Introduction

By Martin Tomitsch and Cara Wrigley

Design is no longer a discipline limited to the concerns of a singular, specific domain. Like most other industries, the field of design is being challenged by the arrival of the fourth industrial revolution. Systems are becoming more complex, requiring more intuitive user interfaces and multiple touch points, from wearable screens to virtual reality headsets. Digital systems are weaving their way into physical environments and products, from smart cities to internet-of-things and medical devices. Technological advancements are changing the process of design. As a result, we must integrate the requirements of all the domains, aspects and features that make up the most innovative solutions worldwide. We must design – think – make – break – and then repeat.

Design evolution

The responsibility of design has evolved over time along with industrial, technological and market shifts (Owen, 1991). For almost a century, design has been used to achieve a competitive advantage across industries. At the beginning of design as a profession, this involved designers working with engineers to achieve better construction techniques.

As markets changed and caught up with this trend, the role of design shifted to delivering a strategic advantage by having products with better appearance, better human factors or usability, and better performance. Around the turn of the century, the role of design changed again, with companies seeking designers to help them develop better ideas and better integration, now also including better experiences and social inclusion.

As our global and lived environments are becoming more complex, the role of design is changing yet again. We are facing unprecedented global challenges, such as population growth and mass urbanisation, and technology is advancing and penetrating all aspects of our lives at a rapidly increasing rate.

Design is now seen as a pathway for solving complex, nonlinear problems, which can't be solved with technological or scientific approaches alone. It provides a framework for understanding the needs of the people, as well as the space to translate these needs into solutions. For the first time, in the evolution of design as a field, the use of such methods is no longer limited to skilled design professionals. Using design as a way of thinking provides a strategic advantage
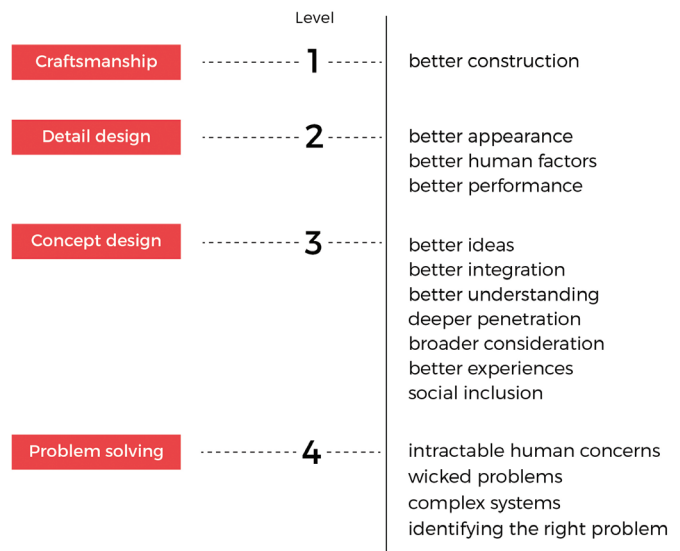
across many professions. Design is, therefore, becoming a capability-enhancing skill, equipping people with the ability to deal with uncertainty, complexity and failure.

The last two decades have seen much excitement around the term 'design thinking', largely due to its adoption into business as an alternative approach to business strategy development. Herbert A. Simon first referred to design as a 'way of thinking' in his book 'The Sciences of the Artificial' (Simon, 1969), proposing a structured approach for translating an existing situation into a preferred situation using design methods – helping to connect different elements contributing to a final solution. In the 1980s the term 'design thinking' was used to describe the process of designing in architecture and urban planning (Rowe, 1991). Since then several frameworks have been formulated to provide guidance for when, how and which methods to apply at the various stages of a design process. These early works have laid the foundation for today's role and place of design as an innovation method.

Two popular design models that translate this way of thinking into a framework are the 'honeycomb' model proposed by the d.school at Stanford University and the 'double diamond' model published by the UK Design Council. The honeycomb model involves the stages of empathise, define, ideate, prototype and test, and stresses the importance of iteratively moving between those stages while working on a design project. The double diamond model entails the phases of discover and define (the first diamond), and develop and deliver (the second diamond). Each

diamond encourages divergent thinking followed by convergent thinking. The first diamond starts from a problem situation and ends with a problem definition and focuses on understanding the problem. The second diamond uses the resulting problem definition as design brief and is concerned with finding the right solution.

Despite being criticised by some scholars for their simplified view of design as a process, models like the honeycomb and double diamond offer distinctive perspectives and considerations. They allow organisations to adopt their own formalised design approach to inform how they operate and design their products and services.

Level

Craftsmanship	1	better construction
Detail design	2	better appearance better human factors better performance
Concept design	3	better ideas better integration better understanding deeper penetration broader consideration better experiences social inclusion
Problem solving	4	intractable human concerns wicked problems complex systems identifying the right problem

The changing role of design to provide a competitive advantage by achieving products, services, systems and environments of better quality. Levels 1 to 3 based on an original diagram by Owen (1990).

Design. Think. Make. Break. Repeat.

Arriving at an innovative solution is usually not a clear, straightforward pathway. Design requires learning about the context (the thinking part), building prototypes as tangible representations (the making part) and testing potential solutions (the breaking part). Rather than investing a lot of time in each step, it is more productive to go through the process as quickly and as often as possible (the repeating part). The earlier an idea or concept is broken, the quicker we can focus on improving it.

Design thinking

For an innovation to be successful, it is critical to not only have the technical and business opportunities in place but to also ensure that there is a real need, a desire, for the product or service. According to Eric von Hippel, a Professor at the MIT Sloan School of Management, 70 to 80 percent of new product developments that fail do so not for lack of advanced technology, but rather a failure to understand users' needs. It's understanding who we are designing for and how to address their needs that companies find most challenging.

To understand who we are designing for (users, customers or other stakeholders), it is important to develop the skill of empathy. Design thinking uses a wide array of methods to develop empathy by collecting data from and about real people and for translating this data into ideas and concepts.

Design making

Data and ideas collected during the design thinking phase can be turned into concepts and prototypes – the design making part of the process. This is where we build a tangible representation (or many representations) of the solution. In some cases, this is also referred to as the minimal viable product (MVP). A concept, prototype or MVP can be a representation of a specific scenario, the entire user interface, or just one feature built as a technical proof of concept.

Design

Learn   Build   Test

Think -------> Make -------> Break

Repeat
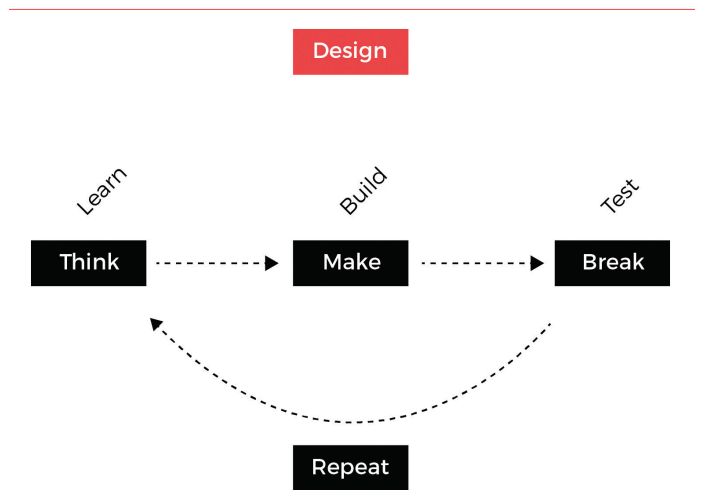
The steps of a design process are linked and interconnected. They don't happen in isolation from each other. The better the research data collected initially, the more useful the tangible representation of the solution will be.

Design breaking

One way to find out whether an idea works is to put it in front of potential users or customers. Sometimes it might be necessary to let go of an idea or concept to make room for even better ideas to emerge. To break a design solution requires embracing failure. Taking a different perspective and exploring many approaches rapidly can effectively solve complex problems.

In 1959, British industrialist Henry Kremer created a prize for designing a human-powered aircraft that could fly a figure-eight course around two poles half a mile apart. Despite more than 50 official attempts, the prize went unclaimed for over 17 years. In 1976, Paul MacCready, an aeronautical engineer, completed the challenge by looking at the problem from a different perspective. While everyone else was trying to build a human-powered plane that can fly a figure eight around two poles, he built a plane that could be crashed and re-built within hours. His team would often break the plane several times a day, and from those failures learn how to improve their approach. The solution was to build a lightweight plane that could fly very slowly. Constantly breaking their concept sped up the process of finding a new, successful solution.

Repeating the steps

The final step is to repeat all or some of the previous steps. Every iteration leads to new insights, and the new insights are what will set a product or service apart from other solutions in the market. Designing, thinking, making and breaking many different representations quickly rather than striving to create one perfect solution leads to a more innovative outcome.

According to David Bayles and Ted Orland a ceramics teacher one day announced that he would divide his class into two groups (Bayles & Orland, 2001, p.29). He explained to the groups that all those who sat on the left side of the studio would be graded based on the number of works they produced, while the right side would be graded based on quality. When it came to grading the students' submissions, he found that those focusing on quantity had come up with much more interesting and novel works than those striving to develop a high-quality submission. Not getting fixated on one idea allowed the students to try out many different ideas quickly and that way producing overall higher-quality works.

Who we are designing for

In interaction design, the end consumers of the designed products are commonly referred to as users. This notion is also reflected in terms used to describe emerging design disciplines, such as user experience design, and methodologies like user-centred design. However, this is not always an accurate reflection of who is purchasing or engaging with an end design solution. Within the business and commercial world, the term customer is frequently used instead. In some cases, the user might not be the customer of a product. For example, users on Facebook are different from the customers, who are paying, for example, for targeted advertising. The design of Facebook as a platform needs to consider and target both. A design process may also need to consider other stakeholders, who are individuals or organisations with an invested interest or stand to gain or lose from the solution. The terms user, customer and stakeholders are not always equally interchangeable and have been carefully selected and used throughout this book.

How to use this book

This book is written as a learning resource and reference guide to scaffold the reader's understanding of the design process as a method for complex problem-solving and developing innovative solutions. The methods included in the book are applicable to a variety of design projects and across a range of domains and industries. This cross-perspective approach is also reflected in the choice of design briefs and case studies included in the book, which ranges from autonomous vehicles to designing the future shopping experience.

The book is divided into methods that include a full description along with step-by-step exercises and ready-to-use blank templates. The methods are included in alphabetical order, rather than structured by phases, to reflect that they can be flexibly used and adopted across multiple phases. Icons indicate the phases, in which each method is typically used. However, there is no hard rule about when a method can or cannot be applied.

Templates can be photocopied or used inside the book. The book is accompanied by a website (designthinkmakebreakrepeat.com), which provides printable versions of templates as well as further resources to illustrate the use of the methods.

As well as being a rich resource of design methods and materials, the book supports the teaching of students and readers from all disciplinary backgrounds. It provides everyday tools that assist with developing an understanding of design thinking by practically applying the methods through exercises. The methods included in the book have been contributed by leading experts in the field. The exercises are based on many years of experience in teaching the methods. All methods are grounded in research and link to academic articles that provide more detail on each method.

The authors encourage researchers, practitioners and learners to use, modify, re-interpret and critique the contents of this book. We welcome any feedback, suggested improvements or experiences with successes – and most definitely failures! In the spirit of the book, we look forward to its ongoing development through conversations with you.

References

Bayles, D., & Orland, T. (2001). Art & fear: Observations on the perils (and rewards) of artmaking. Image Continuum Press.

Owen, C. L. (1990). Design education and research for the 21st century. Design Studies, 11(4), 202-206.

Owen, C. L. (1991). Design education in the information age. Design Issues, 7(2), 25-33.

Simon, H. A. (1969). The sciences of the artificial. Cambridge, MA: MIT Press.

Rowe, P. G. (1991). Design thinking. Cambridge, MA: MIT Press.