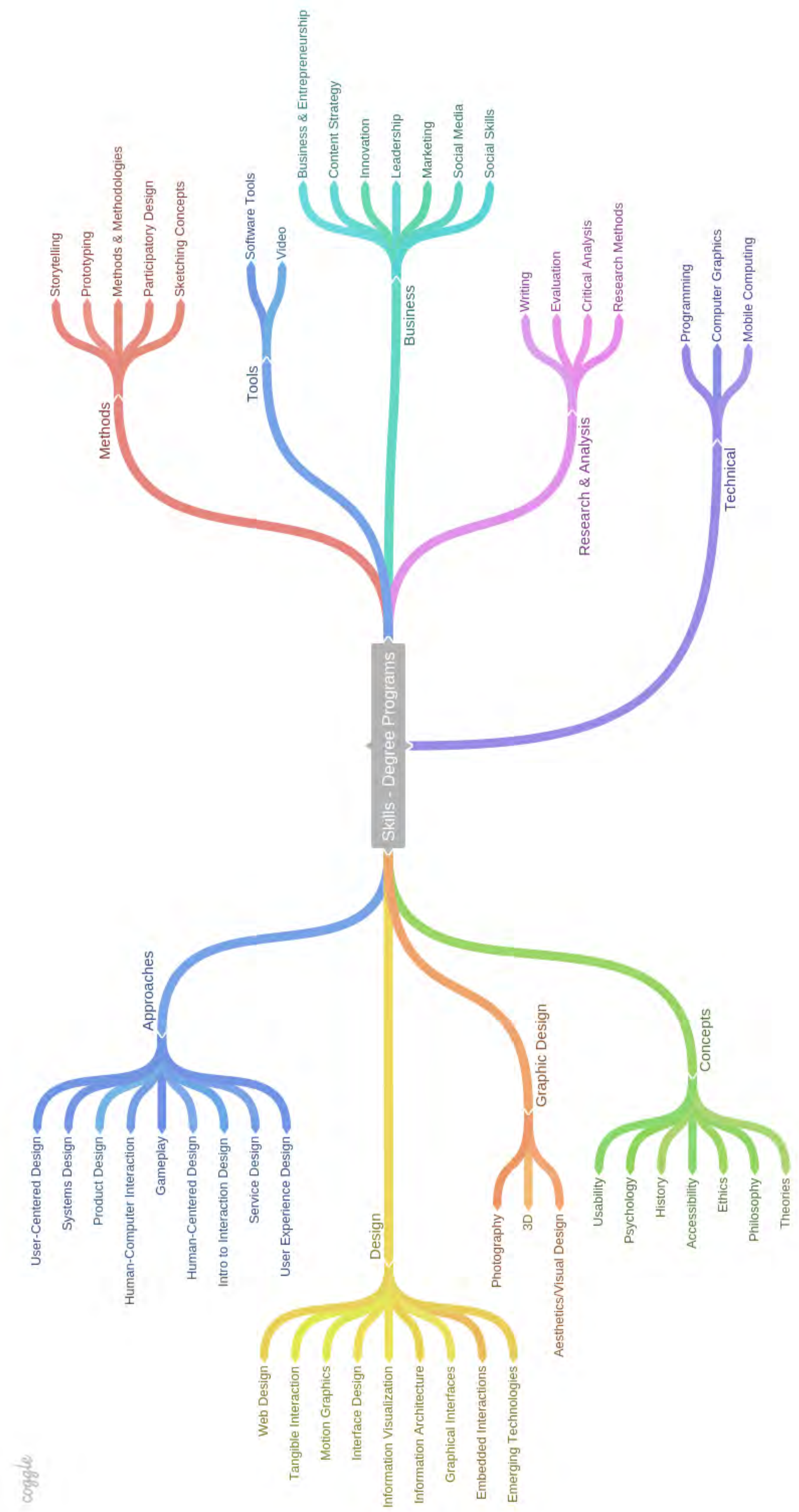
Final Questions

- Any resources or people you would recommend talking to?
- Would you be willing to do a follow-up interview?
- Contact information

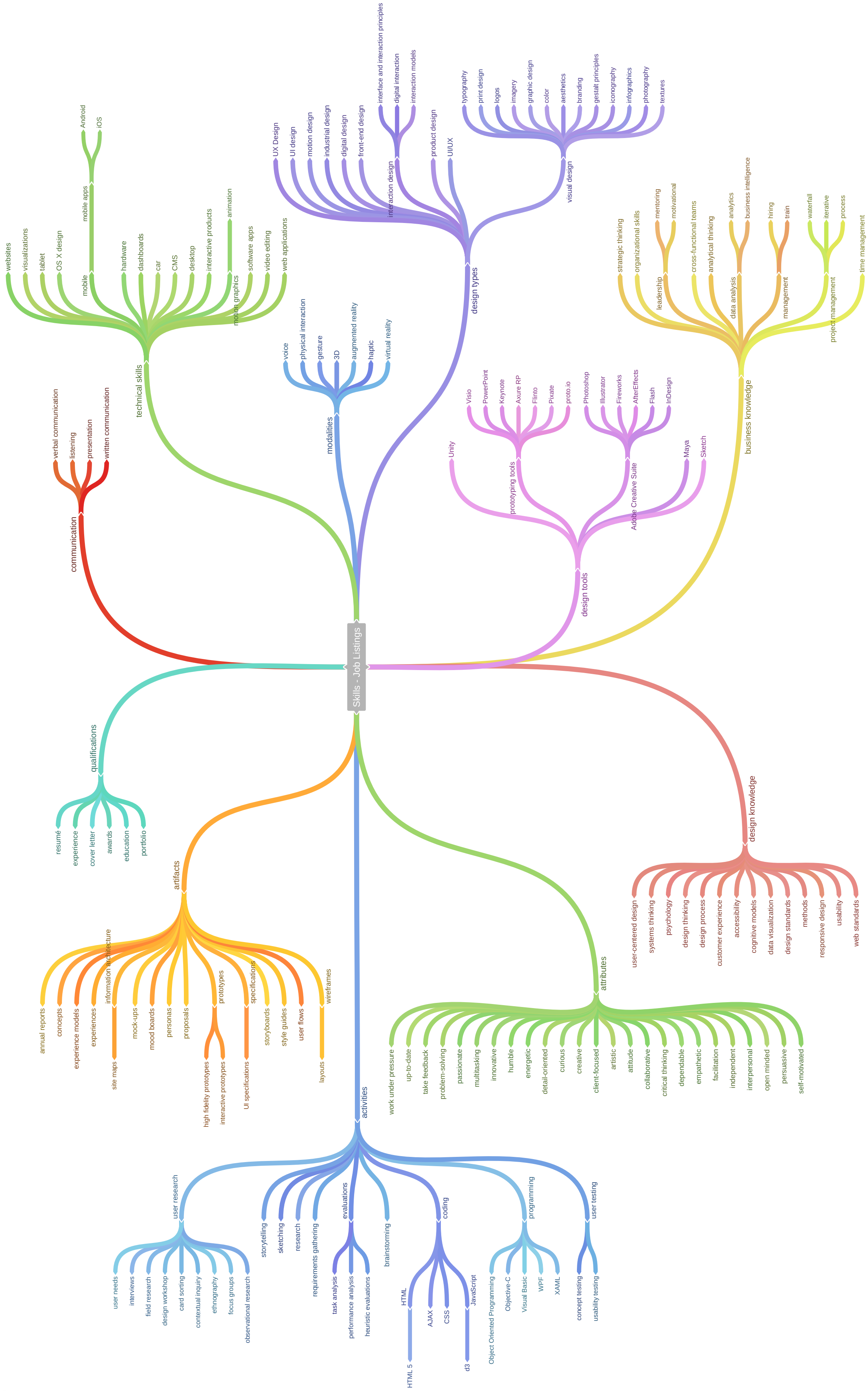
Appendix C: Interviewee Responses



Appendix D: Degree Program Competencies



Appendix E: Job Listing Competencies



Appendix F: WhatsaDesigner.com Competency List

Accessibility (ADA Compliance, Section 508, WCAG)
Adobe Creative Suite (Adobe CS)
Adobe Illustrator
Aesthetics
Agile
AJAX
Analytics and Data
Attitude/disposition
Axure RP
Balsamiq Mockups
Big Data
Building a Portfolio
Business Analysis
Business Development
Card Sorting
Case Studies
Client Facing
Cloud Computing
Cognitive Psychology
Collaboration
Communication
Compromise
Content Strategy
Copywriting
Creativity and Innovation
Crit sessions
CSS
Culture making
Curiosity
Customer experience mapping, user journey
Design documentation
Design studio
Design Thinking
Diary studies
Digital business administration
Documentation
Emerging trends
Empathy
Empathy and Communication
Entrepreneurship
Ergonomics
Ethnography
Expressing ideas
Eye tracing
Field studies
First click testing
Flexibility
Flinto
Focus groups
Front-End Development
Gamification
Gesture-based interactions
Git
Group work
Hierarchy
High Fidelity Mock Ups
High-Fidelity Prototypes
HTML
Icon Design
InDesign
Information Architecture
Interaction Design (IxD)
International scope
Internet of Things
Interpersonal skills
Interpreting data
Interviews & Interviewing
Javascript
Keynote
Leadership
Leading Meetings
Learnability
LESS/SASS
Listening
Longitudinal studies
Marketing
Mental Models
Mentoring
Mobile Interaction
Multi-channel/Omni-channel experience
Multi-device interaction
Observation
Omnigraffle
Open-minded
Optimistic
Organization/time management
Paper prototypes
Patternry
Persona Creation
Persuasive Design
Photography
Photoshop
Portfolio
PowerPoint
Preference testing

Preprocessors (grunt)
Presenting
Print & Layout Design
Privacy
Problem-solving abilities
Programming & Coding
Project Management
Prototypes
Prototyping
Psychology
Public speaking
Rapid prototypes
Reading & writing
Real Clients
Requirements Gathering
Responsibility
Responsiveness
Running Workshops
Scenario Design
Search Engine Optimization (SEO)
Selling
Sketch App
Sketching
Slack
Smart homes
Socio-cultural acumen
Software Craftsmanship
Stakeholder Management
Storyboarding
Strategy
Strong, clean visual design sense
Surveys
Taxonomy Design
Teamwork
Technical Writing
Time Management
Tools for Design (Illustrator, Photoshop, Sketch, etc.)
Tools for Diagrams, Flowcharts (Coggle.it, ConceptDraw, Visio, OmniGraffle, etc.)
Tools for User Research, Testing (Lookback, Morae, Silverback, UserTesting.com, etc.)
Tools for Wireframing, Prototyping (Axure, Balsamiq, Invision, OmniGraffle, UXPin, etc.)
Touch interfaces
Transversal vision and Curiosity
Tree testing
Typography (fonts, typefaces)
Understand screen resolution
Usability
Usability testing
User Experience (UX) Design
User Interface (UI) Design
User Research
User Testing
User-Centered Design (UCD)
UXPin
Verbal Communication
Visual Design
Visual Interface Design
Voice Interaction
Wearable tech
Web and Mobile development
Web Development
Wireframes
Wireframing
Work Ethic
Writing Specifications
Written Communication

Appendix G: Competencies

Design Domain

<table>
<tr><th colspan="3">Knowledge Facet</th></tr>
<tr>
<td>3D
Accessibility (Section 508, ADA Compliance, WCAG)
Aesthetics
Art Direction
Art History
Augmented Reality
Branding
Color Theory
Content Strategy
Design Patterns
Design Process
Design Standards
Design Thinking
Emerging trends
Ergonomics
Front-end Design
Gameplay
Gamification
Gestalt Principles
Gesture</td>
<td>Graphic Design / Visual Design
Hierarchy
Human-Centered Design
Industrial Design
Information Visualization (Infovis)
Interaction Design (IxD)
Interaction Models
Interface and Interaction Principles
Interface Design
Methods & Methodologies
Mobile Interaction
Multi-channel/Omni-channel experience
Multi-device interaction
OS X Design
Participatory Design
Persuasive Design
Print & Layout Design</td>
<td>Product Design
Responsive Design
Scenario Design
Service Design
Smart Homes
Software App Design
Tangible/Physical Interaction
Touch Interfaces (Haptic)
Typography (fonts, typefaces)
UI/UX
Understand screen resolution
Usability
User Experience (UX) Design
User Interface (UI) Design
User-Centered Design (UCD)
Virtual Reality
Voice Interaction
Web Design
Web Standards</td>
</tr>
<tr><th colspan="3">Skills Facet</th></tr>
<tr>
<td>Brainstorming
Concepts
Dashboards
Design documentation
Desktop
Experience Models
Graphical User Interfaces
High-Fidelity Prototypes
Icon Design
Infographics
Information Architecture
Interactive Products</td>
<td>Interactive Prototypes
Layouts
Logos
Mobile
Mobile Apps
Mock-ups
Mood Boards
Motion Graphics & Animation
Personas
Photography
Proposals
Prototyping</td>
<td>Site Maps
Sketching
Specifications
Storyboarding
Style Guides
Tablet
Taxonomy Design
User Flows
Video Editing
Websites
Wireframing</td>
</tr>
</table>

Tools Facet		
Adobe Creative Suite (Adobe CS) After Effects Axure RP Balsamiq Mockups CAD Crit Sessions Fireworks Flash Flinto High Fidelity Mock Ups Illustrator InDesign	Maya OmniGraffle Paper Prototypes Patternry Photoshop Pixate Proto.io Prototypes Sketch App Software Tools Tools for Design (Illustrator, Photoshop, Sketch, etc.)	Tools for Diagrams, Flowcharts (Coggle.it, ConceptDraw, Visio, OmniGraffle, etc.) Tools for Wireframing, Prototyping (Axure, Balsamiq, Invision, OmniGraffle, UXPin, etc.) Unity UXPin Visio
Attitudes Facet		
Artistic Creative Critical Analysis	Curious Optimistic Passionate	Problem-solving Take Feedback
Qualifications Facet		
Degree in Design	Portfolio	

Computing Domain

Knowledge Facet		
Big Data Car Interface Design Cloud Computing Computer Graphics Embedded Interactions Emerging Technologies	Front-End Development Hardware Human-Computer Interaction Internet of Things Object Oriented Programming Programming	Programming & Coding Software Craftsmanship Web and Mobile Development Web Applications Web Development
Skills Facet		
AJAX Android CMS Coding CSS D3	HTML IOS Javascript LESS/SASS Mobile Computing Objective-C	Technical Skills Technical Writing Visual Basic WPF XAML

Tools Facet		
Git Preprocessors (grunt)		
Attitudes Facet		
Analytical Thinking	Detail-oriented	Innovative
Qualifications Facet		
Degree in Computer Science	Degree in Engineering	

Research Domain

Knowledge Facet		
Customer Experience Ethnography Evaluation Evaluation Methods Field Research	Heuristic Evaluations Performance Analysis Research Methods Search Engine Optimization (SEO)	Task Analysis User Needs User Research User Testing
Skills Facet		
Concept Testing Data Analysis & Interpretation Interviews & Interviewing	Observation Observational Research Research	Tree Testing Usability Testing Web Analytics
Tools Facet		
Card Sorting Contextual Inquiry Customer Experience Mapping, User Journey Design Workshop Diary Studies	Eye Tracing Field Studies First click Testing Focus Groups Longitudinal Studies	Preference testing Surveys Tools for User Research, Testing (Lookback, Morae, Silverback, UserTesting.com, etc.)
Attitudes Facet		
Humble	Learnability	Open Minded
Qualifications Facet		

Business Domain

Knowledge Facet		
Agile Business Development Business Intelligence Case Studies Ethics Innovation	Iterative Management Manufacturing Marketing Privacy Process	Project Management Selling Strategy Systems Thinking Time Management Waterfall
Skills Facet		
Business Analysis Copywriting Cross-functional Teams Documentation Entrepreneurship Hiring	Mentoring Organizational Skills Presentation Presenting Public speaking Reading & writing	Requirements Gathering Responsibility Running Workshops Stakeholder Management Training
Tools Facet		
Keynote	PowerPoint	Slack
Attitudes Facet		
Client-focused Dependable Facilitation	Independent Multitasking Up-to-date	Work Ethic Work Under Pressure
Qualifications Facet		
Degree in Business	PMP Certification	

People Domain

Knowledge Facet		
Cognitive Models Cognitive Psychology Group work	International scope Leadership	Mental Models Psychology

Skills Facet		
Client Facing Communication Compromise Culture making	Flexibility Leading Meetings Listening Social Skills	Socio-cultural acumen Storytelling Verbal Communication Written Communication
Tools Facet		
Social Media		
Attitudes Facet		
Attitude/disposition Collaborative Empathetic	Energetic Interpersonal Motivational	Persuasive Self-motivated
Qualifications Facet		

Appendix H: Competency Counts for Job Listings

Design Domain

Knowledge Facet	
Interaction Design (IxD)	19
Graphic Design / Visual Design	18
User Experience (UX) Design	18
Design Standards	13
User-Centered Design (UCD)	12
User Interface (UI) Design	10
Usability	9
Methods & Methodologies	8
Design Thinking	7
Typography (Fonts, Typefaces)	7
Interface and Interaction Principles	6
Design Process	5
UI/UX	5
3D	4
Branding	4
Color Theory	4
Information Visualization (Infovis)	4
Product Design	4
Tangible/Physical Interaction	4
Touch Interfaces (Haptic)	4
Responsive Design	3
Accessibility (ADA Compliance, Section 508, WCAG)	2
Aesthetics	2
Gesture	2
Interaction Models	2
Print & Layout Design	2
Voice Interaction	2
Augmented Reality	1
Front-End Design	1
Gestalt Principles	1
Industrial Design	1
OS X Design	1
Software App Design	1
Virtual Reality	1
Web Standards	1

Skills Facet	
Mobile	15
Wireframing	15
Concepts	13
User Flows	13
Information Architecture	12
Interactive Prototypes	11
Specifications	11
Mock-ups	8
Layouts	6
Mobile Apps	6
Motion Graphics & Animation	6
Style Guides	5
Experience Models	4
Interactive Products	3
Personas	3
Sketching	3
Storyboarding	3
Websites	3
Brainstorming	2
Desktop	2
Icon Design	2
Site Maps	2

Dashboards	1
High-Fidelity Prototypes	1
Infographics	1
Logos	1
Mood Boards	1
Photography	1
Proposals	1
Tablet	1
Video Editing	1

Attitudes Facet	
Passionate	17
Problem-solving	11
Creative	5
Take Feedback	5
Curious	3
Artistic	2
Critical Analysis	2

Tools Facet	
Prototypes	19
Adobe Creative Suite (Adobe CS)	7
Axure RP	7
Photoshop	7
Illustrator	6
After Effects	4
InDesign	4
Tools for Wireframing, Prototyping (Axure, Balsamiq, Invision, OmniGraffle, UXPin, etc.)	4
Flash	3
Tools for Design (Illustrator, Photoshop, Sketch, etc.)	3
Pixate	2
Sketch App	2
Visio	2
Fireworks	1
Flinto	1
Maya	1
Proto.io	1
Unity	1

Qualifications Facet	
Experience	16
Education	15
Portfolio	13
Awards	1

Computing Domain

Knowledge Facet	
Programming	4
Web Applications	4
Hardware	2
Car Interface Design	1
Object Oriented Programming	1

Skills Facet	
HTML	8
CSS	7
JavaScript	6
Technical Skills	4
Android	3
IOS	3
Coding	2
WPF	2
AJAX	1
CMS	1
D3	1
Objective-C	1
Visual Basic	1
XAML	1

Attitudes Facet	
Innovative	12
Detail-oriented	10
Analytical Thinking	3

Research Domain

Knowledge Facet	
User Research	14
User Testing	10
Evaluation	4
User Needs	4
Performance Analysis	3
Ethnography	2
Customer Experience	1
Field Research	1
Heuristic Evaluations	1
Task Analysis	1

Skills Facet	
Usability Testing	4
Data Analysis & Interpretation	3
Concept Testing	2
Research	2
Web Analytics	2
Interviews & Interviewing	1
Observational Research	1

Attitudes Facet	
Open Minded	3
Humble	2

Tools Facet	
Contextual Inquiry	2
Card Sorting	1
Design Workshop	1
Focus Groups	1

Business Domain

Knowledge Facet	
Time Management	9
Strategy	7
Project Management	6
Process	5
Iterative	4
Management	2
Systems Thinking	2
Business Intelligence	1
Waterfall	1

Skills Facet	
Cross-functional Teams	15
Mentoring	10
Requirements Gathering	6
Organizational Skills	4
Presentation	3
Hiring	1
Training	1

Attitudes Facet	
Up-to-date	8
Client-focused	5
Facilitation	3
Independent	3
Multitasking	3
Work Under Pressure	2
Dependable	1

Tools Facet	
Keynote	1
PowerPoint	1

Listening	1
Storytelling	1

People Domain

Knowledge Facet	
Leadership	13
Cognitive Models	2
Psychology	1

Skills Facet	
Communication	16
Written Communication	12
Verbal Communication	7

Attitudes Facet	
Collaborative	22
Persuasive	11
Empathetic	7
Self-motivated	7
Attitude/Disposition	2
Interpersonal	2
Energetic	1
Motivational	1