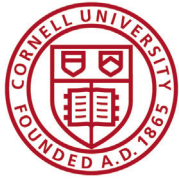


Systems Design Thinking

THE MAKING OF THE GE ADVENTURE SERIES

CASE STUDY NO. 3 • FEBRUARY 2018



The GE Adventure Series is both a poignant and remarkable success story about the transformation of the imaging experience from one riddled with fear for pediatric patients and their families to an interactive storytelling adventure. GE's Adventure Series turned sterile, cold imaging machines into themed, character-based stories that feature fantastical worlds — complete with fun characters, immersive audio and visuals, and hands-on activities — so children feel more comfortable during the imaging process and no longer needed sedation to complete the procedure.

What the team accomplished through design thinking changed the landscape for GE Healthcare, a leading provider of medical imaging equipment, both from a business and a human perspective. Yet, while design thinking was an essential and powerful part of the process, analysis reveals that it was not enough; systems thinking, too, was required to give design thinking 'teeth.' This case shows the power and potential of systems thinking in the design process by exploring the ways in which metacognitive rules came into play behind the scenes.¹ In particular, the GE Adventure Series is a case for why systems thinking and design thinking are two sides of an inseparable coin.

The Proud Engineer

The story of how the GE Adventure Series came to be starts with one GE Healthcare engineer, Doug Dietz². Doug was proud of the magnetic resonance imaging (MRI) machine that he designed. These machines are modern engineering marvels; for example, the Discovery™ MR750 model boasts a third-generation, short-bore, superconducting 3.0T magnet and high performance whole-body gradients, Autocalibrating Reconstruction for Cartesian (ARC) parallel-imaging, a volume-reconstruction engine, and OpTix optical RF technology³. So, when Doug was on his way to the hospital to see the new imaging product in action, he was excited:

"I was going to the facility to check out how the design was doing. I'm thinking totally about the shiny object, about the product — my baby."⁴

But then something happened. Doug had a chance encounter that changed his life and motivated him to rethink his design perspective:

"Down the hallway I saw a silhouette of this couple, they had their little daughter in between them coming down the hallway. I'm standing against the wall, and I could see the little girl slowly falling back behind her parents. I caught the dad saying — he kind of leaned down to the little girl — and said, 'You know we talked about this, are you going to be brave?' I'm thinking to myself, be brave? I don't understand. And of course the tears start to come, because she doesn't want to go into the scanner."⁵

Doug realized that the little girl (the patient, or alternatively the "end-user" of his product) was completely terrified. One of the necessary requirements of the image scanning procedure is that she lie perfectly still — which is hard for most patients to do — in a noisy, scary-looking machine. Sedation is frequently required to keep pediatric patients from moving during the scan, which affects the fidelity of the images. Sedatives are usually administered through an intravenous (IV) line. In some cases, general anesthesia is necessary. As a result, the child's breathing, heart rate, blood pressure, and blood-oxygen levels must be closely monitored by a healthcare professional during the procedure. Additionally, the child may suffer from side effects: nausea, vomiting, mild allergic reactions, headache, and dizziness after the sedative wears off. Thus, the procedure becomes a stressful ordeal for both the parents and their children.

At that moment in the hallway, Doug sadly realized that he had not considered the needs of pediatric patients in his machine's design:

"I'd been looking at this totally wrong. I saw that this is a pretty terrifying experience. That was really, for me, where I realized that as a designer I basically failed... I totally missed the struggle the family was going



through. It doesn't make a bit of difference if this thing is the most gorgeous piece of equipment known to man. It doesn't matter at all, because it doesn't work."⁶

Designing the wrong product

Doug had been designing the wrong product. Prior to this experience, Doug believed the product was the MRI machine. After witnessing the scene at the hospital, he came to realize that the product was the patient's *experience*. Doug became immediately motivated to design a totally different, more inviting imaging experience for pediatric patients. He first made the "user experience" central to his design — a core principle of design thinking, an approach he had used for many years prior. What Doug did not realize was that improved design thinking meant that he would need to *think systemically* at each point in the design process.

Thinking Systemically by Design

Design thinking methodology is widely used across sectors, including international development, social entrepreneurship, health care, and design.⁷ Design thinking involves the following five steps;

1. work to fully understand the experience of the user (empathize),
2. form a user point of view that will be addressed with the design (define),
3. generate a large quantity of diverse possible solutions (ideate),
4. transform ideas into physical form to experience and interact with them (prototype), and
5. try out high-resolution products, use observations and feedback to refine prototypes, learn more about the user, and refine the original point of view (test).⁸

Figure 1 provides a linear, big picture framework, of design thinking that can be a helpful heuristic for developing innovative solutions to both local and global challenges.

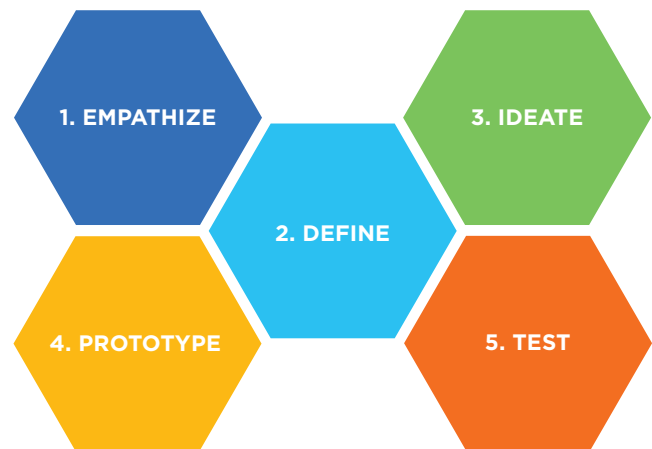


Figure 1: 5 Steps of Design Thinking

According to Tim Brown, the CEO of IDEO⁹:

"Design thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success."¹⁰

Design thinking is only as powerful as the thinking behind it. The five steps of design thinking alone cannot help you navigate the many complexities we face in our volatile, uncertain, complex, and ambiguous (VUCA) world. The degree to which you feel empathy requires delving into, and deeply understanding, perspectives other than your own. Defining an actionable problem statement or user point of view requires metacognition, introspective questioning, and analysis. Systems thinking provides the cognitive structure that makes it possible for design thinkers to deepen analysis, improve creativity, and increase innovation.

Systems thinking is the alignment of our mental models about the world with feedback from reality. We form mental models by taking in information, giving it structure, and making meaning. The four simple rules of systems thinking provide that structure and underlie all of our thinking processes:



- Distinctions Rule - any idea or thing can be distinguished from the other ideas or things it is with
- Systems Rule - any idea or thing can be split into parts or lumped into a whole
- Relationships Rule - any idea or thing can relate to other things or ideas
- Perspectives Rule - any thing or idea can be the point or the view of a perspective

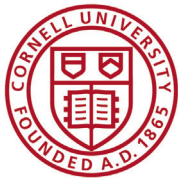


Figure 2: Systems thinking is the root of all thinking heuristics

Design thinking and systems thinking work together. Design thinking requires systems thinking — or the mixing and matching of the four patterns of metacognition: making distinctions, organizing part-whole systems, identifying action-reaction relationships, and taking many perspectives to build better understanding of any concept or process. Table 1 illustrates how thinking systemically is a natural part of the design thinking process.

Design Thinking	Systems Thinking
Empathize	Figure out the user's perspective at a deep level.
Define	Build a systemic mental model of the user's perspective that considers the user's perspective both in the form of its many parts and within its context as a whole; state it clearly and synthetically.
Ideate	Generate new and robust ideas based on perspective taking and synthetic thinking.
Prototype	Move from mental model (conceptual thing) to prototype (physical thing) and make product prototypes based on your creativity, innovation, and ideas.
Test	User-test the prototype and translate user actions and feedback into a new mental model that, in turn, can be translated into an improved physical prototype... repeat.

Table 1: Thinking systemically is embedded in design thinking



Mapping Systemic Thinking for Design

We increase both our understanding and awareness of how and what we think (our metacognition) when we map our thinking using tools that are both visual and tactile. As we continue to explore the making of the GE Adventure Series, we'll use metacognitive maps to illustrate systems thinking in the design process.

GETTING PERSPECTIVE

Doug missed the experience of the child because he was centrally focused on developing an award-winning product design:

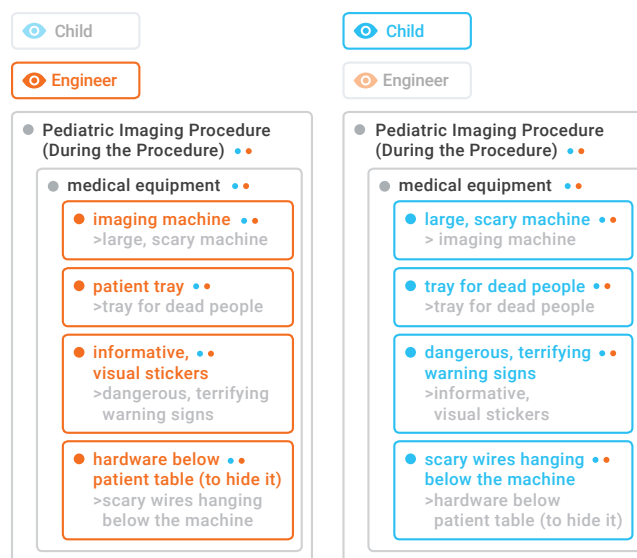
“When I looked at it through the designer's lens, through my perspective, I was literally looking at the product and thinking about what design award I was going to win. That's how myopically focused from a designer's point of view I was looking at this.”¹¹

The realization that the product he was designing was an *experience* – and a terrifying one at that – led Doug to take a more holistic view of the product. He began to empathize with the patient, which required deep perspective taking. He literally got down to the child's level to see the world through her eyes: the eerie fluorescent light, the ‘crime scene’-like tape and warning symbols, the deafening noise of the machine. Doug empathized with the little girl and took her perspective to understand the cause and intensity of her fear.

Design thinkers want to do anything and everything to get out of their own perspective and into the perspective of the user. When design thinkers *think systemically*, they understand that the user is making different distinctions, cares about different relationships, and organizes things into part-whole groupings differently than they do. Therefore, designers must listen deeply and observe fully, to deeply and empathically take the perspective of the user.

Map 1 shows the different perspectives on the imaging perspective. In other words, the map on the left shows you what the engineer sees when they think about the procedure; mostly the equipment and its specifications. Whereas

the map on the right illustrates a child's view of the same procedure in which she sees a large, scary machine full of deadly warning signs and scary images. This is the contrast that was foundational to Doug's epiphany about his award-winning design.

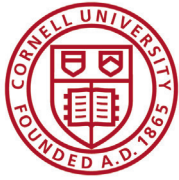


Map 1: Contrasting Engineer and Child Perspectives¹²

EXPANDING PERSPECTIVE

Doug decided to fully explore this difference in perspectives and thus built a design team to better understand the family's entire pediatric imaging experience, from the moment the need was introduced to the car ride home after the procedure. He surrounded himself with experts: medical professionals that could give insight into medical processes, child life specialists that could provide guidance on translating the medical process to a child, learning specialists that could provide feedback on what children do and do not understand, and interaction designers that could transform the imaging process into a magical experience:

“We started to really think about the perspective of the family, especially the child, and thinking as best we could through their lens. You're not going to get that perspective unless you spend time with them and listen to them, and take an incredible amount of notes.”¹³



Perspective taking is a core element of design thinking. Perspective circles, or ‘P-circles,’ as shown in Figure 3, are common cognitive structures that illustrate how we metaphorically see any given event, situation, object, or idea from different perspectives.¹⁴

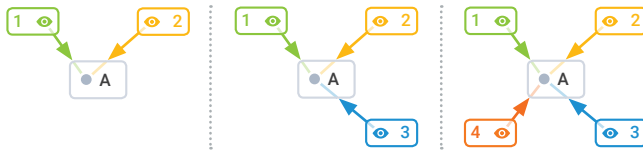
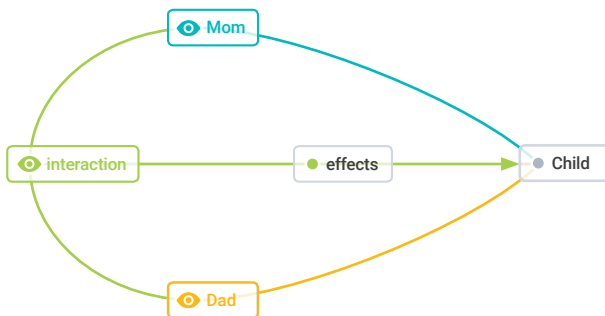


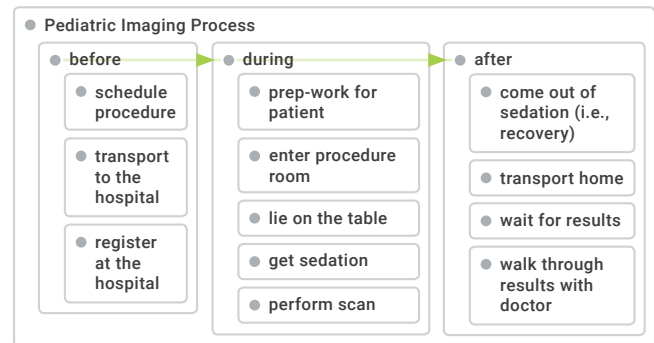
Figure 3: Perspective circles

The design team provided new perspectives that expanded the ways Doug understood the family, and all elements of the scan process. Doug and his team explored not only the child’s perspective, but also the perspective of the family as a whole and discovered that the relationship between the parents — specifically, how the child might interpret their interactions — had a notable effect on the child’s imaging experience. Map 2 illustrates this effect.



Map 2: Exploring the family perspective¹⁵

It was important for Doug and his team to take the perspective of the family in terms of the process of completing a scan, from beginning to end, to allow them to fully transform the process into a better experience. Map 3 shows the part-whole systems that make up the pediatric imaging process, which the team had to understand from the family’s perspective.

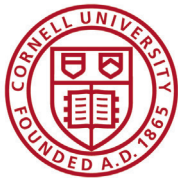


Map 3: Process mapping the pediatric imaging experience¹⁶

When we change our perspective, the distinctions we make change too. With this new, more nuanced understanding, Doug and his team were able to make a critical distinction between designing a product and designing an adventure experience:

“We did our first brainstorming session on the floor in a daycare center. [We] did these immersive workshops where we sketched and brainstormed and made these little scaled rooms of what the experience could be like. The children would sketch different ideas on paper and we would paste them on the wall, like a low-fidelity prototype. And then we started thinking... What could this be? What are the possibilities? How could we bring some of these new things to light?”¹⁷

Design thinkers *think systemically* when they deconstruct the user’s perspective to determine underlying wants and needs they can manifest in product design by building a systemic mental model (made up of distinctions, interrelated part-whole systems, and additional perspectives). Focusing on the salient aspects of the user’s perspective allows design thinkers to take the designer’s perspective on the user’s perspective of the product experience. This simple act leads to true empathy with a user, a foundational element of design thinking and product success.



CREATING THE GE ADVENTURE SERIES

The GE Adventure Series was a complex project, with many moving parts. There were a lot of details that needed to be explored to better understand the solution. Doug and his team examined each phase and element of the imaging experience to transform it into an adventure:

“We identified aspects of the scan that could cause anxiety or that are hard for a child to understand: the noise, the hospital smell or the need to be still. Then we thought of imaginative ways to make sense of these anxiety points. For example, the MR room’s space theme was specifically chosen to target the MR scanner’s noise. In this room, where the scanner is disguised as a spaceship, children don’t have to understand why the MRI scanner makes noise because they can imagine a spaceship rumbling through space.”¹⁸

Design thinkers like to “think outside the box” or “step beyond the obvious,” which fundamentally, means *thinking systemically*. This process includes: challenging distinctions, organizing part and wholes differently (e.g., splitting parts when other people are lumping them, and lumping when other people are splitting), understanding the subtleties and complexities of webs of action-reaction relationships, and taking multiple perspectives to explode the landscape of ideas (divergence) or constraining the landscape of ideas using limiting perspectives (convergence).

To bring their ideas to action, the design team first distinguished and systematized the parts of the scan room and the parts of an adventure experience. Because the four simple rules of systems thinking offer both a cognitive and physical model, the conversion/translation of ideas to reality is 1:1. This means that if you create a mental model in visual mapping language, it can be easily translated to a physical reality such as code, design features, or user interface (UI). A relationship channel, or ‘R-channel,’ illustrates these 1:1 analogous relationships. Figure 4 demonstrates that R-channels relate two systems as well as all the parts that make up those systems, and distinguishes each of the relationships.¹⁹

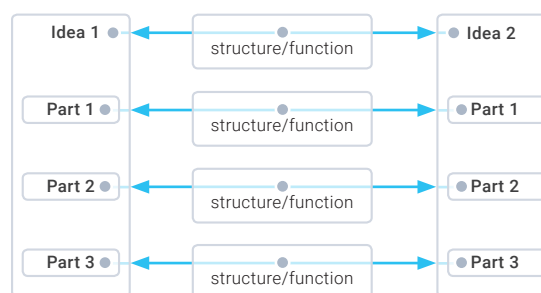
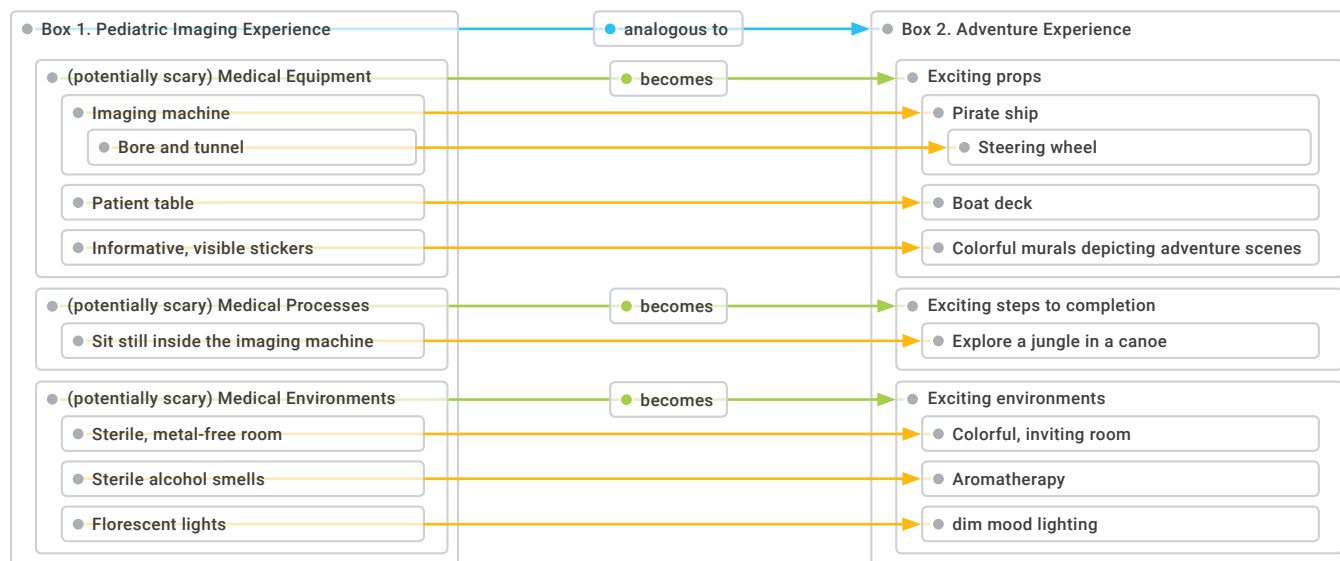
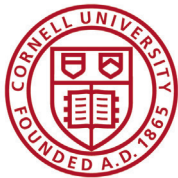


Figure 4: R-channels relate two systems

In the case of the GE Adventure Series, the R-channel relates the parts of the pediatric imaging experience to the analogous parts of the adventure experience, as shown in Map 3. In thinking about these relationships, Doug and his team considered:

“What are the things that are making the child smile? What’s the richness of the story? What’s bringing that out? How can we make this a special experience for the family that’s coming through here? How can we respect that human experience?”²⁰



Map 3: Pediatric Imaging Experience R-Channel²¹

Doug describes the Adventure Series:

“The rooms have these different elements that the child can see and there might be something they identify with... and you can see the parents pick up on that as well. There’s some [rooms] with a little bit of humor. We have a weird looking box on the wall, so we make it look like a mailbox, and then we put a snail on top of the mailbox. Well, of course, the parents are like ‘snail mail!’ and the kid doesn’t have any idea what that is. That smile-factor of the parents is totally being picked up by the child who is sitting up on the table getting ready for their scan.”²²

Design thinkers *think systemically* when they translate conceptual models into prototypes. The design team developed ten R-channels to translate these conceptual ideas into ten unique adventures for CT, MR, X-ray, PET, and nuclear medicine scans, shown in Figure 5. Adventures cover a range of experiences — from camping to exploring the high seas to blasting off into outer space.

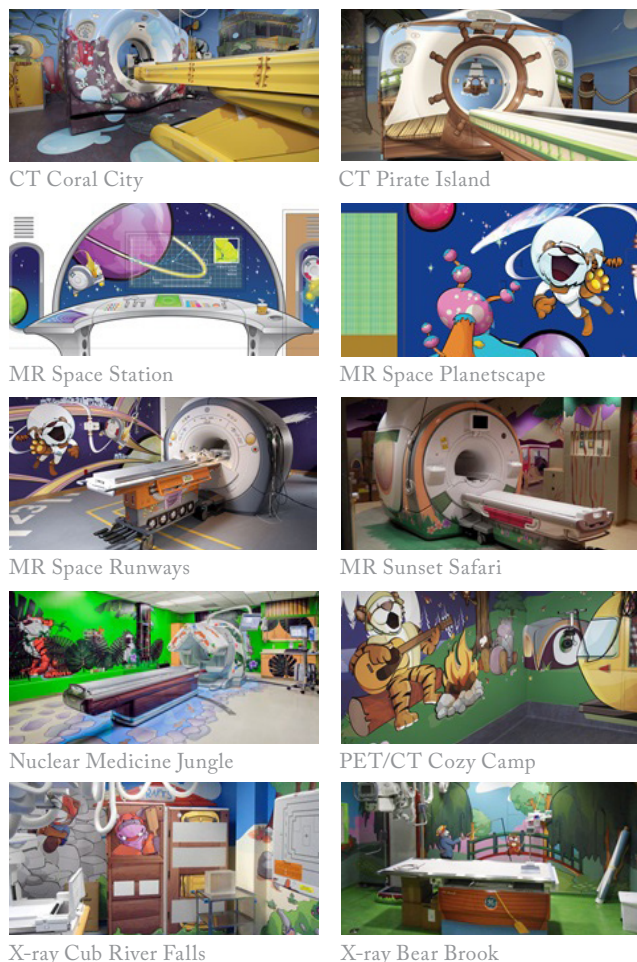


Figure 5: The Pediatric Imaging Experience R-Channel Led to 10 Unique Adventures



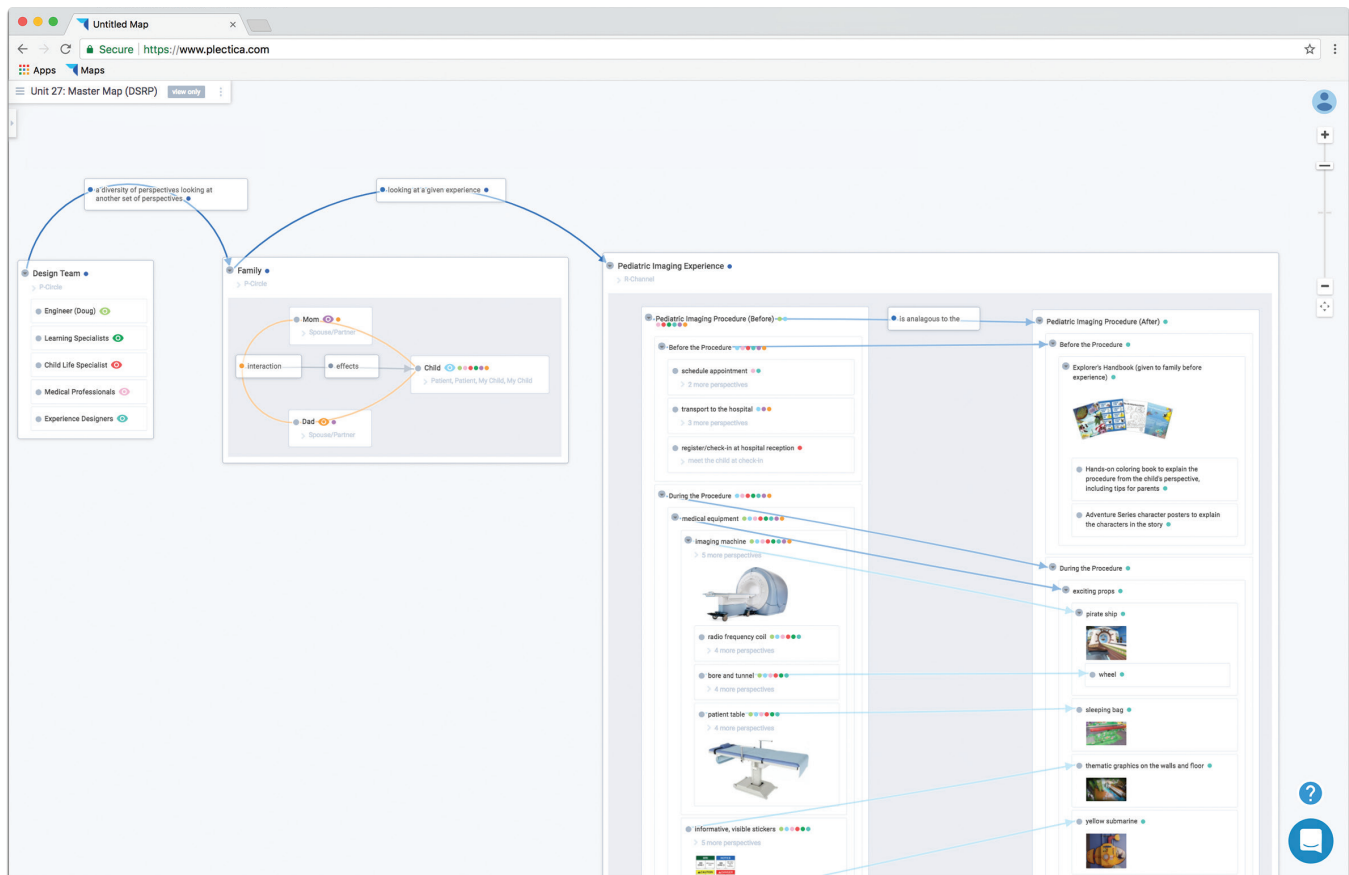
IMPACT OF THE NEW DESIGN

Pilot tests for the Adventure Series produced an *80% reduction in patient sedation*, a *92% increase in patient satisfaction*, and an elimination of the patient backlog. Among outcomes that are not measurable are the ‘smile factor’ and child engagement in the experience:

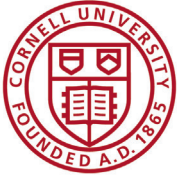
“One of the beautiful things I saw was one of the first family’s going through (the new adventure experience). There was a little boy. We put stones for the jungle adventure out in the hallway. He’s walking on the rocks. He looks back and his parents aren’t on the rocks; they’re just walking down the middle (of the hallway). He calls out ‘No, no! You’ve got to be on the rocks!’ The child is leading the family to the experience.”²³

The transformational redesign of the imaging experience was only made possible through deep empathic listening and perspective taking. The design thinker’s ability to *think systemically* is what underlies listening, perspective taking, mental model building, and translation to physical models.

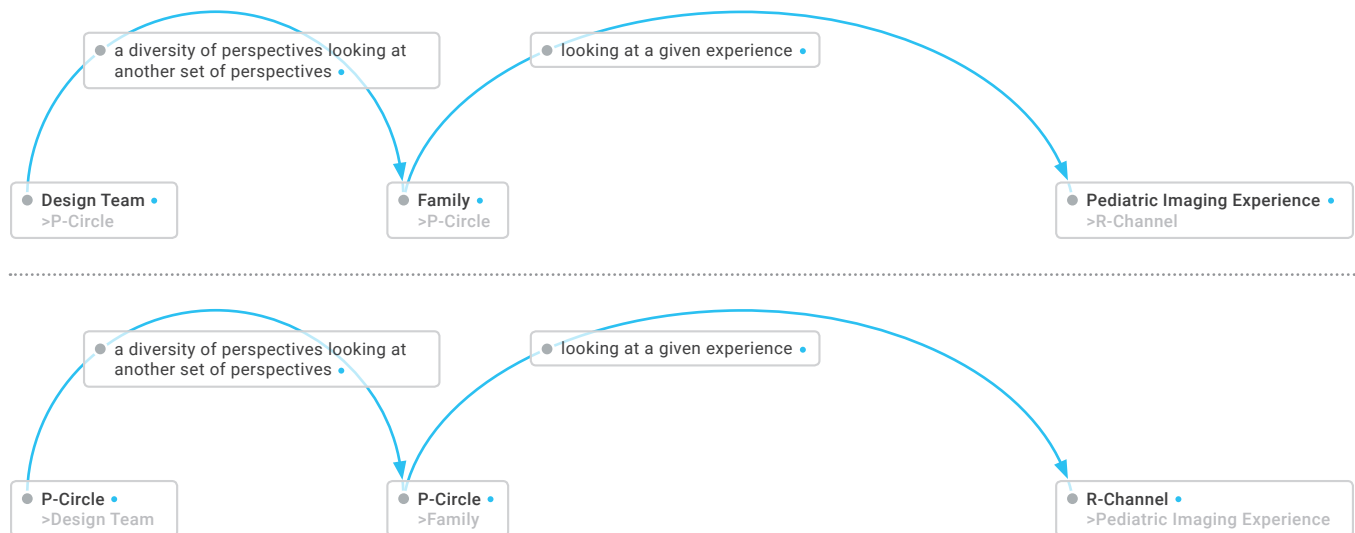
Map 4 illustrates the design process which took into account many different perspectives — in particular that of the family and everyone involved — and led to a new solution that completely transformed the pediatric imaging experience.



Map 4: The design process ²⁴



The design team navigated incredible complexity in order to produce the Adventure Series. If we look at the design process from a systems thinking perspective we can see that there is a structural simplicity that underlies all the complexity. Map 5 illustrates this perspective: a circle of perspectives (the design team) is looking at another circle of perspectives (the family), which has its eye on a relational map of the imaging experience and adventure series analog.



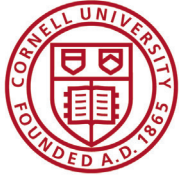
Map 5: The design process from a systems thinking perspective ²⁵

No matter how complex what we're looking at is, the underlying structure can be quite simple. The four basic rules of systems thinking allows anybody to think through and break apart seemingly complicated problems and processes.

CONCLUSION

Design thinking requires that the thinking gets manifested in some way (prototype), yet its central dilemma is reconciling the conceptual world with the real-world. The universal patterns of systems thinking underlie design thinking and bring out rich and robust complexity from an otherwise oversimplified, though useful, heuristic. Systems thinking gives design thinking 'teeth.' Explicating the metacognitive rules that we follow when we think systemically can elevate design thinking, making it more impactful and accessible.

Thinking systemically — with the added benefit of mapping those thoughts — makes the difference between success and failure in the design process. If we open our eyes to the possibilities of systems thinking and metacognition, designing innovative solutions to our most wicked problems is not only possible, it's probable. If we can embed the power of metacognitive awareness into our existing models and processes, we can substantially improve the human condition across many domains.



Footnotes

- ¹ This case was developed as a result of an online training on systems thinking Plectica developed for GE. Plectica. (2018) Systems Thinking Made Simple 101 (MOOC Course).
- ² Doug speaks in detail about his experience designing the GE Healthcare's Adventure Series in a TED Talk. Dietz, D. (2012). Transforming Healthcare for Children and Their Families (Video file). Retrieved on February 15, 2018 from <https://www.youtube.com/watch?v=jajduxPD6H4>.
- ³ GE Healthcare. (n.d). "Discovery™ MR750 - 60cm." Retrieved February 15, 2018 from: http://www3.gehealthcare.com/en/products/categories/magnetic_resonance_imaging/3-0t/discovery_mr750_3-0t
- ⁴ Dietz, D. (2017, December). Personal Interview with Photosynthesis Productions.
- ⁵ Dietz, D. (2017, December). Personal Interview with Photosynthesis Productions.
- ⁶ Ibid.
- ⁷ Design thinking, originating at the Stanford University Hasso Plattner Institute of Design, is a popular problem-solving approach. Today, courses and workshops are dedicated to teaching design thinking to students and practitioners alike, and studying its impact, around the world.
- ⁸ Stanford University d.school. (2010). An Introduction to Design Thinking Process Guide (Pamphlet). Stanford, CA: Hasso Plattner Institute of Design.
- ⁹ An international design and consulting firm that uses the design thinking methodology.
- ¹⁰ IDEO U. (2018). "Design Thinking." Retrieved February 15, 2018 from: <https://www.ideo.com/pages/design-thinking>.
- ¹¹ Dietz, D. (2017, December). Personal Interview with Photosynthesis Productions.
- ¹² Plectica (Online software). (2018). Retrieved from www.plectica.com
- ¹³ Dietz, D. (2017, December). Personal Interview with Photosynthesis Productions.
- ¹⁴ Cabrera, D., & Cabrera, L. (2015). *Systems thinking made simple: new hope for solving wicked problems*. Odyssean Press.
- ¹⁵ Plectica (Online software). (2018). Retrieved from www.plectica.com
- ¹⁶ Ibid.
- ¹⁷ Dietz, D. (2017, December). Personal Interview with Photosynthesis Productions.
- ¹⁸ GE Healthcare. (2011). GE Adventure Series: Imaging that puts children first (Brochure). Waukesha, WI.
- ¹⁹ Cabrera, D., & Cabrera, L. (2015). *Systems thinking made simple: new hope for solving wicked problems*. Odyssean Press.
- ²⁰ Dietz, D. (2017, December). Personal Interview with Photosynthesis Productions.
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- ²³ Dietz, D. (2017, December). Personal Interview with Photosynthesis Productions.
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- ²⁵ Plectica (Online software). (2018). Retrieved from www.plectica.com

