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Design Science Research in PHC: From Insight to Artefact

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Photo by Stefan Els

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3. Design Science Fundamentals
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The Problem

- **The Challenge:** Health professionals lack a structured theoretical foundation for systematically engaging with and improving information systems in healthcare. Without established design science principles, clinicians cannot effectively tap into the knowledge that already exists within digital artefacts or create new solutions in a rigorous, evidence-based manner.

- **The Gap:** Current healthcare innovation efforts lack a coherent methodology for building upon existing systems or developing new digital tools. There is a need for a structured approach that enables health professionals to systematically understand, evaluate, and enhance artificial systems while contributing to the broader knowledge base of healthcare innovation.

Background: Artefacts are designed

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Design Science

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Background: Artefacts are designed

Design Science Research

- Artefacts may be things, representations, or processes.

Introduction & Context

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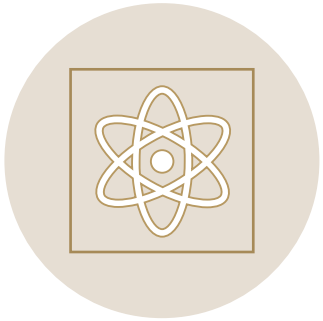
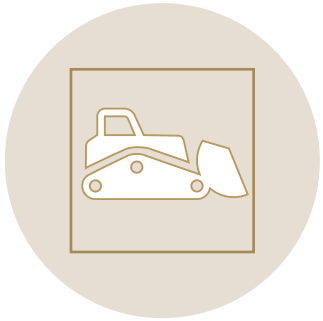
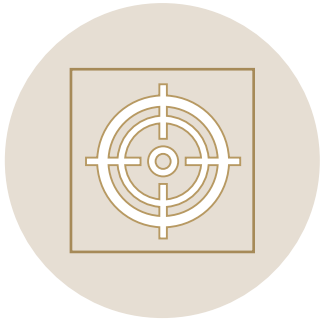


What is Design Science? A problem-solving approach to create and refine solutions (artefacts) that improve real-world situations.



Why it Matters: Tackling PHC challenges with innovation and rigour, moving beyond ad-hoc fixes to sustainable solutions.

Context: Health as a data-driven, innovative sector (e.g. Health



Goal: Equip clinical leadership with design-oriented frameworks to address strategic issues in PHC, DHS, and Family Medicine

Design Science Fundamentals

Definition: Design Science = systematic development of **artifacts** (e.g. tools, processes, models) to solve problems and contribute knowledge.

Key Idea: Create **evidence-based solutions** (build → evaluate → refine). Combine creativity with scientific validation for effective outcomes.

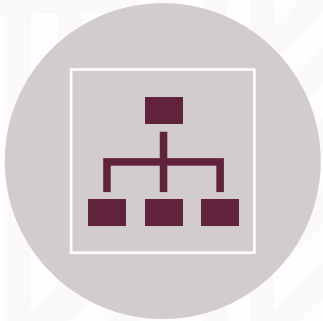
Artifacts: Can be a new clinical decision support tool, a referral tracking system, a patient monitoring dashboard, a digital patient satisfaction survey, etc., designed to meet specific care needs.

Academic Roots: Inspired by Herbert Simon's **"Sciences of the Artificial"** – focusing on how things could be, not just how they are.

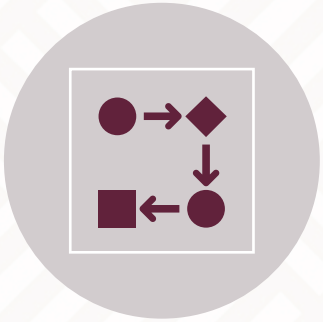
Not Just 'Research': Think of it as design engineering for healthcare systems – solving real clinical issues in a structured and rigorous way.

Design Science Research: Types of Artefacts

Constructs: foundational concepts or ideas that form the theoretical basis of a DSR artifact. They represent the core abstractions essential to its design.



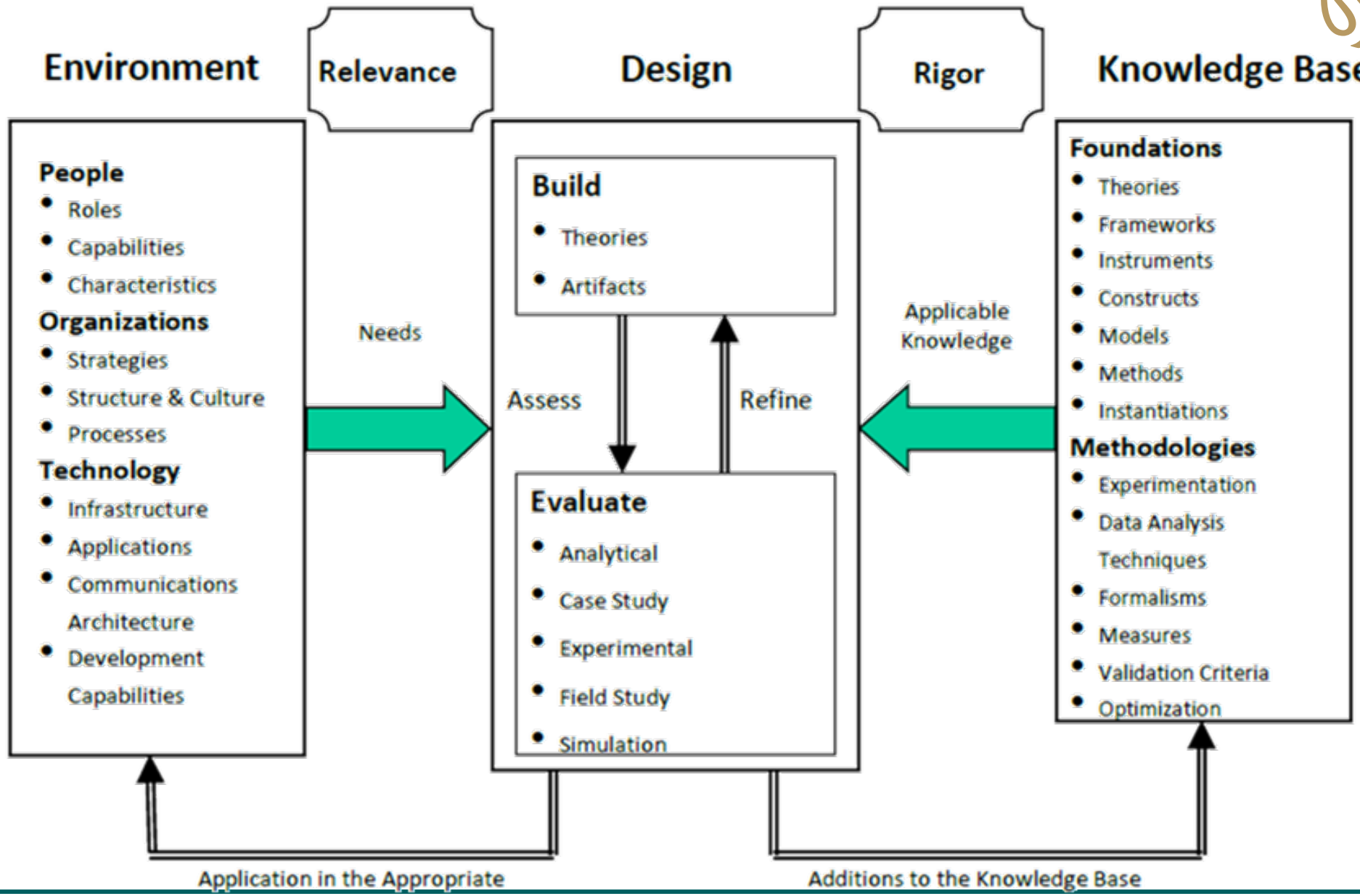
Models: represent constructs and their relationships. They help structure and explain complex phenomena, using forms like diagrams, concepts, or equations.



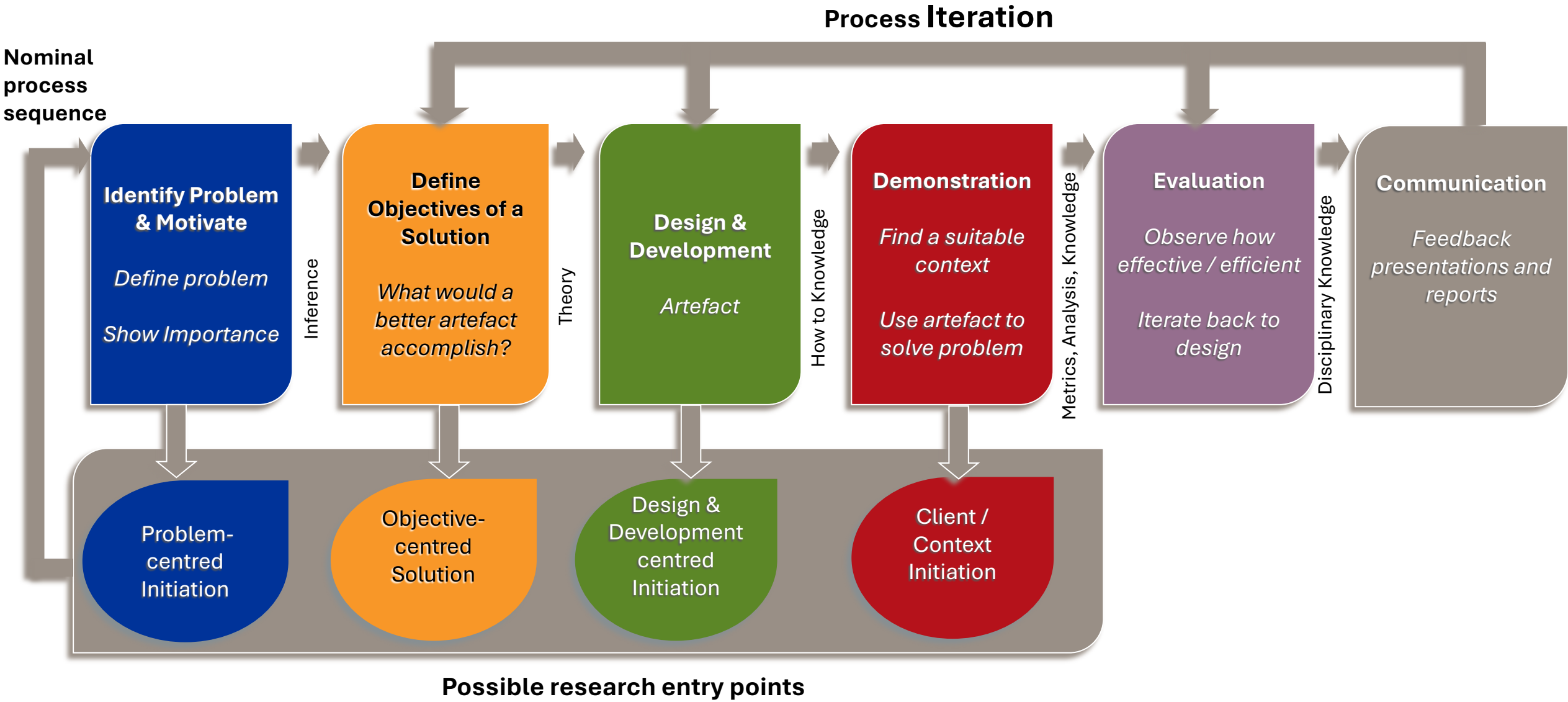
Methods: structured processes used to design, build, and evaluate an artifact. They offer repeatable steps and guidelines for implementation.

Instantiations: real-world implementations of a design. They bring the artifact into practice through forms like software, hardware, or physical prototypes.

Design Science Framework: Adapted from Hevner et al 2004

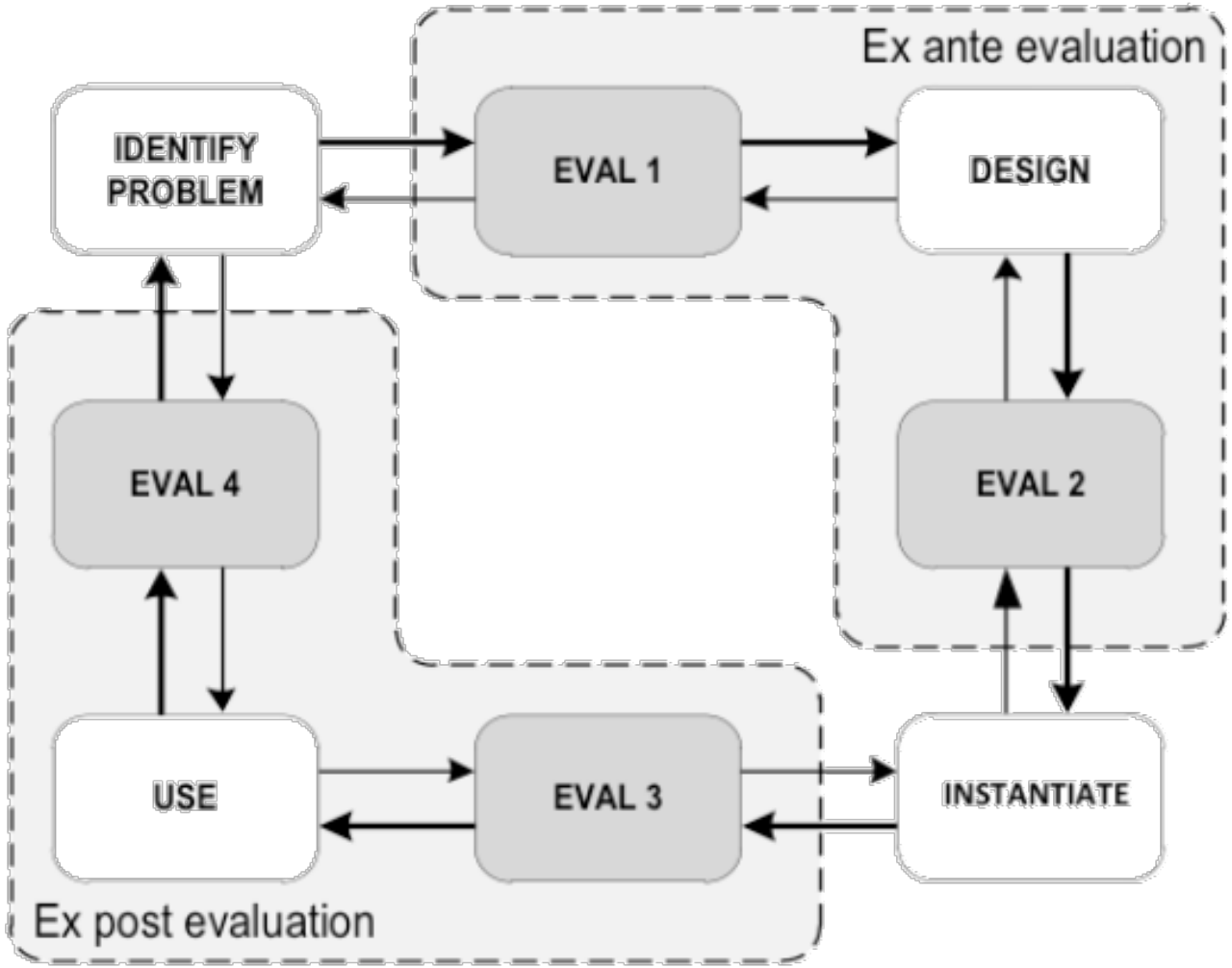


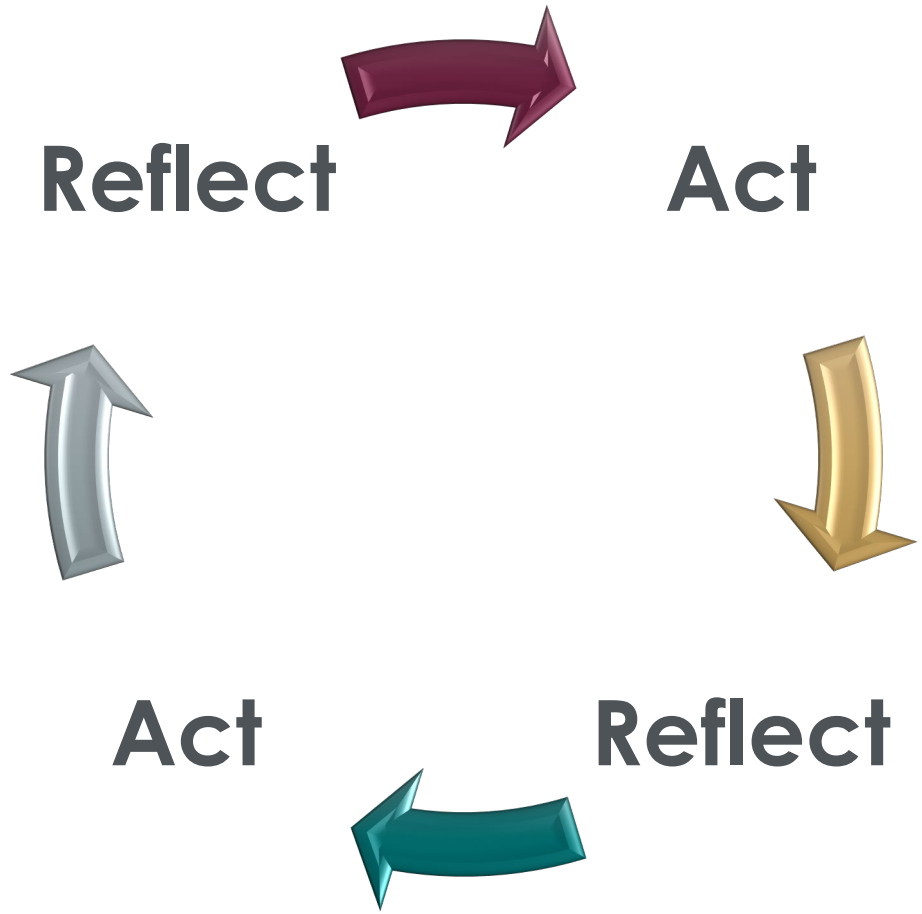
Design Science: Process



Source: Adapted from Peffers et al. 2013

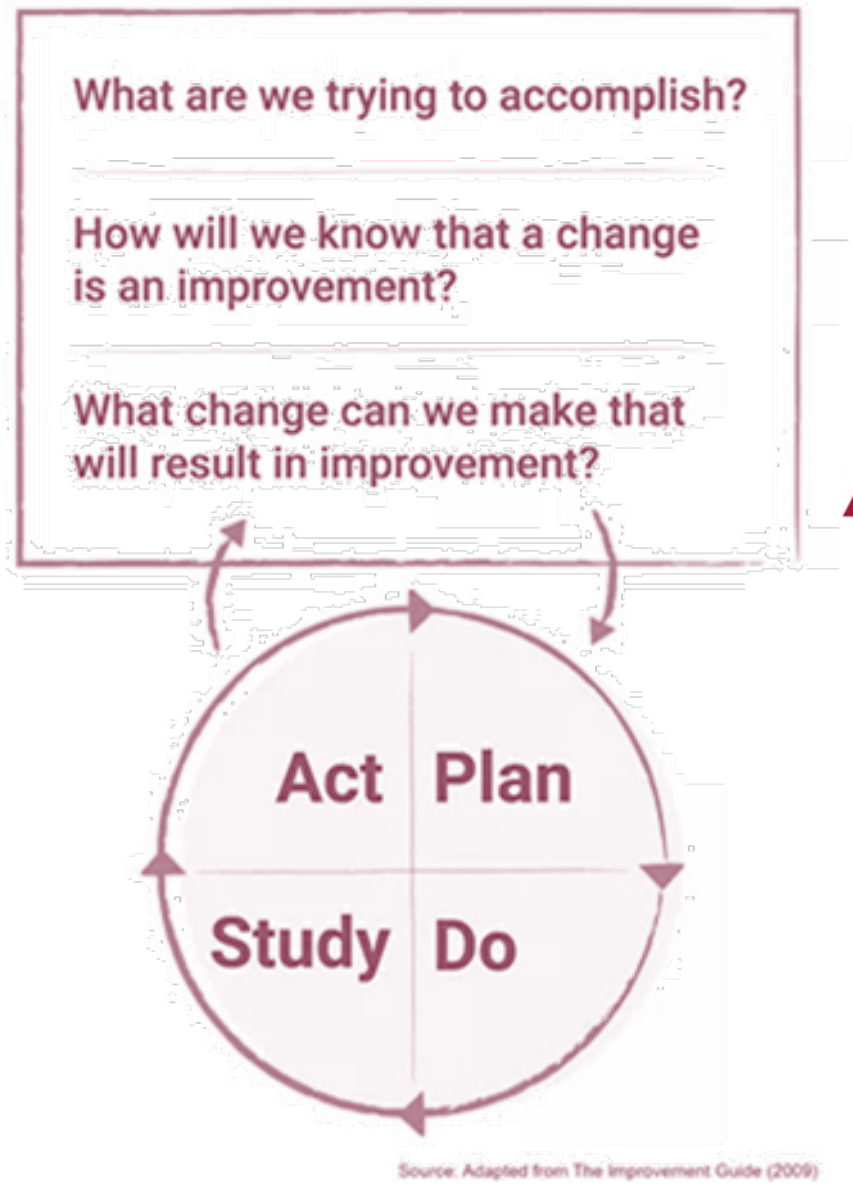
Design Science: An iterative process

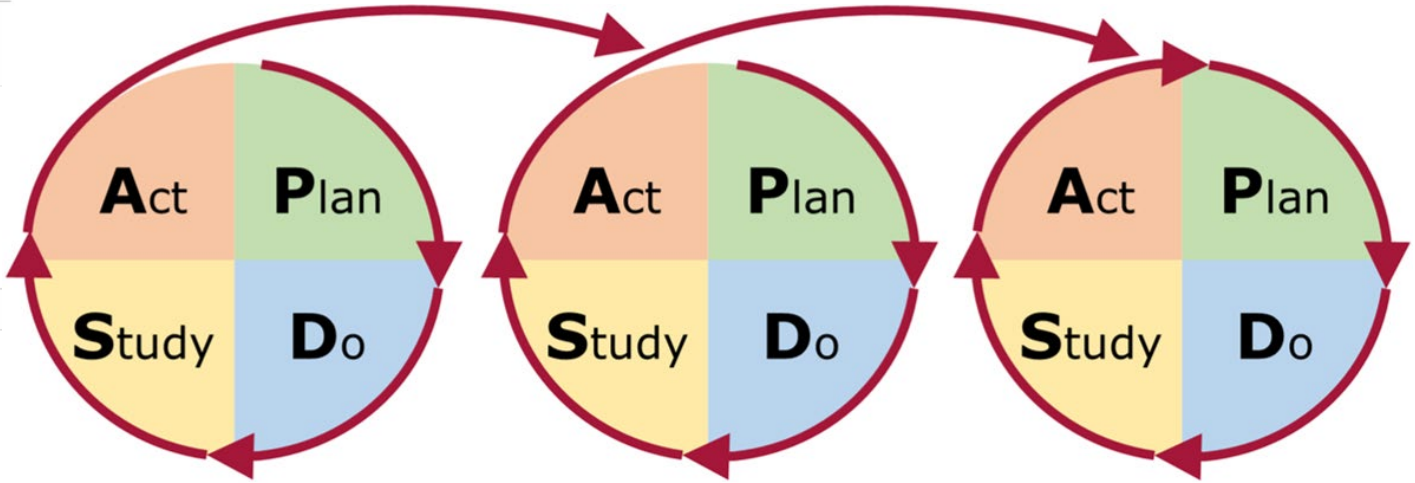




Evaluation Activities within the DSR Process (Adapted from Sonnenberg and vom Brocke (2012))

Quality Improvement





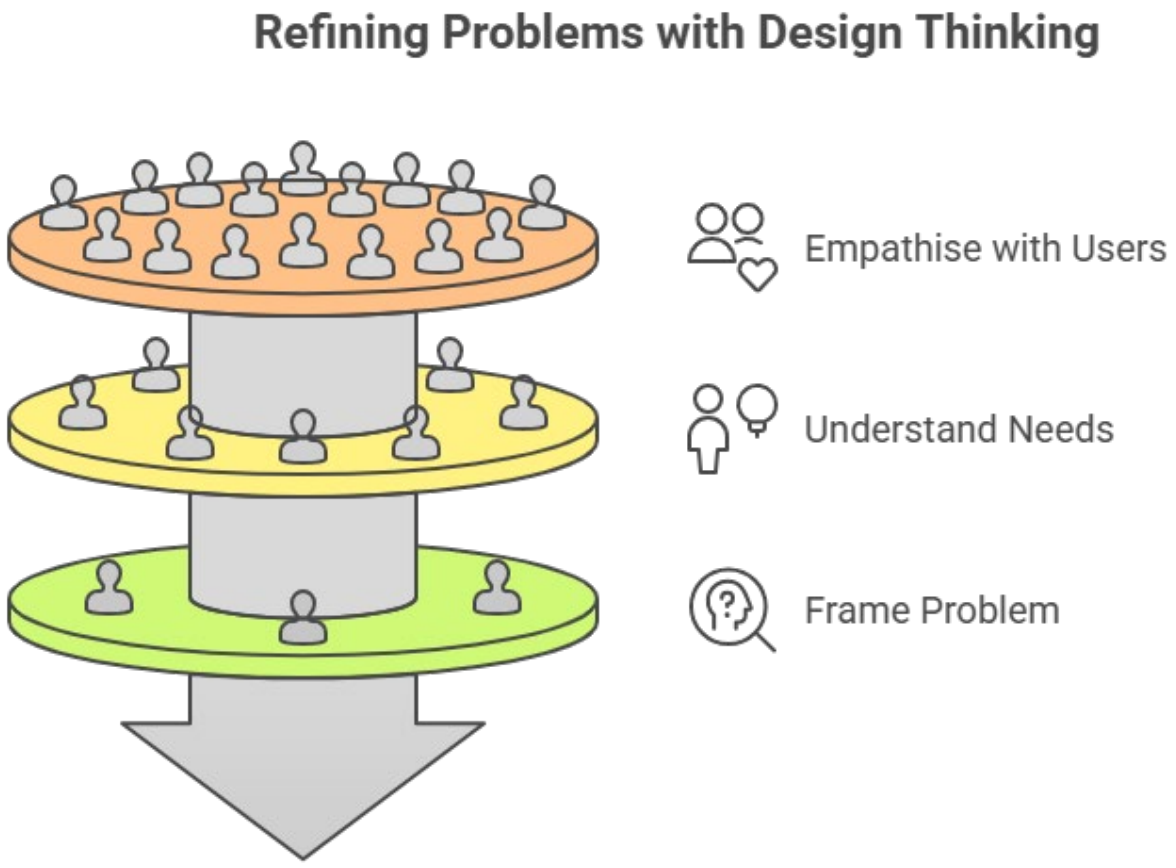
Design Science vs. Quality Improvement

	Design Science	Quality Improvement
Focus	Rigorously designed artifacts to **solve problems**	Systematic improvement of care processes and outcomes
Approach	Build → Evaluate → Refine	Plan → Do → Study → Act (PDSA cycles)
Strength	Scientific validation and solution impact	Measurement-driven sustainable change
Output	Evaluated tools, systems, models	Improved processes, protocols, reduced variation
Used for	Structuring and testing interventions	Optimising existing care delivery systems

These two approaches are complementary:

- Use Quality Improvement to systematically enhance existing care processes.
- Use Design Science to build and enhance digital/system solutions.

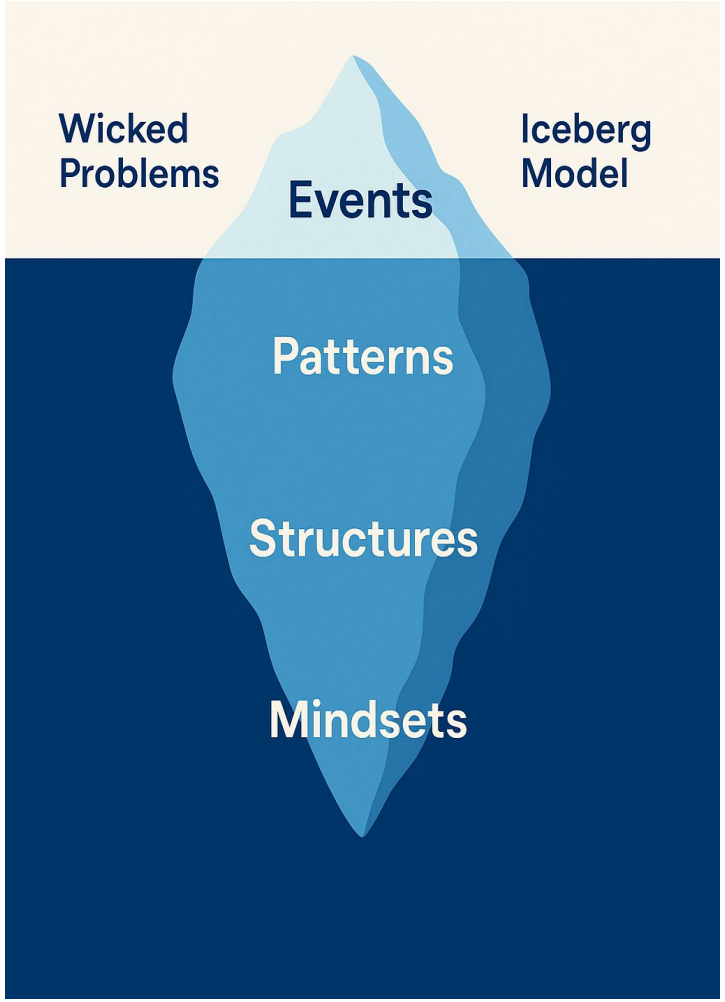
Design Thinking & the ‘Identify Problem’ Step in DSR & QI



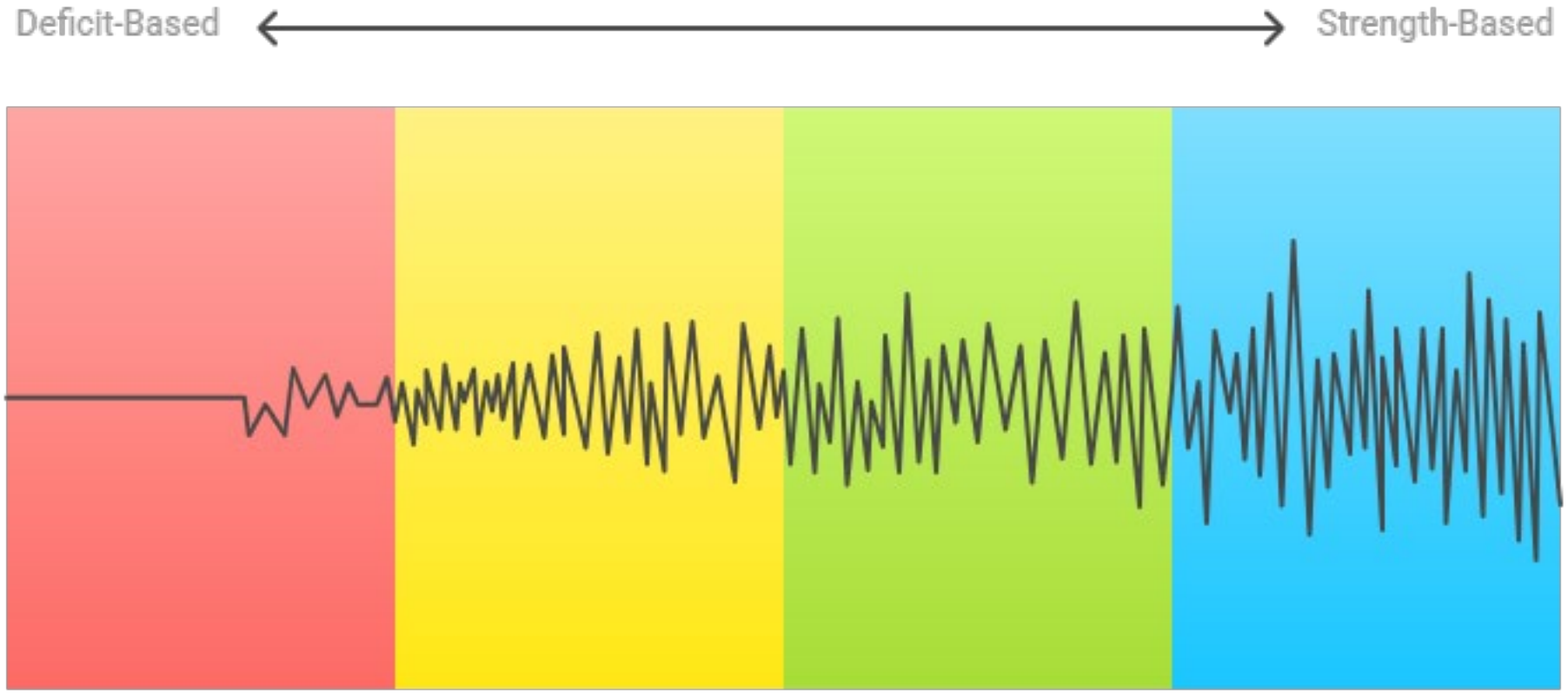
- Both DSR and QI begin with identifying a problem
- But many real-world problems are complex, messy, or ill-framed
- Design Thinking helps unpack the human side:
  - Empathise with users and stakeholders
  - Understand needs, frustrations, behaviours
  - Frame the problem in human-centred terms
  - **Result**: A clearer, more meaningful starting point for design / improvement.

Systems Thinking & Wicked Problems

- **Wicked Problems:** Complex issues with no clear solution or endpoint (e.g. health inequities, chronic disease burden, patient non-adherence). Often involve conflicting interests, shifting requirements, and unintended consequences.
- **Systems Thinking:** A way of understanding how different parts of a healthcare system interact. It helps identify root causes and interdependencies rather than treating symptoms in isolation.
- **Iceberg Model:** What we see (events) is only the tip. Patterns, structures, and mindsets below the surface drive what's visible.
- **Why It Matters:** Helps avoid short-term fixes that backfire. Encourages interventions that are systemic, preventative, and sustainable.
- **In Our Context:** Essential for understanding how patients navigate care systems, how clinical workflows affect outcomes, and how digital solutions fit into existing care processes.



Appreciative Inquiry In DSR and QI



Design Science Applications in PHC - Examples

Use Case	Problem	DSR Solution	Outcome
Patient Flow Management	Long waiting times and bottlenecks in clinics	Build integrated patient flow tracking system	Reduced waiting times; improved patient satisfaction
Chronic Disease Monitoring	Fragmented care across multiple visits and providers	Create longitudinal patient dashboard with care alerts	Better disease management; early intervention
Registrar Case Documentation	Supervisors can't effectively monitor registrar patient encounters for learning	Create digital case logging system with supervisor feedback loops	Better supervision quality; improved clinical competency development

Participatory Activities

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1

Activity 1: Iceberg Analysis – Use the Systems Thinking Toolkit to unpack a real challenge

2

Activity 2: Design Thinking Sprint – Ideate solutions to the challenge

3

Activity 3: Design Science Planning – Draft how you'd test and evaluate one solution

Design Science Research
Workshop Activity 1

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Design Science Research
Workshop Activity 2

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Design Science Research
Workshop Activity 3

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Conclusion & Next Steps

Key Takeaways

- Design Science = innovation with rigour
- Quality Improvement = systematic enhancement of care processes
- Design Thinking = tools for human-centred problem framing
- Systems Thinking = see the bigger picture, address root causes
- Appreciative Inquiry = focus on strengths and aspirations, not just deficits

In Our Context

- Family physicians can apply these methods in patient care systems, digital health tools, and clinical workflow improvement.

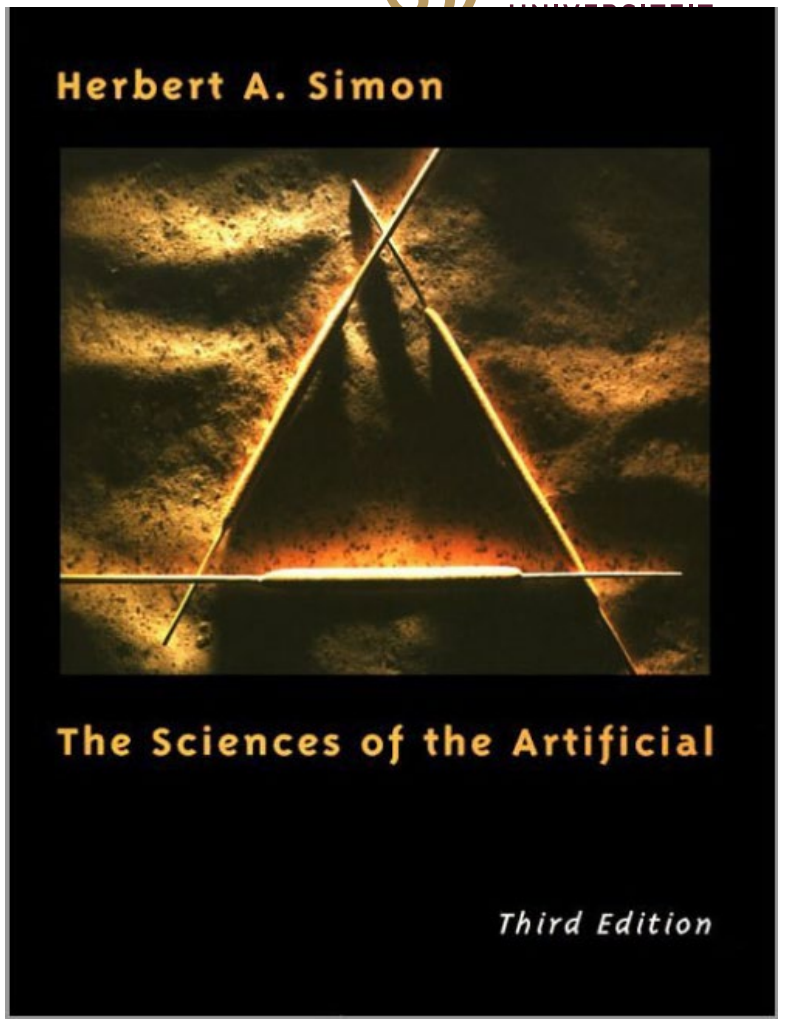
Next Steps

- Identify one project to apply this approach
- Share these concepts with your team
- Collaborate across units using design-led workshops

Herbert Simon: The Sciences of the Artificial

"Everyone designs who devises courses of action aimed at changing existing situations into preferred ones.

The intellectual activity that produces material artifacts is no different fundamentally from the one that prescribes remedies for a sick patient... or a social welfare policy for a state."



Further Reading

- *Key references*

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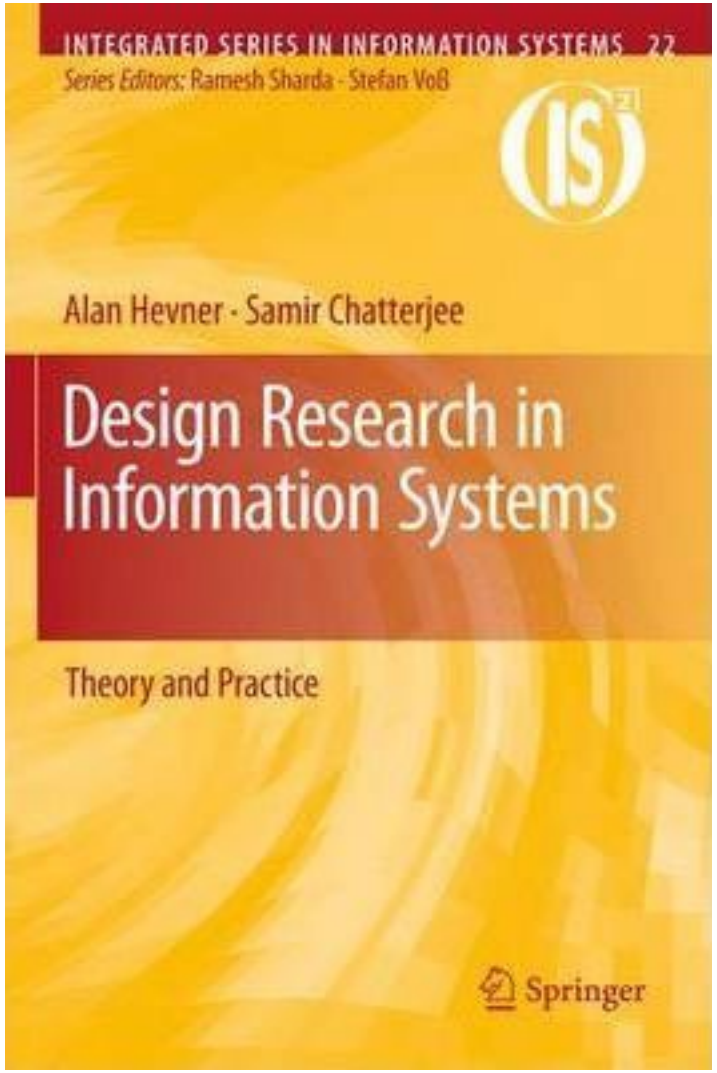

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