Chapter 3.
What Practices Do Design Professionals Generally Value for Innovation and Sustainability?

Summary: In order to determine what designers, engineers, and design managers value in different sustainable design methods, some background should be established regarding what these practitioners value generally in their design process. Before design methods were analyzed or workshops taught, interviews with 27 professionals investigated what sustainable design practices should be studied here, what professionals actually use and why, how they measure innovation, and how they believe sustainability can be driven in their companies. After the workshops, an additional eight interviews with participants verified the earlier findings were consistent with the participant population. A total of 43 interviews were conducted with 42 designers, engineers, managers, executives, and sustainable design specialists.

3.1. Introduction

To guide this study and ensure that its findings would be useful to practitioners in industry, 45 professionals in design-related careers were interviewed about what design practices they value and why. These included designers, engineers, design team managers / executives, and design professors. The goals were to investigate what professionals actually use and why, how they measure innovation, and how they believe sustainability can be driven in their companies. Interview data were then compared to two questions from professional pre-workshop surveys, to check validity and generalizability.

The first goal, finding what professionals actually use and why, was motivated by a need to narrow down this research to a feasible scope, and a need to understand what professionals value in design practices generally. Scope-narrowing was required because many sustainable design methods exist—to many to study in depth in this research; however, few of these are used in industry, so it was helpful to narrow down the list of what design methods to study by asking expert practitioners for recommendations. Finding why practitioners value their present design practices was considered important to make recommendations they will find valuable in new design practices. Since the ultimate goal of this work is to improve the effectiveness and adoption of sustainable design practices, human-centered design suggests that the user needs (design practitioners' values in design practices) be understood first. Similar studies (Agogino et al., 2016), (Gericke et al., 2016) have found design practitioners of all kinds use brainstorming, requirements lists, prototyping, and other practices, but different demographics (e.g. designers versus engineers) often use their own job-relevant practices.
as well. Design practices have also been qualitatively categorized by what kind of value they provide in the design process (Roschuni et al., 2015).

The second goal, measuring innovation, was motivated by the inconclusive nature of the current literature on the subject. Indeed, even the definition of innovation is not universally agreed upon (Keeley et al., 2013). However, there is consensus that it is not mere creativity, but creativity involving products, services, or other technologies that affect the outside world, with the goal of being better than existing competition, especially in the form of financial success in companies (Anahita Baregheh et al., 2009). Many have proposed and tested methods for measuring innovation, but none are universally agreed upon. Perhaps the most widely cited in mechanical engineering design literature is Shah's system of measuring Quantity, Quality, Novelty, and Variety of ideas (Shah et al., 2003a), (Shah et al., 2003b). Several have refined or expanded on it (Verhaegen et al., 2013), (Nelson et al., 2009); Oman's “Multi-Point Creativity Assessment” (MPCA) uses only Shah's Quality and Novelty measurements (Oman et al., 2013). Other methods to quantify innovation in physical product design include “Sapphire” (Srinivasan and Chakrabarti, 2010), “linkography” (Vidal et al., 2004), Dieter Rams's 10 principles (Lovell, 2011), the “Creative Product Semantic Scale” (Besemer and O’Quin, 1986), (O’Quin and Besemer, 1989), (O’Quin and Besemer, 2006), simple idea quantity (Diehl and Stroebe, 1987), and self-evaluation (Kudrowitz, 2010). The goal of measuring innovation was also motivated by the intent to quantify the innovativeness of workshop results in this study, as discussed in later chapters.

The third goal, how professionals believe sustainability can be driven in their companies, was motivated by the need to contextualize the user needs (practitioners' general values in design practices, and their definitions of innovation) in their larger reality. This was to determine if there were external circumstances that sustainable design practices must overcome or fit into in order to be successful. For example, designers in consultancies may face different limitations and opportunities for their practices than executives in product manufacturers. Even designers in similar companies who work at different levels (e.g., industrial design versus product strategy) may face different limitations and opportunities (Gardien et al., 2014).

The 28 interviews of professionals not participating in any workshops also provided the study with a broader industry context, both geographically and for practitioner experience level in sustainability. Interviewees were from nine countries, including seven US states, and many have been practicing sustainable design for over twenty years, whereas most workshop participants were relatively new to sustainable design.

3.2. Methods

3.2.1. Participant Demographics

First, 27 professionals not participating in workshops were interviewed, to establish relevance to industry context. Then seven workshop participants were interviewed after
workshops, to check generalizability of professional sentiment by comparing those who participated in workshops against those other states and countries. Finally, ten participants were interviewed six to nine months after their workshops; these were primarily follow-up interviews asking about workshops, but also included questions described here. While these are small samples, others have shown interviews of ten to twenty people are sufficient to capture the preferences of a target audience (Griffin and Hauser, 1993). Note that two participants were interviewed twice (post-workshop and follow-up), and two participants shared one post-workshop interview, so there were 43 interviews of 42 participants. See Table 3.1 for all demographics.

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<tr>
<th>Int.#</th>
<th>Interview Type</th>
<th>After Workshop Type</th>
<th>Job role</th>
<th>Gender</th>
<th>Company Type</th>
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Table 3.1 shows that participants were comprised of 52% designers, 31% engineers, 40% managers or executives, 29% sustainability specialists, and 17% design professors (percentages here and elsewhere can add to over 100% due to people performing multiple roles, sometimes for multiple companies). They were located in nine countries, including seven US states, and were 33% female, 74% male, working 55% for large companies, 57% for small companies. Industry sectors were 40% consumer electronics, 10% furniture, 31% "other" (housewares, apparel, medical, etc.), and 31% "all" (companies who consult in a wide variety of industries). Company types included 74% consultancies, 21% manufacturers, and 21% universities; most manufacturers were large, while most consultancies were small (see Figure 3.1). Two participants were interviewed twice (#33 and #34), both for a post-workshop and follow-up interview months later. In terms of design methods, The Natural Step had four post-workshop and two follow-up interviews (6% and 3% respectively of the total Natural Step workshop participants); Whole System Mapping had five post-workshop and seven follow-up interviews (4% and 6% of the workshop's participants); Biomimicry had one post-workshop and three follow-up interviews (1% and 4%). Interviews were desired from a more balanced distribution of the workshops, but since participation was voluntary, it was not possible to control.

Figure 3.1 Interviewee companies, sorted by company type (product development consultancy versus manufacturer) and size ("small", below 100 employees, versus "large", above 100).

Figure 3.1 shows how product manufacturers in this study were primarily large (over 100 employees), while consultancies were more often small (below 100 employees). This was similar to the trend for workshop participants.
3.2.2. Data Collection

Most non-workshop interviews lasted 45 – 60 minutes, though two were 90 minutes and three were opportunistic five- to ten-minute interviews at a conference; the short interviews did not substantially change the results, but were included because their quotes were useful for qualitative insights. All post-workshop and follow-up interviews lasted 15 – 30 minutes. Most interviews were conducted by phone or Skype, but five non-workshop interviews and five post-workshop interviews were conducted in person, and seven non-workshop interviews occurred by email, due to schedule logistics. Full-text transcripts were analyzed wherever possible, but this was not possible for eight interviews, due to participants wishing not to be recorded, or due to poor recording conditions (e.g., opportunistic interviews at conferences); in these cases, written notes were used.

Interviews were semi-structured, with universal questions followed up for details. Interview questions for non-workshop participants varied over time, as some questions proved less fruitful than others, and exact phrasing of each question varied; question order was generally consistent but sometimes altered to adjust to conversational follow-up. For non-workshop interviews, the following questions were asked, in this order, of most interviewees:

- Tell me a little about yourself.
- How is innovation important to your business?
- How do you measure innovation?
- What design processes or methods do you usually use? What would you say are the activities / mindsets used in it?
- What do you value in those activities or mindsets?
- How do those drive innovation? (As opposed to production, or organization, or other business necessities.)
- Do you regularly practice sustainable design?
- What green design method or tools do you use? Why?
- How do those drive environmental improvements?
- If you wanted sustainability to provide a business value at your company, would innovation be your top choice? Or would other factors be more important, or more natural fits?
- Do you think designers can lead sustainability at your company? Or would management need to lead, and designers implement?
- What do you think would be the best way to test green design methods for innovation? More interviews, or workshops on green design methods, embedding in a company, or something else?
- Do you have anything else you would like to say?

In addition to these, early interviews contained questions asking participants to rate design practices using Cherry's Creativity Support Index (Cherry and Latulipe, 2014):
“On a scale of 1 – 10, how would you rate [this design practice] for collaboration, enjoyment, exploration, expressiveness, immersion, and results being worth the effort?” However, these were dropped for most interviews due to poor results (see Results section for details).

Post-workshop interviews were also semi-structured, with universal questions followed up for details. Exact phrasing varied, but overall the following questions were asked, in this order, of most post-workshop interviewees:

- Tell me a little about yourself.
- In the survey results, I noticed people said ______. What do you think about that?
- Did anything in the workshop give you innovative ideas? If so, what and how?
- Did anything in the workshop improve product sustainability? If so, what and how?
- Did anything in the workshop provide any other business value besides innovation or sustainability? If so, what and how?
- Do you regularly practice sustainable design?
- What design methods or activities or mindsets do you usually use?
- What do you value in those activities or mindsets?
- How do you measure innovation?
- Do you have anything else you would like to say?

Follow-up interviews, as earlier interviews, were semi-structured, with varied phrasing and questions by conversational flow, but overall the following questions were asked, in this order, of most follow-up interviewees:

- Has your team ever done anything like that workshop / those workshops before?
- Did your team pursue any of the design ideas from the workshop(s)? If so, what and why?
- Did your team keep using the method or any of the design activities or mindsets after the workshop(s)? If so, what and why?
- What do you think are the advantages and disadvantages of this design method / these design methods for your team?
- Did anything in the workshop(s) provide innovation? If so, what and how?
- Was anything in the workshop(s) useful for sustainability? If so, what and how?
- Did anything in the workshop(s) provide any other business value besides innovation or sustainability? If so, what and how?
- What do you think would drive sustainability most in your company?
- Do you have anything else you would like to say?
3.2.3. Analysis

Interview transcripts were analyzed by qualitatively coding each specific activity / mindset / method mentioned, sustainability-related, innovation-related, other business benefit-related, valued or criticized, and reasons why. Initial “open coding” of activities / mindsets and reasons for value or criticism were clustered into code categories for final coding. After clustering, 190 codes remained (33 value / criticism-related, 25 innovation-related, seven sustainability-related, five related to other business benefits, 89 design practices, 31 for questions and yes/no answers thereto). For example, ways of measuring innovation included “functionality”, “marketability”, “cost / profit of product / manufacturing”, “robustness”, etc. Reasons people valued design methods included “focus / clarify thought”, “visual”, “handling tradeoffs / priorities”, “collaboration”, etc.

MaxQDA software was used to quantify co-occurrences of these codes in text. For example, the interview text “Design Guides tend to have two effects, at least ones that I’ve observed. One is that it helps people pull out of their shell if they’ve forgotten to think about something, it allows them to think about it and explore it a little deeper” was tagged with three codes: “Design Guide”, “valued”, and “reason – focus / clarify thought”. The text “I would say the four system conditions were the most useful, because they give me a specific frame or lens through which to look that I would not necessarily have looked through before. So I think that was the most useful part from a sustainability point of view” was coded “sustainability-related”, “Four System Conditions”, “valued”, and “reason – new lens”. In answer to the question on measuring innovation, the text “first, I search for a solution and then in the next step I measure it against usability, and then the next step, I measure it against the doability in ways of production and in the next step, I think how expensive will that be” was coded “valued”, “Quality - ease of use”, “Quality - feasibility / manufacturability”, and “Quality - Cost / profit of product / manufacturing”. Such code co-occurrences were counted only once per interview, to avoid vocal minorities. Occurrences counted even outside of the specific survey question if the text related to that question, as interviewees frequently made statements relevant to multiple questions at once.

The lead author coded all interviews and determined coding rubrics, then four research assistants were trained in the coding rubrics using the three shortest interviews and one average-length interview, and the 39 other interviews were coded by both the primary investigator and one research assistant. One more round of negotiation was used to align coding rubrics between all coders, resulting in an intercoder reliability Cohen's Kappa of .82 for the results presented here. For quantitative analyses of code counts and code co-occurrences, binomial 95% confidence intervals were calculated by an Adjusted Wald method for higher accuracy at low numbers of participants (Agresti and Coull, 1998), (Bonett and Price, 2012). Differences in results were considered statistically significant if they differed from the mean with a p-value less than .05.

After all interviews were analyzed, they were divided into demographic subgroups to determine if different populations held different values. The demographics tested were job role (designer / engineer / manager / sustainability specialist), company type
(consultancy / product manufacturer), company size (large / small), gender (female / male), and industry (consumer electronics / furniture / apparel / other).

3.3. Results

3.3.1. Measuring Innovation

Most participants strongly emphasized the importance of innovation in their practice (“We market ourselves as innovation consultants... the entire focus of the firm, really pretty much every aspect we do here, is trying to find ways to help our clients be more innovative, to grow their brands predominantly through new products and new services.”) Despite this, however, not a single interviewee used any formal means of measuring innovation, much less any quantitative means, and several actively resisted the idea that innovation could or should be quantified. Instead, most listed general feelings for describing innovation; the frequency of these mentions are in Figure 3.2.

Figure 3.2 Frequency of interviewees reporting how they measure innovation (for all interviews, n=43). Error bars show 95% binomial confidence intervals.

Figure 3.2 shows the number of participants mentioning the different ways they informally define innovation, for all aspects mentioned by two or more respondents. Mentions were clustered primarily using Shah's definitions of quantity (number of ideas), quality (how “good” ideas are), novelty (how different ideas are from each other or the norm), and variety (how thoroughly a set of ideas traverses a possibility space) (Shah et al., 2003a). Thus, quality includes several good aspects of a product, including cost, functionality, aesthetics, robustness, etc. The only statistically significant finding was
that Quality was overwhelmingly the most important consideration for practitioners studied here, mentioned four times as often as anything else ($p=2\times 10^{-10}$ by total number of responses rather than respondents). Novelty was also important. Quantity was often mentioned, though many of these mentions were neutral or negative, not positive. Variety was only mentioned twice independent of questions from the interviewer; most people needed to have the concept explained to them, and some of those criticized it (“one of the mistakes I made as a young designer is that I thought I needed to be comprehensive, that I had to have ideas that covered the full spectrum. And that was really exhausting and left a lot of work in business sort of taking it forward.”) These results suggest that for academic metrics of innovation, Oman's “Multi-Point Creativity Assessment” (Oman et al., 2013), which only counts quality and novelty, may be more useful than Shah's because it is simpler and more targeted towards what design teams value. Finally, despite patents being an obvious measurement of innovation, they were only mentioned by two people; they are apparently not common for most design teams, perhaps because they are used for inventions, which are markedly more novel than incremental innovations (Faste, 1995).

When results were divided into demographic subdivisions (job role, gender, company type, company size, and industry sector), there were no statistically-significant differences. This may be due to small sample sizes (as shown in the Methods section, most demographics contained 10 – 20 respondents, but some were smaller: only one from apparel and four from furniture). However, results from surveys in later chapters with far larger sample sizes also showed nearly no statistically significant variation between demographics.

3.3.1.1 Qualitative Explanations of Innovation

Qualitatively, the reasons why practitioners valued or did not value these aspects of innovation were more complex. Quality was still overwhelmingly the most important; some said quality was their only goal, regardless of innovation (“Whether it's innovative or not, did it solve the problem in a fast, cheap, reproducible way?” or “it's nothing without problem-solving. If you don't have that, forget it, you're done.”) There will be more discussion on this below. The most-often mentioned aspect of quality was Cost / Profit (“The bottom line is profit”, or “how much did you save the client”, or “What's most important to the companies probably is going to be cost.”) Cost improvements also sometimes included sustainability improvements (“is it innovative that in the end it costs you less when you're not painting a part? Sometimes we even have that argument with clients, that you can actually save money by going green, but I wouldn't say that's innovation, that's trying to good for the environment while being good to your bottom line at the same time.”) As expected, other qualities such as functionality, user experience, robustness, etc., were also part of how quality was defined.

Novelty was often mentioned as a definition for innovation (“a little bit more new or novel”, or “have I seen that before?” or “If I'm familiar with it, then it's probably not super innovative.”) One design consultancy had a sophisticated distinction between
finding new solutions and finding new needs (for needs, “did you uncover a new need?” or “did you solve problems bigger than what you set out to solve?”) For solutions, “getting the experience right”, or “Were you able to solve a problem which would have been perceived as being impossible to solve?”) However, it was clear novelty alone was not valuable without also achieving quality (“people will be coming up with 20 novel ideas that are different than the original, but maybe don't solve the problem any better”, or “Hey, we came up with this new amazing concept people aren't excited by, or aren't exactly sure how to use... It's typically a big loss for us”, or “it's up to the client as to whether they're willing to take a chance on some of those really unique approaches because, well, no doubt the development cycle would be very expensive. And potentially fail. So it's rare that that level of innovation, the degree of uniqueness, if you will, achieves enough interest on the part of any engaging clients.”)

**Quantity of ideas** was often mentioned as being irrelevant to innovation (“Whether or not we generated 50 ideas to get to the one idea or three ideas to get the one idea is less material, than how the one idea itself is gauged”, or “we can come up with 20 all-good, relevant ideas, but maybe three of them are really novel, really unique, really strong. Someone else only comes up with 10, but eight of them are really novel, and really intact.”) The few people who valued quantity and explained why said that it was not an end in itself, but usually required to generate quality ideas or novel ideas (“you can't see the innovative idea until you start stepping forward with maybe less than innovative ideas. So this idea that you’re just gonna have the lightning bolt strike and you're gonna see this radical idea... That's a pretty rare experience. You usually have to do the hard work of stepping forward and seeing what you can see from that first idea and a second idea.”)

Other measurements of innovation included Surprise and Elegance / Simplicity. **Surprise** may be an extreme form of novelty (“I think product success is equal to the innovation, a little bit more new or novel or surprising so people would love it”); specifically, it may be novelty that provokes an emotional response (“you definitely also need some sort of, a-ha!” or “When you see the right solution, then you kind of go, Oh, wow! Of course. Why didn't we think of that earlier? This makes absolute sense.”) **Elegance / Simplicity** was not defined aesthetically, but functionally (“elegance in engineering issues, 'oh, that bike frame is elegant', [is] not form or aesthetic, it's just the use of the structure... I try to be an elegant functionalist, even with a lot of these needs, these technical, but also environmental and social aspects.”) It seemed to be the achievement of the most functional quality with the least complexity or effort (“the ones that I felt were really the most innovative and most successful, were the ones that struck this chord of elegance, that made it feel robust, but almost obvious”, or “I feel like simplicity and innovation tend to go hand-in-hand. If you can figure out a way to do something with less materials for cheaper in a more robust and elegant way, I feel like that's kind of the pinnacle to me, of an innovative idea.”)
3.3.1.2 Not Measuring Innovation

As Figure 3.2 shows, most interviewees do not measure innovation; many of these actively resisted the very notion of it. Some resisted because they believe it killed creativity (“Do you think Steve Jobs would use any of these? He would run away from these things.”) Others resisted because they believed it was pointless (“If it gets the attention & support of the CEO, it becomes a thing without numbers, or evaluating... We take it on faith... without any numbers.”) An engineering consultancy said it was not their job (“maybe this is a little cynical, but in our business the less innovation is probably the best. The value of our company isn't in our IP, it's in our ability to take someone else's [intellectual property] and make it a useful, desirable device.”) Some design consultancies believed innovation was too difficult to measure because circumstances differed so much between clients (“because everything we do is unique it's difficult to have consistent milestones or markers against which to gauge relative innovation”, or “We tend to, honestly, develop metrics for success with our clients, but it's very bespoke; it's per client, and it isn't necessarily about how innovative essentially are we, what needs and purposes are we trying to serve and how well are we doing that, and how can we all agree on what this looks like at the end of the day?”) Manufacturers also struggle, as one manager explained at length:

“From a historic perspective, people tried to measure effectiveness, like this many things happened, and even in our trade shows we'll talk about it. But now, there aren't hard numbers anymore, decisions aren't made with hard numbers, the hard numbers are almost color, if you will. So, decisions are made largely around getting people who make the decisions to prototype this and get the experience that you want, and... get the faith or knowing that this person can get it done.”

One respondent resisted measuring innovation by citing Faste's “fried egg” model of innovation, where ideas cannot be judged good or bad until tried (Faste, 1995). Several resisted because quality was their most important goal (“I've never tried to measure how innovative an idea is, to be honest because for me, it doesn't matter how innovative it is, it matters more how effective it's going to be.”) One said measuring quality is all that is needed, because improving quality automatically innovates (“you can't do the job without innovating, so I don't know how you could be more one than the other one.”) One explained at length:

“Innovation, in some sense, lost its specificity and meaning. Our clients are just everything from, 'I need a breakthrough in a well-trodden product or service' or 'I really need help' to 'I have no idea what's next. Help me imagine the future for my business to grow this sector.' And so... Fundamentally, it's about developing something that they think will provide good value and profit. It's always imperative to have a good profit for them, and good growth potential. ...I think for a while, they were coming with this hunger, in a sense, for, 'We want to be innovative, and by working with IDEO, we'll feel more so.' But I think, if you can't get
more concrete than that, people walk away at the end of the day not feeling very good.”

Finally, one criticized innovation from a cultural or environmental perspective:

“I hope, if this is part of your research, you're being critical of that whole idea of the kind of fetish of innovation... There are a lot of people that are exhausted from innovation for innovation's sake. ...I heard the term 'industrial cannibalism': the new products are devouring the old products. It's like this really terrible circle that we don't even give products a chance to root before we're already devouring them.”

Because of these criticisms, and the lack of industry or academic agreement on how to measure innovation, this research abandoned the notion of quantifying innovation in the empirical studies, instead relying on participants' self-reporting of what design practices drive innovation.
3.3.2. Most Valued Design Practices

Figure 3.3 Frequency of non-workshop interviewees (n=27) mentioning design practices they value, and whether they were mentioned as sustainability-related or innovation-related. Frequency of criticisms is also included.
Qualitative reasons why people valued the design practices in Figure 3.3 are discussed at length in section 3.3.4. “Why Design Practices are Valued, Generally”, below. Most design practices were valued for sustainability or innovation but not both. Quantitatively, 15% of these design practices were valued primarily for innovation (defined as more than 1/3 of mentions being innovation-related, but fewer than 1/3 being sustainability-related); 53% were valued primarily for sustainability (over 1/3 of mentions sustainability-related but not innovation-related); 17% were valued for both (over 1/3 of mentions for both). Design practices valued for both sustainability and innovation were Systems Thinking, The Natural Step, Analogy, Company Culture, Whole System Mapping, and Natural Capitalism / Factor Ten Engineering. Cradle to Cradle Book / Idea and Biomimicry also had several interviewees mention them as innovation-related; they only failed to reach the 1/3 cutoff because people mentioned valuing them more often than most other design practices. These results do not carry statistical significance, but helped inform the qualitative research below. Note that while differences by demographic did appear, such as sustainability experts valuing green design methods, they were not statistically significant due to small sample sizes.

Note also that some design practices were mentioned as sustainability-related more often than they were mentioned as valued; these were being criticized. No practices were mentioned as innovation-related more often than they were valued. Perhaps driving innovation is always valued; such questions are outside the scope of this study. Some design practices were simultaneously often valued and often criticized, such as LCA and Biomimicry.

Before analyzing qualitatively, the reliability and generalizability of the 27 interviews in Figure 3.3 were checked against pre-workshop surveys, which also contained a question about what design practices people valued. These results are shown in Figure 3.4.
Figure 3.4 Frequency of pre-surveys from professionals (n=183) mentioning design practices they value.

Figure 3.4 shows much overlap with Figure 3.3, but there are substantial differences as well. The largest overlaps and differences between interviews and pre-surveys are shown in Table 3.2. Also note that no pre-survey respondents made any critical / negative comments, and almost none made any comments about the sustainability or innovation value of the design practices they mentioned. This may be due to the curtness of survey responses—simple lists of a few words rather than conversations, generally 1/10th – 1/100th the length of interview responses.
Table 3.2 Comparison of design practices valued in interviews versus pre-surveys. “Often” = five or more mentions for interviews, ten or more mentions for pre-surveys. “Sometimes” = two or more mentions for either interviews or pre-surveys.

Table 3.2 shows that many traditional design practices were often mentioned as valued in both interviews and pre-surveys, or sometimes mentioned in both. This included the prevalence of “Other” practices in both, showing the wide variety of tools design teams employ. These ranged from specific branded methods, sometimes sustainability-related (“Datschefski’s Total Beauty”, “Nine Windows”, and “Roger Martin’s strategic planning framework” among others) to generic but practical activities (“implementation”, “clustering [ideas]”, “user segmentation”, “work very closely with the engineers”) to individual creations (“my own approach, too, that's based mostly on my books”) to vague generalities (“intuition”, “prove if it's a valid idea or not”, “problem solving”). They varied widely in type of intervention, from conceptual to product-specific to personal or organizational (“more formal mentoring”, “going to the factories”, “put together a final presentation”, “inspect the materials”, “prove if it's a valid idea or not”, “changing up that whole pecking order”), and more).

The main difference Table 3.2 shows between interviews and pre-surveys was that interviewees often valued sustainable design practices that survey respondents did not (Green Goals / Strategies, LCA, Cradle to Cradle Book / Idea, Biomimicry, Systems Thinking, The Natural Step, Design Spec / Brief, Green Certification, Green Design Guide, and Custom Method / Combination). This was likely due to a difference in sampled population: non-workshop interviews included sixteen sustainable design experts (59%), while workshop participants (and thus pre-survey responses, post-workshop interviews, and follow-up interviews) contained negligibly small percentages of sustainability experts. This exemplifies the fact that sustainable design is a niche skill, and underscores the motivation of this research to bring sustainable design practices to more students and professionals.
3.3.3. Why Design Practices are Valued, Generally

Figure 3.5 Reported frequency of reasons why participants value design practices (for all interviews, n=43). Error bars show 95% binomial confidence intervals.

Figure 3.5 shows the most often-mentioned reasons why interviewees valued the design practices they mentioned. For all graphs, error bars show the binomial 95% confidence interval. The only statistically-significant finding (p=0.07 by total number of responses rather than respondents) was that a design practice’s results (quality of ideas, quantity of ideas, novelty, and surprisingness combined) were the most common reason for valuing a design method, activity, or mindset (“just if you're producing good ideas. If it's conducive to producing more ideas, more quality ideas.”) While differences by demographic did appear, they were not statistically significant.

3.3.3.1 Qualitative Explanations of Values

**Design Results** were valued for different reasons, as mentioned above: “quality” included meeting user needs, functionality, marketability, aesthetics, robustness, and ease of use (“What I value is delivering something that makes sense for the user”, or “like any brainstorm, 'cause this is what we do all day, morning and night. Here's a product, how can we make it better? How can we create a better user experience?”) These, as well as quantity of design ideas, novelty, and surprise have all been discussed above in
measurements of innovation. Sometimes consultancies valued design methods not only for the marketability of the ideas they generate, but the firm's marketability to clients (“when we're picking and choosing the way in which we attack problems, we have to both describe a methodology which we think is gonna yield clever and interesting and innovative results, and also get our client excited and intrigued enough to select us versus some other alternate marketplace.”)

**Enjoyment / Interest / Inspiration** was a popular reason to value a design practice for the process itself (“are there sparks flying?” Or “just make us learn faster, get inspired more thoroughly, 'cause everybody just gets more engaged”, or “engagement in brainstorming, engagement in the general design conversations is an important metric, not so much for our client success, maybe just for how we're doing as a company, how we're engaging our employees and making sure that they're growing and enjoying what they're doing.”) Amusingly, however, two people actively resisted this notion (“making it fun is never on the radar”), so it is not a universal value.

**Collaboration** was another value of the process itself, valued for two reasons: First, aligning the design team among themselves (“it certainly has the effect of giving people a sense of ownership and giving people a common vision because they develop the vision together”, or “it helps the conversation between designers and engineers to make sure that everyone understands, why something is happening.”) Second, for consultancies, aligning the design team with the client (“we're not designing our own products, we're designing for other people and all those decisions require convincing them, the client, that it's worth the time and the money to pursue these goals which they don't realize, which they might not have in their personal goals for the project.”)

Other process-related values included **Clarifying Thought** to dig deeper into specific details of a problem, a **New Lens** or new perspective to reconsider problems, and **Broadening Scope** to see problems from a bigger picture view (all quoted later for specific design practices). Simple expedience was also valued (“in a perfect world, enjoyable and collaborative and maybe learning something new would be the most important things, but in reality it is easy to use, fast results.”)

### 3.3.3.2 Cherry's Creativity Support Index

Attempts to use Cherry's Creativity Support Index (CSI) to rate design practices failed, for two reasons: First, interviewees often contradicted themselves in the process of rating different aspects of design practices, and comparing design practices against each other, and found it generally too confusing (“I've already forgotten the six categories that you mentioned before and I think the complication of that makes it more difficult for people to get on board with it. So, I wouldn't go that route.”) Second, some interviewees disagreed with Cherry's premise that all design practices can be measured along the same spectrum, where there is only one set of coefficients for how important collaboration is versus immersion, expressiveness, etc. Rather, they said different design practices were good
for different reasons ("I would absolutely weight them differently, and almost in some cases, completely opposite, depending on what's being done", or "an important skill of a team leader is to set that rhythm up and recognize when it's time to work together, and when it's time to split apart for a while. ...there's also an element of what kind of a design problem it is. In other words, is it a problem that lends itself to parsing out different challenges? Or is it a problem that really has to be integrated?") For example, expressiveness is useful for divergent stages of design, but not for convergent stages; collaboration is useful for some activities but not others, where individual focus is more important. These contradictions can be exacerbated for sustainable design, as its specialization means practitioners of different skill levels need different tools:

"Different people are at different points. In the beginning of someone's journey, awareness alone is golden because if you don't make people aware of these things, they won't ever even learn more. So that's a really important thing that we raise awareness around all of these issues without hopefully overwhelming someone. The next step is that a lot of these tools actually are action-oriented, and they give you a place to start... In one hour, you can remind someone of important things that maybe fell out of the process or fell out of mind, and put them back on the table. That's super important, too. And then the next level is if they can help step people through these processes so that better decisions are made, especially helping designers step through their peers through these processes, that's golden too. At the very least, most of these tools and not just on the sustainability side but the design tools in general, they're confidence builders. They help a designer walk into a meeting with engineers and accountants and CEOs, and confidently address issues that are important to those people while bringing up issues that those people may not have even considered. And so sometimes, if that's all the value that's being added, that's still not so bad."

CSI still no doubt provides valuable insight on what practitioners value in design practices, and some interviewees mentioned aspects of it unprompted ("we definitely measure the engagement and the efficacy"), but this research was not able to use it as a rating system to compare design practices against each other. While this seemed disappointing at first, it actually reinforces the premise of this study, that designers will benefit from finding what components of design practices are valued and why, so they can combine the best tools for different jobs in sustainable design.

3.3.4. Why Specific Design Practices are Valued

Understanding when and why to use each design practice, as well as when and why to combine them with other practices, requires understanding why each practice is valued. Unfortunately, pre-survey responses were not useful for determining why practitioners valued general design practices; although the survey question did ask why, responses
were curt (generally $1/10^{th} – 1/100^{th}$ the length of interview responses), merely listing design practices with no explanation. Of all 183 respondents, only five listed any explanation that could be categorized as either innovation-related or sustainability-related. Future surveys on this topic should likely ask separate questions for what and why, to elicit more verbose responses. Therefore, these qualitative results come entirely from interviews. Because the number of interviews was more limited (43), no reasons for valuing any activity, mindset, or method were mentioned often enough to quantitatively determine the top reason; still, enough data was gathered to qualitatively list reasons mentioned. This section describes why interviewees valued the traditional design methods most-often mentioned positively by both interviewees and pre-survey respondents. These are Brainstorming, User Needs / Empathy, Prototyping, Human-Centered Design, Design Thinking, Research, and User Testing. It also describes why interviewees valued the sustainable design methods most often-mentioned positively: Green Goals / Strategies, LCA, Cradle to Cradle Book / Idea, Biomimicry, Systems Thinking, The Natural Step, Design Spec / Brief, Green Certification, and Green Design Guide. Because Custom Method / Combination was mentioned more often than any one sustainable design practice, its importance will be discussed after each individual practice.

3.3.4.1 Traditional Design Practices

**Human-Centered Design** (d.school, 2013) was valued for collaboration (“They provide a taxonomy that we could share with our clients and our co-workers, to both level up people on expectations and activities and paths”), in addition to all the values of its component activities and mindsets, listed below. While **Design Thinking** (d.school, 2012) was valued, no respondents described why. **Brainstorming** (Osborne, 1953) was valued for the quantity of ideas it produced (“Working as a group, as you know, we're much better than the sum of our parts and so you might get 100 ideas instead of the 15 that you would spend all this time and energy as an individual trying to generate.”) It was also valued for producing novel ideas and for the ultimate goal of one high-quality idea:

“This one's a brainstorm, I need a lot of ideas because I want to make sure that I'm not being closed-minded about this. So, what I value in the initial brainstorm is the variety [referred to in this paper as “novelty”] of ideas and the quantity, right? I want a lot of them, and I want them to be very different from each other, because what I'm really trying to do, trying to spur an idea in my head that will eventually lead to that simple elegant solution that I'm talking about. But generally, to get there, I take that massive spider web of ideas, and take a couple of key metrics that matter most to the project, and try and weed out the ideas that matter most. To me the ones that I think would work better than others given those constraints.”
Brainstorming was also valued for collaboration ("We're a small group and we work well collaboratively, and you come to, you arrive at some great solutions because everybody sits down. No one's afraid to contribute or share their opinion for that reason. Everyone has a voice.") During this study, a related discussion on a public design-related email list occurred; while the discussion was not analyzed here due to privacy concerns, one manager said Brainstorming's collaboration value is more important than the actual idea generation ("I use brainstorming to get people aligned about the problem space, not to solve it... Getting a useful idea out of a session is nice bonus.")

**User Needs / Empathy** (Patnaik and Becker, 1999) was valued for focusing / clarifying thought ("we certainly can ideate or innovate in a space that you're totally unfamiliar with, so it's interesting as well as critical to undertake an adequate research or get smart phase where you can get into the client's shoes and maybe quite importantly get into the shoes of the people who are going to be the client's customers.") It was also valued for exploration ("I've never been tempted to go into industry and work for a manufacturer because I will lose the opportunity to design stuff I have no business to stay in and learning about stuff I don't have any knowledge of. So that's one of the payoffs if you're talking about what I value.") More general **Research** was valued for reframing problems and thus helping drive innovation ("the more you understand what's going on and understand the problem and the components, to me that frees me up to be more innovative because now I can understand what I'm trying to solve.")

**Prototyping** (Agogin et al., 2016) was valued for allowing user testing ("the real value for our clients is really almost doing rapid build of environments so that they can role play what a service or experience can be like in really rapid ways they couldn't do internally.") **User Testing** (TheDesignExchange, 2017a) was valued for feedback to guide design direction ("good designers just intuitively understand it, like, I need to stop designing and get feedback.").

**Defining / Reframing the Problem** (TheDesignExchange, 2017b) was not the most mentioned, but was valued very emphatically by those who mentioned it ("reframing, which is the most important step", or "reframing is the most important thing to me about design. It's a thing that sets design thinking apart"). It was also sometimes mentioned as part of people's definition of innovation because it provided a new lens ("when I see a solution, that I can tell they went inside and understood the problem underneath and then they redefined it, in a different way, and that solved the real problem. And you could have something that's totally different than where you started, and a good process does that.") Finally, Reframing was explicitly mentioned as a traditional design tool that greatly helps sustainable design:

"The design process says, 'Well okay, first thing you do is now that you have a better understanding of what the context is, check your assumptions.' And that's what reframing is, right? Are we really supposed to be designing a better car here? Or maybe, we should be thinking about transportations at large. Maybe they don't need a car. Maybe they need access to a car. They need Uber or they need car
sharing, or maybe it's a motorcycle. So that reframing thing is right there in design process, but now you're pulling in all your sustainability context, as well as the other market context that designers hopefully do anyway.”

3.3.4.2 Sustainable Design Practices

**Green Goals / Strategies** included any eco-design outcomes, such as recyclability, energy efficiency, material use reduction, non-toxic materials, etc. No interviewees mentioned reasons why their green goals / strategies were valued, interviewees simply listed sustainability considerations they use (“We'll think about materials and flexibility, and trying to eliminate processes that use bad materials or ...create parts or assemblies that are not recyclable or that have poor end-of-use”; other lists included “workers' rights, carbon footprint”, “design for recycling, energy efficiency”, “avoid painting the plastics”, etc.) They were not valued for innovation (“none of that is really innovation, I don't think, those are just best practices to be sustainable.”) They may be valued for simplicity, so design teams can aim for sustainability targets without learning new skills or spending billable hours on sustainability-specific activities; or they may have seemed so obviously beneficial to interviewees that their benefits did not require explanation.

One designer criticized Green Goals / Strategies for being short-sighted (“We're always looking at sustainability or recyclability of specific materials and all that stuff. But without that Whole System Mapping approach, we never look at how things end up early on in the process or way down the road when things are thrown away and recycled, and things like that. ...And so this definitely seemed like a better way to look at it than in just our immediate view.”)

**Life-cycle assessment (LCA)** (Guinée, 2002) provided the most unique value compared to other green design practices: making the consequences of design decisions concrete (“ultimately, you're relying on the kind of goodwill and desire of the designer to do things that are net positive for the world. And so the only way you can know whether they're net positive is to have visibility... [of] how your decisions are impacting the environment. And so, just as with that life cycle analysis tool, the ability to understand in immediate ways the impact of certain decisions in a very kind of actionable way.”) One benefit of making consequences concrete is clarifying priorities to decide between tradeoffs (“because the client said, 'Oh, wow! I didn't realize that this aspect of the device was so impactful,' they gave us the green light to start focusing on combining and simplifying that area”, or “How about we do the relative trade off of those two things? ...The Natural Step definitely helped to identify some of the actions that are contributing, but it didn’t... at least to me, it didn't really identify the relative benefit taking each one of those actions... I think that LCA... That's tangible, that you're gonna spend an extra million dollars but you're gonna get this benefit.”) LCA was also valued for being immersive (“if I want an engineer to really care about a project and they do the LCA on it, they are in it and that's up to their eyeballs, so, super immersive.”) However, many people criticized LCA for being difficult and expensive in time (“life cycle assessment is often a really big effort”, or “I have no time for LCAs.”) Whether it is worth the effort depends on circumstances (“the results can be worth the effort, but only if people who
are calling the shots agree to it. So you can spend a lot of time on an LCA, show it to a client and they say, wow, that's interesting, and then nothing changes... it really helps focus in on the right part of the design and it can be extremely effective. But in the wrong hands, I think it can be an exercise that's almost just done just to go through the motions, to say they did an LCA, and then not do anything with it.”

**Cradle to Cradle Book / Idea** (McDonough and Braungart, 2002) was valued for its simplicity (“Cradle to Cradle, that was just, it’s more cut and dried”). This simplicity allows for ubiquity in the design process (“Cradle-to-Cradle, I guess that's just kind of always a part of what we're talking about.”) It was also valued as a new lens (“avant garde thinking”, or “They contribute different things into the wider conversation. For instance, Cradle to Cradle contributes this idea of upcycling, and separating technical nutrients from natural nutrients.”) It was criticized for being too abstract, as with many sustainable design practices (“I don’t see Cradle to Cradle or Natural Capitalism, or to some extent even Natural Step as being more than, here is an inspiration, a conceptual guideline to apply to our innovation, but now where are the tools to use during the innovation process that's gonna help us innovate sustainably as well as in the marketplace?”) Note that Cradle to Cradle Book / Idea did not refer to the certification, which was less-often mentioned and is included below under “Green Certification”.

**Biomimicry** (Benyus, 1997), (Baumeister et al., 2013) was valued for being a new lens, which drives innovation (“You discover things with Biomimicry, you realize you would have never been in that neighborhood without using it”, or “The one that brings out the most surprises and different things was the Biomimicry one.”) This innovation value was even mentioned as helping design consultancies market themselves (“Having another way to look at problems and come up with ideas, especially if it's something that we can do in front of clients when we're brainstorming, is great. Like coming up with ideas that are feasible or sound good and are also really off the wall, proves our value in front of clients, or in front of other partners or vendors. So that's a good tool to have, for sure.”) It was also valued for being a simple and inspiring idea (“you can learn about Biomimicry and read a couple of examples and be inspired to do something”, or “biomimicry was the one that made the most sense to me.”) However, as Figure 3.3 shows, Biomimicry was often criticized, usually for difficulty or unactionability (“there's the rub of, okay, but what does it take to actually make it happen? ...he's super passionate around biomimicry and really wanting to make impact, but he found that in the context of these workshops, they weren't seeing the actual tangible change was making it to market. And so he was feeling frustrated by that as well.”) Even some who valued it also mentioned its difficulty (“I say it's not faster. It actually takes time... but I say that what it will do, it'll open up avenues that you had never considered and it's gonna lead to radically new innovations. ...It won't even be cost saving up front, because it'll spend more time on your research. But it could be a game changer for you.”) Many interviewees valued Biomimicry as driving sustainability (“I start with the Biomimicry tool and the Life's Principles... because that side's the innovation side. That also tends to drive, when you look at it deeper, it helps drive sustainability. Because, if I may, I can do more with material and shape by not using new material.”) However, several interviewees, especially engineers, explicitly mentioned it not helping sustainability (“I
learned a lot from biomimicry, and I see it as being very useful, but I didn't see a direct connection between that and sustainability.”) Or, at greater length:

“I don't agree that biomimicry should be in as part of the sustainability discussion. ...if I mimic something, but man it's destroyed the environment 'cause I've got to do this chemical process to get those little gecko foot pads. ...For me as an engineer, biomimicry is probably the most interesting one just from a mechanism point of view, or new materials, or new processes point of view.”

**Systems Thinking** included any generic reference to thinking on the systemic level. It was valued for broadening scope, to define the problem well (“each one starts with whole system thinking, and we sit down and we say, okay look, here's what we're trying to accomplish. Are we focusing on the right problem in terms of addressing the impact of this? Let's sketch it out, let's make sure that's we've got our sights pointed in the right direction.”) It was also valued as a new lens for innovation ("I do cooler, weirder, groovier things, having known that, than I did before... having a solid understanding of systems thinking methodologies, and several of them, not just one, is very freeing to know what my limits are, to know where I'm starting.") Systems Thinking was also valued for collaboration ("I'm not an engineer. But I can sit there with Pepsi and Dole, and whoever the heck else, and their management crew and VPs and everything else, and talk about... what this could mean in the bigger picture, and how it works on production, and that kind of stuff, but without systems thinking methodologies, there's no way I could do that, no way, absolutely.") Systems Thinking was also valued in traditional design, not just sustainable design (“we talk about systems and processes with our clients quite a bit but for the most part, those are human systems, idea systems”, or “I always think about the people who're using it and in the whole system, kind of that... you can afford it, and then you can handle it, and then it does what it should.")

**The Natural Step** (Robért, 1991), (Baxter et al., 2009) was valued for focusing thought ("I do that exercise a lot, and I find that's a common resistance point for everybody, in that exercise, is, everybody goes fuzzy. I do it all the time. And I have to seriously force myself to get really concrete.") Many design practices were valued for that, but the Natural Step was the only design practice valued for focusing thought on envisioning perfection ("You just clearly articulated what a sustainable future looks like in this particular segment of the world, and now that you've actually articulated what it looks like and doesn't, I can actually see gaps. Because by saying something is sustainable in and of itself, it's almost meaningless, I don't know what that means. It's a nice idea, but until it's made more concrete, I can't do anything with it.") It was also valued for providing a new lens ("I would say the Four System Conditions were the most useful. 'Cause they give me a specific frame or lens through which to look. That I would not necessarily have looked through before.") This can also drive innovation ("to be honest I hadn't really considered the social justice row a whole lot before today at all. So, that is definitely, as a whole... As a whole category, that counts as innovative for me.") The Natural Step was also valued as a structured process (“Imagine, just like us, everyone in that room was very much concerned about the environmental... impact that humans are
having. I think maybe we're enjoying being ignorant. Our actions are contributing to that. So now that we have this formal structure, I think we have a better way to talk to our clients and say, you know what? I'm sure you guys care about this stuff too, you just don't really know what it takes."

**Design Specifications / Briefs** were any generic reference to codifying sustainability goals in company design requirements documents. They were valued for committing teams to sustainability, but most interviewees mentioned it hypothetically ("what we frankly should be doing is building it into our project plans, but once a proposal is written and approved then it becomes difficult to inject new efforts that may have cost attached to them", or "In the consulting world I think the biggest driver would be if we were able to either have it come directly from the client or have it directly written into the scope of work. I think that would be the biggest thing that would allow us to actually implement it."). Few mentioned it being regular practice ("Sadly, I don't think we've had a single client who's really come to us with a sustainability requirement. They've come to us with a certification requirement, we need to now comply with RoHS, we need to pass the CE directives.") Such specs can even cause resistance from clients ("I think at some point we were trying to write the sustainability aspect into every proposal, and some clients are interested and some clients aren't... they see it as a cost, they don't see it as an opportunity, that was a challenge.") However, sustainability requirements in design briefs may drive innovation ("any time you're considering new materials for instance or new sources or new assembly methods, new technologies, it has a trickle-down effect because it affects everything else in a complex assembly... So I think to the extent that they become not optional, they force innovation.")

**Green Certifications / Scorecards** included any sustainability scoring system, such as Cradle to Cradle Certification (MBDC, 2012), EPEAT Certification (IEEE, 2009), the Wal-Mart Packaging Sustainability Scorecard (Wal-Mart, 2006), etc. Certifications were valued for providing the business value of marketability in products ("gives the user pride in buying, if they have the option between one which is not certified at all and which is platinum. And it comes to a point where they say, okay, I am willing to pay $5 more for the iPhone which is platinum certified.") They were also valued for aligning teams ("It's made working with engineers a lot easier, because I can walk in and say, 'Are you prepped for scoring against the scorecard?' They're like, 'Yeah, yeah, we're set.'") If certifications / scorecards were used by companies dominating an industry, they were valued for being powerful market-drivers ("when Wal-Mart initiated their packaging scorecard in 2006, it completely changed my industry... Even clients that I have that don't sell to Wal-Mart, we're still affected by what Wal-Mart has. In fact, I have no clients that sell to Wal-Mart. But we're still affected by the Wal-Mart scorecard, because that affects our suppliers.") However, they were also criticized for being expensive ("The problem with the [Cradle to Cradle] certification is it's so expensive that only the largest companies can even participate, which limits its ability to have any impact.")

**Green Design Guides** included any published list of design for sustainability guidelines, such as Living Principles (Brink et al., 2009), the Designer's Field Guide to Sustainability
by Lunar (LUNAR, 2008), Okala Practitioner (White et al., 2013), and others. They were valued for being easy yet comprehensive (“I've found that they're the most effective, because they're sort of easy. They're easy, but they're persistent, and they're omnipresent. So, they don't only apply at one stage of design. They apply at all stages of design”, or “They are sort of simple metrics to use to remind the person designing of what they should be thinking about. So I kind of like it, because they cover a lot of bases, and they're not just relegated to one specific portion of the design cycle.”). They were also valued for providing a structured process (“they provide a structured methodology to get the process started and to prevent individuals and processes from falling into vapor lock”, or “it can actually kind of create entrenched workflows, where people start to do the same thing over and over again,” or “It tends to compartmentalize the things that seem really big to them, right? It's a lot of stuff to think about, and something that helps them organize that and makes them feel like they've got a handle on it, people just seem to enjoy that a lot and to have conversations about it.”) Combined with the structured process, design guides were also valued for focusing thought (“kind of checking off the list, did I think about this? Did I think about this? Did I think about this?” or “I think it encourages people to explore the nooks and crannies they haven't been thinking about, like the sort of nuts and bolts details; and that starts to get them thinking about it in a lot of different points of contact”, or “Probably most of the tools are the same, the value is having someone prod you to ask the questions that you need to be asking. And outside of an LCA, that's really the chief value of all of these things.”)

In addition to these most often-mentioned practices, a sustainable design practice mentioned only moderately often but relevant to the rest of this study was Whole System Mapping (Faludi, 2015), (Faludi et al., 2010). It was valued for collaboration (“Whole Systems Thinking in my experience has been super collaborative”, or “really gives people the ability to sort of express their thoughts about the project itself, to communicate what's important to take in or what they observe as important in the impact. I like that a lot.”) One value of this collaboration is aligning teams (“they're good for kind of a cross disciplinary team in understanding what other portions of it do. The Systems Mapping is especially good for this because... it helps the conversation between designers and engineers to make sure that everyone understands why something is happening. We say that we shouldn't do this because it's going to be more expensive or it's going to be more harmful. We can say this is why and then maybe we can get a conversation going about what we could do besides that. It's kind of like a team building bridge almost.”) Whole System Mapping was also valued for focusing thought; this came from the Draw System Map activity, as did the value of being visual (“When you are able to map it out in a visual way, it makes you really understand what's going on. So, for the next time you do it, you are going to have that memory stored away. This caused this problem, this caused this problem, I remember seeing it. So, for visual learners, it definitely helps out that way. I think the mapping is crucial for that. The second thing is to make sure you haven't missed anything.”) Focus also came from the LCA activity (“From the engineering side of it, it gives us something we can latch on to and just fully get behind and point to a number and say this is why.”) However, one interviewee mentioned limits to its quick-and-dirty LCA that would drive them to use proper detailed LCA (“I think it gives the opportunity to identify lots of ideas, but not
really to explore any of them, because it's like looking at a map and saying, 'Hey, these countries exist.' These countries exist, but actually going to them and putting your boots on the ground, I think you kind of need some of these other tools to do that.

3.3.5. The Importance of Creating New or Combined Sustainable Design Practices

Participants describing both traditional and sustainable design practice both showed an extreme prevalence to not use just one design method, but use several (“I kind of pick and choose, I'm a salad bar”, or “Each designer has their own special tool belt or toolkit that they'd like to carry with them to every project.”) This was true both for teams and individuals (“I'm so often designing on my own that it's all just mixed together and intuitive more than anything else.”) This was especially true for sustainable design practice (“We are building a website as a resource for Swedish designers with different methods [for sustainability], and it seems like the design companies I have talked to have looked at different resources and then developed their own guidelines.”) Respondents also spoke of the importance of combining sustainable design practices with Human Centered Design or other traditional design practices.

For traditional design practices, practitioners combined them because their needs varied by time or project (“Everybody sort of has a gut feel for what's the right tool for now”, or “We don't really have any tools or any upstage battle that we follow. It's like idiosyncratic or just recognizing opportunities.”) Design consultancies also combined practices due to the bespoke nature of their client work (“each of our projects tends to be so different that it's not that we have a checklist of, here are the activities that we must do”, or “we very much follow a framework, but there's a lot of variability within that framework. So it's not a cookie cutter mold, but we know we're going to make cookies.”) Sometimes mixing methods was not only for problem-solving, but also for marketing their services (“every problem is a little bit unique, every client is a little bit unique... what I value is a combination of what I think will yield an effective and innovative result, and also what I think is likely to get the clients excited and more likely to choose us versus competitive alternatives in the marketplace.” Or “It's really compelling if we can have a client explain to us a problem, and then come up with a really off the wall solution that sounds great that they've never thought of before, or several. And so having more tools or a broad range of ideation tools, of knowledge of materials and processes and stuff, is really helpful for us.”)

For sustainable design, all the above factors applying to traditional design still apply, and in addition, the tools of green design practices are specialized to particular problems, thus only applying to certain types of product or stages in the design process (“I'm very clear about saying none of these yet are complete, and none of them are particularly easy to use because it's not like they have all these well-honed tools that you can suddenly just unlock and start applying to design.”) One designer and professor of sustainable design said combining was necessary and influence was inevitable:
“Having learned The Natural Step, having learned Cradle to Cradle, having learned, for that matter, Datschefski’s ‘Total Beauty’, having learned about all these things and applied them once or twice at least in my education, if not my practice, none of those frameworks are complete and they all have to be augmented anyway. So my approach is just, I have a superset that I look at, that would include most of these other things, whether it’s more Circular Economy or more Natural Capitalism. So I just look at the superset, I don’t look at a formal approach because you need to add to it regardless. The other thing I’ll say is that something like Biomimicry, you can’t help but be influenced, especially in terms of ideation, but I don’t formally sit down and do what Biomimicry says to do as a tool.”

In addition, he said sustainable design practices should be combined with traditional design practices, as suggested in Chapter 2, to combine strengths:

“The great thing about design-based innovation and design process is you don't have to, you have to do all of the steps if you want to ensure success, but you don't have to use any particular tool... They're all multiple ways of accomplishing, working away through that innovation process. Sustainability is very similar, in the sense that there's a bunch of tools, you don't have to use them all, you can develop your own, mix of them if you want, but you need to cover all the bases, which are ecological, financial, social, and cultural issues, and impacts throughout the entire lifecycle. And in order to do that, you need to do certain kinds of activities, first with research, and then, this is where sustainability as a process often falls down, it's what do you do once you've researched all these impacts and all these needs and got a sense of what the biggest negative impacts are? How do you go about the next step which is, 'Well, what are we going to build that's better?' And that's where the design process just excels awesomely because the design process says, 'Well okay, first thing you do is now that you have a better understanding of what the context is, check your assumptions.' And that's what reframing is, right? Are we really supposed to be designing a better car here? Or maybe, we should be thinking about transportations at large. Maybe they don't need a car, maybe they need access to a car... So that reframing thing is right there in design process, but now you're pulling in all your sustainability context, as well as the other market context that designers hopefully do anyway. And, so, it lays into ideation, prototyping, and then testing, of course. Now you need mechanisms to be able to test the impacts on social, environmental, cultural and ecological levels.”

One post-workshop interviewee’s criticism of The Natural Step also led to an endorsement of combining design methods:
“a primary disadvantage of it compared to other design methods, not that I'm an expert on design methods, is that it's just us sitting around a table. It's us, it's some people sitting in a room, and unless you've already done the work, it's not informed by reality and your customer. The disadvantage I see here relative to a Human Centered Design process is I'm not out in a field, sitting with my customer or my user, looking at them trying to use this thing. So I would say that's, in my mind, a bit of a disadvantage, where in and of itself it wouldn't feel complete, it would feel like I would need to pair this with something else that has me in person with my customer, to not only generate empathy, but also to just pick up all the stuff you can't pick up unless you're there.”

3.3.6. Drivers of Sustainability

Three interview questions investigated what would best drive sustainability in design teams generally. First, in non-workshop interviews, “Do you think designers can lead sustainability at your company? Or would management need to lead, and designers implement?” and “If you wanted sustainability to provide a business value at your company, would innovation be your top choice? Or would other factors be more important, or more natural fits?” Second, in follow-up interviews: “What do you think would drive sustainability most in your company?” Results are shown below.

3.3.6.1 Who Can Lead Sustainability

![Bar chart showing responses to who can lead sustainability in their company.](Figure 3.6)

Figure 3.6 shows that there was not a statistically-significant favorite in answering the question, “Do you think designers can lead sustainability at your company? Or would management need to lead, and designers implement?” Literature has also produced conflicting answers to this question (Epstein and Buhovac, 2014), (Chick and
In fact, many respondents resisted the question's assumption that the only options were designers or management; instead, many said both were needed, and equally many said it was neither, but that clients could best drive sustainability. The latter respondents were particularly emphatic about it, mentioning it multiple times (hence Figure 3.6's second graph showing total number of mentions). This suggests that there is no one role that can best drive sustainability, but rather it is a possibility for any role, and it seems likely that all roles must support initiatives in order for them to succeed. While differences by demographic did appear, they were not statistically significant.

Qualitatively, interview quotes provide reasons for these conclusions. Respondents suggested the designer's role is to suggest sustainability solutions ("designers have to lead, the management doesn't... They don't know what they don't know. They don't know what's possible, our job is to help them understand what's possible.") One design consultant and professor said design thinking is required for sustainable innovation:

"I also don't think that it's possible to innovate sustainably without the design process. And so, sustainability degrees that don't teach design-based, design thinking or design-based innovation, are really limiting their graduate's ability to accomplish anything because sustainable design principles fit so perfectly into design-based innovation, design process, design thinking, whatever, that neither should ever be taught without the other."

However, designers alone are usually not empowered to make significant enough change ("designers trying to drive the [sustainability] innovation on their own, but it doesn't work.") Some designers resort to what one called "ninja sustainability" ("It's a sustainable design that they don't really know about, and it's kind of geared towards simplifying the product and reducing costs and a handful of those things.") This happens both within design teams and between design consultancies and clients ("Just get the regular client and just do the sustainable thing without telling them", or "When we were explicit with clients, then people were not interested. It didn't get any traction. And then we started to take that approach of we are gonna do it anyways and not tell them. And it sort of becomes an, 'Oh, by the way, this is more sustainable, too, because of this, this, and this,' but not present that we had spent any extra time and effort on it. So, sort of insinuating it opportunistically.") Perhaps because of these difficulties, one designer mentioned sustainability fading from the culture of design ("I think the world has changed... in the past, the designers were the conscience of the company. And I didn't see that happening in other parts of the company. I don't think that's totally true today.")

Those arguing that executives can lead sustainability used the simple argument that they are in charge ("if it's established at a Patagonia level, corporate level, as kind of mission statement, then it will be part of the process, and the priority is set by the business.") Top-down decrees can cause resistance or resentment in designers ("you can see on the designers face, it feels like they're being handcuffed.") However, it may be effective regardless ("if there was a dictate from on high that as the very first recourse every
material that you spec should be non-petroleum based; yeah people would be pissed off, but they would accommodate, that would be the rule. Yeah, it would just happen, so they'd be pissed off, but they would do it anyway.")

Because of these interdependencies, the arguments were strong for designers and management both being required to drive sustainability. Partly because both must be aligned to work well together (“it would have to take someone that can also speak business... and also understands the financials... Yeah, I would have to take either a business person that speaks designer, or better yet, a designer that speaks business.”) Also, both are required because designers must implement, but they cannot implement without resources (“where I've seen it most successful, I think, is when there's a handful of designers passionate about it, and it's like a call and response. They voice that passion and then a management team steps up and actually gives them the resources they need”, or “Sometimes you need air cover, sometimes you need ground game. Government legislation, executive buy-in is like air cover. It helps move the troops, but the troops need to move. You can have all the air cover you want, but if there’s no troops on the ground, then you don’t get anywhere. And it's all part of the culture.”) Without resources from management, designers will fail (“People actually doing the work are the ones who are the most excited about it, because they're the ones who are grinding through it day to day, but they need the backing and the resources to do it. And so I think it's a little bit of both. What I have realized, I think, sadly over the years, it's happened in a lot of these places, is the designers trying to drive the innovation on their own, but it doesn't work.”)

Finally, many in design consultancies said neither designers nor management in their companies could drive sustainability, but their clients could. This was usually stated as a barrier (“it's not a top priority for our clients; there's kind of a sense that they're looking to minimize their budgets and schedule wherever possible,” or in a follow-up interview, “In the end, we’re at the will of our clients... the things that we learned [in the workshop] definitely sparked a lot of creativity and ideas for me on ways that we could innovate. Whether or not that happens is, I think, a different story.”)

Often design consultancies felt extremely limited:

“Most of the time, the client comes to us with 'we want that project' and then they either already have components for it, so we don't get to question too much. Like our task, even though it's already being interesting and big, but it's not sometimes broad enough that we can bring a bigger thinking. ...it's very limited, so maybe we could... design more in this type of selection of materials, but that depends if the manufacturer or if the client already had a certain type of manufacturing process established, or a relationship they have with certain types of vendors.”
These limits drive short-sightedness:

“It's about meeting our clients where they're at, and if the client's main stressor is really around super low-cost and they want a fast low-budget sprint project, it makes it really hard to really develop that holistic view that would be necessary to think about key opportunities for impact... We don't do the same process over and over again, so it's not that you can get super up to speed on a particular product or process and then use it again on the next 15 projects.”

However, one designer mentioned it as a benefit when clients do care (“their entire company mission statement is they want to make things as sustainable as they can. And so when I have a repeat client like that, it becomes easier to hit that [sustainable project quota], because at that point, it's driven by them, right?”) Thus, in the end, it seems that designers, managers, and clients (where applicable) must all work together to drive green design practices.

3.3.6.2 Overall Drivers of Sustainability in Design Teams

The follow-up interview question, “what do you think would drive sustainability most in your company?” did not elicit one dominant response. Rather, it elicited a scattered array of different answers, each too few to analyze quantitatively. Results are shown in Figure 3.7.

As Figure 3.7 shows, no more than two or three people mentioned any one design method, activity, mindset, or other business practice. This was due to the small sample size (ten), and likely also due to the often-decried lack of “silver bullet” solutions to sustainability (Senge et al., 2008). While differences by demographic did appear, they were not statistically significant. Though not statistically significant, the most often-
mentioned solutions were arguing the business case for sustainability and changing company culture, which other studies have also found to be primary drivers for sustainability in companies (Lozano, 2015), (Post and Altma, 1994). Marketing sustainability, changing design team culture, focusing attention on sustainability, and LCA were also mentioned by multiple interviewees. Figure 3.7’s category of “Other Design Practice” captures all practices mentioned only once each; these included Whole System Mapping, The Natural Step, AskNature.org, Green Goals / Strategies, Green Design Spec / Brief, ease of use of green design practices, and measuring sustainability generally (not via LCA). Those mentioned more than once are discussed below, except for Marketability and LCA, which have been discussed earlier in this chapter.

The Business Case For Buy-In was both often-mentioned, usually quite emphatically (“the real driving forces that push designs in one direction or another are usually money. The financial element of it. The cost of it. The end cost to the user, the cost to the manufacturer.” Or, “showing, where possible, that it actually is an advantage to the company. That it can be an economic advantage. Or that there are tangible benefits to the company. Not just, feel good, sound good benefits to the company. That there are actual real returns that a company can accrue from doing this work.” Or, “to align the incentive to be sustainable with the business interest is, I think... If you can get there, then everything else falls into place. But if you can't get there, then no matter how effective the tool, in the absence of that motivation, it's hard to... It's understandable that there's not an expectation of actually achieving or implementing.”) Business Case for Buy-In was even independently brought up in response to other questions. When explaining why they did not use activities / mindsets from a workshop, one engineer said, “what we need is really the business case, that's really the bottom line.” When asked if they used ideas from a workshop, a design manager said, “I think once we have a business case... that can be applied on product design, not just packaging, then that would probably resonate better with management, and then they would get more support, and this can be put on the design brief early on, before we start any design work and brainstorm.” When asked what green design practices his team used, one design manager said, evocatively:

“I've always seen profit as this sort of wild horse that's running around, and all you have to do is get on it, and it will take you almost anywhere you need to go. And it's a tough thing to do, and it could destroy a lot of stuff; if you don't reign it in, direct it where you want it to be directed, it can be super destructive. But if you do, it can be really, really constructive. And potentially, it can be the most prolific force, I think, in history... When something is profitable, people will do it, period.”

Some spoke of successes aligning business and sustainability goals (“I've just spent a lot of time with clients just trying to figure out how to make green design and profitability synonymous. And there are a lot of places where those two things overlap in. I felt like my efforts were best focused there.” Or, “Al Gore and these guys... they had beaten most of the industry by doing hard-core sustainability work and investing. ...In very real
economic terms, they had just made more money for their limited partners than traditional investors have. That goes a very, very long way in swaying things.”

Company Culture may be surprisingly important. As Figure 3.3 showed, company culture (or design team culture) was valued for general design practice as often or more often than CAD, sketching, competitive analysis, Cradle to Cradle Certification, Agile / Lean, and many other design practices. Outside of this study, some management gurus have argued that “Culture eats strategy for lunch” (Coffman and Sorensen, 2013). This means a design team's culture of creativity and excellence can determine success much more than what formal design processes they use. Such “culture” may be a collection of design and communication practices, but they may be too subtle and interwoven to be identified, even by their practitioners, without in-depth ethnographic observation. Figure 3.7 suggests the same applies to sustainability. Interviewees said design team culture can resist sustainability as it would resist any other change (“Companies have personality or a culture. If you go try to go against that culture, you’ll be expelled like a virus.”) Or lack of sustainability culture can make initiatives languish (“without a champion and without enthusiasm, something like that doesn’t get realized.”) However, cultures valuing sustainability can deeply affect points of view:

“I think some of it is cultural. I was raised to be very thoughtful about waste and thoughtful about resource usage and all of that, some of that is my family. I think that some of that is that I’m a woman and there is some cultural and social baggage that goes along with that. I grew up in Cambridge, so I’ve just been surrounded by environmentalism my whole life in a way that has impacted my thinking, not just in engineering, but in a lot of areas, and I think that's not true for a lot of [the company] overall.”

This quote implies that improving gender balance in design teams and management could improve sustainability culture. Another interviewee suggested education could improve culture:

“personally engineering culture change. Mechanical engineers, and especially the mechanical engineers who work early in the design and prototyping process, often aren’t thinking about sustainability all that much... My degree is in civil and environmental, and so very much throughout that program, sustainability was kind of always in the background... And it seems like that’s not, or wasn’t, part of the mechanical engineering curriculum... pushing that cultural change would certainly raise interest in this. ...[B. F. Skinner] did some research about what motivates people, or how to motivate people. There’re seven things that you can do, and they ranked them in order of effectiveness... I think the most important is cultural norms... I remember guilt being the least effective way to motivate people.”
In addition to company culture, some respondents mentioned the difficulty of consumerist culture ("the biggest driver for sustainability is the mindset of the consumer, not this throwaway culture. And, I guess, in my head, that outweighs whatever effort the mechanical engineering team does.")

**Focusing Attention on Sustainability** was a straightforward suggestion ("It's all about kind of visibility and awareness," or "Drive awareness – more workshops, examples of product successes.") However, this argument was weaker than the previous ones for the business case and team culture; in fact, two people mentioned it dismissively in favor of the business case ("People are aware of global warming and several issues. So yeah, I think a business case will help, definitely help ground this anchor, this model and then everybody is working in unison towards those different things we want to achieve.") One did so at length:

> "Generally, people are like, yes. They understand [sustainability], probably most of them think it's valuable, but it always fell short to actually become reality, because at the end of the day when it's time to execute and mass produce a design, cost is usually the driver and the green topics fall short to actually remain in execution mode and all of that. So, a business case will help definitely, so you can actually structure your process around that. Yeah, I know it's gonna be some work here, but hopefully, with the help of different people around here, some organization we can maybe craft something that will be very exciting to work around."

**Other** practices mentioned to drive sustainability interviewees' companies included positive examples ("if we had... good examples of it or success stories, case studies, almost, that we could use as a selling point, I think that would be the biggest way we'd be able to get it to be something that would be more often done in our consulting world.") More experience would also help ("If we would say, yes, we've done this before. And this is how we did it. And this is gonna take this many hours.") This is an argument for performing more workshops such as in this study. Better design practices or tools were mentioned ("Have more actionable items around these things. How do we apply that really into concrete projects.") Long-term thinking was also suggested ("[lack of] long term thinking I think is the biggest detriment to making sustainable decisions almost across the board with everybody. You can look at any decision and you get that timeline out 10, 20, or 30 years, and it's a no-brainer. But people have a hard time signing that dotted line with the investment right now, that's a problem.")

### 3.3.6.3 Business Value of Sustainability

If building the business case for sustainability is a key to driving its adoption in design teams, what business value does sustainability provide? This study's interviews verified that sustainability, by itself, is not enough motivation for most customers, so green design
requires other benefits ("The real innovation is when the perceived value to the user is higher, because if the innovation is just about doing something that is less intensive, then you [the user] have to do it based on your own intrinsic motivations to be sustainable, which is existing in some and not in others.") Figure 3.8 counts answers to the interview question, "if you wanted sustainability to provide a business value at your company, would innovation be your top choice? Or would other factors be more important, or more natural fits?"

Figure 3.8 shows that the only business benefits mentioned positively by more than one person each were Cost / Profit and Marketability. These are more extreme but similar to results found in other studies (Hahn and Scheermesser, 2006), (Brønn and Vidaver-Cohen, 2009), (Windolph et al., 2014). While differences by demographic did appear, they were not statistically significant. It appears the reasons for these being the top two values are a combination of what provides business value and what sustainability is seen to improve. Comparing Figure 3.8 to Figure 3.2 (means of measuring innovation) shows Cost / Profit more valued than anything else here; responses to this question reiterated that ("If we can cut costs with that, it's still the most important thing", or "If we could have experience in the project in saying this is what it saved us, this is what it was able to do for your bottom line and this is what it was able to do for your marketing numbers, this is why you should do it. If we could point to that, I think that would be very helpful.") Sometimes saving money was connected to regulations ("If you do use this, this will keep you from getting fined; if you stay away from those fines and regulations that's saving money, right?") Some respondents, however, assumed sustainability would increase costs ("I'm under the assumption that an investment in sustainability often comes at the expense of something, because otherwise it's just good business.") Other interviewees reported personal experience with green design reducing product cost ("in that space between more affordable and cheaper, is where I tend to find a lot of..."
ecological benefit. And running life-cycle assessments to shake out that benefit, I think tends to show that if we can make a product more affordable but we do it well, it almost always tends to be more ecological.”) One described this as a tradeoff of short-term versus long-term cost:

“What's most important to the companies probably is going to be cost. And we do point that out whenever we do bring it up, we'll point out that down the road this is gonna save, because you're gonna have less waste. Less landfill, maybe save energy. So, we try to point that out whenever we can. And that one does hit home, but it's often still a trade-off of higher costs today, looking at more expensive tooling for our product, but less secondary operation. Some companies will understand that, some won't.”

In addition to what companies value, there is the question of what sustainability can improve. Several of Figure 3.2’s aspects of how practitioners define innovation are higher-valued than Marketability (e.g., Aesthetics or User Ease / Enjoyment), but Figure 3.8 shows that practitioners do not believe sustainability helps those aspects. They do believe sustainability helps Marketability (“We did some consumer packaged goods work where... sustainability was going to be the brand and marketing message. That was going to be the area of innovation”, or “I would sell it as a lifestyle. ...the millennials just aren't gonna go for other stuff”, or “We would say... I think you'll sell more if you're getting into this market because they appreciate that kind of aspect of your social ethos.”) However, one designer said Marketability may be fading (“there's just a lot less focus on environmental sustainability in the marketplace right now than what there probably was four or five years ago.”)

Several interviewees argued against sustainability driving innovation (“I don't think sustainability leads to innovation, I'm not convinced. ...that's a much harder case study to show than, 'They would have never saved this much money or helped the environment if they didn't have this sustainable mindset.' I think the latter is definitely true, there's huge numbers and examples of that, right?” Or “my reaction is did it harm innovation because it constrained us and it decreased the flexibilities we had? I don't have that sense. But I don't feel like, 'Oh yeah, it opened up this whole new broad camp of thinking and this really radical new way of looking at things as well.' I probably have more of a neutral reaction to your question.” Or “I don't know if it drove it but it was definitely something that he tried to include.”) One stated, as many scholars and pundits have said before, that innovation causing product turnover is inherently unsustainable:

“there is almost a fundamental conflict between consumer products, which is the general industry that I sit in right now, and sustainability, that the majority of our clients are looking to build something, and it's flashy and exciting and new, that you'll buy and you'll use and then in two or three years or whatever, it'll either no longer be flashy and cool or it will have stopped working. And, you then go and spend more money buying their new model... There are ways that we can work to improve the sustainability of that, and make sure that those products are recyclable, or
that they don't end up being really toxic... but I think there is definitely a limit to how sustainable that sort of business model can ever be.”

Thus, according to the professionals studied here, sustainability's main potential for business value is not innovation for its own sake, but for reducing cost / increasing profit, and for product marketability.

3.4. Limitations

While these interviews produced valuable insights, this study was limited in several ways. First, there was a limited sample size; further studies could recruit participants from more kinds of companies, more people from each company type, and could have a more balanced demographic distribution. The lack of statistically significant demographic differences may have been due to sample size, although the survey results in other chapters with much larger sample sizes also produced little to no demographic differences. Second, the pre-survey question asking what design practices people value and why produced disappointing results in the respondents' lack of explanations; the question could have been split into two separate questions. Finally, it would be ideal to compare interview results against long-term observations of the interviewees' actual work practices, because self-reporting can be unreliable. Such studies would be time-consuming and thus expensive, but might provide other benefits such as greater chance for experimentation in real contexts.

3.5. Summary and Conclusions

The interviews of designers, engineers, managers, and sustainability specialists provided a valuable portrait of how they define innovation, what design methods / activities / mindsets they valued and why, what possible business values of sustainability might be, who can drive sustainability in their companies, and overall the major drivers of sustainability in the companies represented. The results supported some of the original directions of this research, such as testing what components of sustainable design methods are most valued, but it also caused some directions to be abandoned, such as quantifying innovation.

Because no respondents quantified innovation, and several actively resisted the notion that it could or should be quantified, this study discontinued plans to do so. However, the interviews did clearly show what design professionals consider important for innovation: primarily quality. Quality included many aspects, such as product cost / profit, meeting user needs, functionality, feasibility / manufacturability, user enjoyment / ease of use, marketability, and aesthetics. Sometimes sustainability was even mentioned as a form of quality. Novelty was another important aspect of innovation, but not novelty for its own sake, only novelty that also improves quality. Quantity of ideas were also mentioned in
relation to innovation, but often not valued for its own sake, instead seen as helping to find quality ideas and novel ideas.

Practitioners valued a wide range of design practices—so wide that most were only mentioned once or twice. Design practices that respondents valued depended on whether they had sustainable design experience or not. Some design practices were valued highly by all interviewees, such as Human-Centered Design and its components of finding user needs / empathy and other research, brainstorming, prototyping, and user testing, as well as its close relative, design thinking. Interviewees with sustainability experience also valued several green design practices not valued by others: green goals / strategies, LCA, Cradle to Cradle (the book), biomimicry, systems thinking, The Natural Step, green certifications, green design guides, and writing sustainability into design briefs. The formal green design practices mentioned were analyzed in Chapter 2 in part because of the number of mentions in these interviews. The value the interviewees placed on these design practices emphasized the specialized nature of sustainable design, implying design teams wishing to practice it should learn sustainability-specific skills, not merely use standard design practices while thinking green thoughts.

Design practices were most often valued for the results they provided; in addition, some were valued for providing a new lens in approaching problems, focusing or clarifying thought, broadening scope, and other benefits more specific to particular practices, such as LCA helping to balance tradeoffs. Some design practices were valued for both sustainability and innovation: systems thinking, The Natural Step, Whole System Mapping, and Natural Capitalism / Factor Ten Engineering; possibly also Cradle to Cradle (the book) and Biomimicry. Their innovation value generally seemed related to their providing a new lens, focusing thought, or broadening scope. Notably, company culture was also valued for driving both sustainability and innovation.

In addition, multiple respondents mentioned the value of combining green design practices with both each other and traditional design practices ("none of those frameworks are complete and they all have to be augmented.") These findings support the main purpose of this research, which is to find what practitioners value in different sustainable design practices so they can make more informed decisions about what components or combinations of design practices to use, and when. They also suggest future research should attempt to develop new green design practices, or combinations thereof, to improve value for design teams.

Drivers of sustainability in design teams included who could drive sustainability and what practices could be performed. There was not widespread agreement about who could best lead sustainability, but the most convincing arguments suggested that both designers and managers / executives (as well as clients, for consultancies) needed to work together ("the management doesn't... know what's possible, our job [as designers] is to help them understand what's possible" and "it's like a call and response. They voice that passion and then a management team steps up and actually gives them the resources they need.") The two practices that interviewees most often suggested can drive sustainability in design teams were building the business case for green design and changing team
When asked if sustainability could provide innovation as a business value, most interviewees instead listed cost savings and marketability as sustainability's business benefits.

In conclusion, the interviews of design professionals showed that they value a wide range of design practices, both traditional and sustainability-related, and they are treated as tools to mix and match (“Each designer has their own special tool belt or toolkit.”) This reinforces the central theme of this research, to find what tools are contained within different green design methods and what their value is. While most design practices were mentioned as only innovation-related or sustainability-related, a few were seen as both. Three of these (The Natural Step, Whole System Mapping, and Biomimicry) were studied in workshops described in the following chapters to find what tools they offer and what they are valuable for.