LEAN IN DESIGN FORUM

MAY 27–28, 2020

Conflicting Design Requirements

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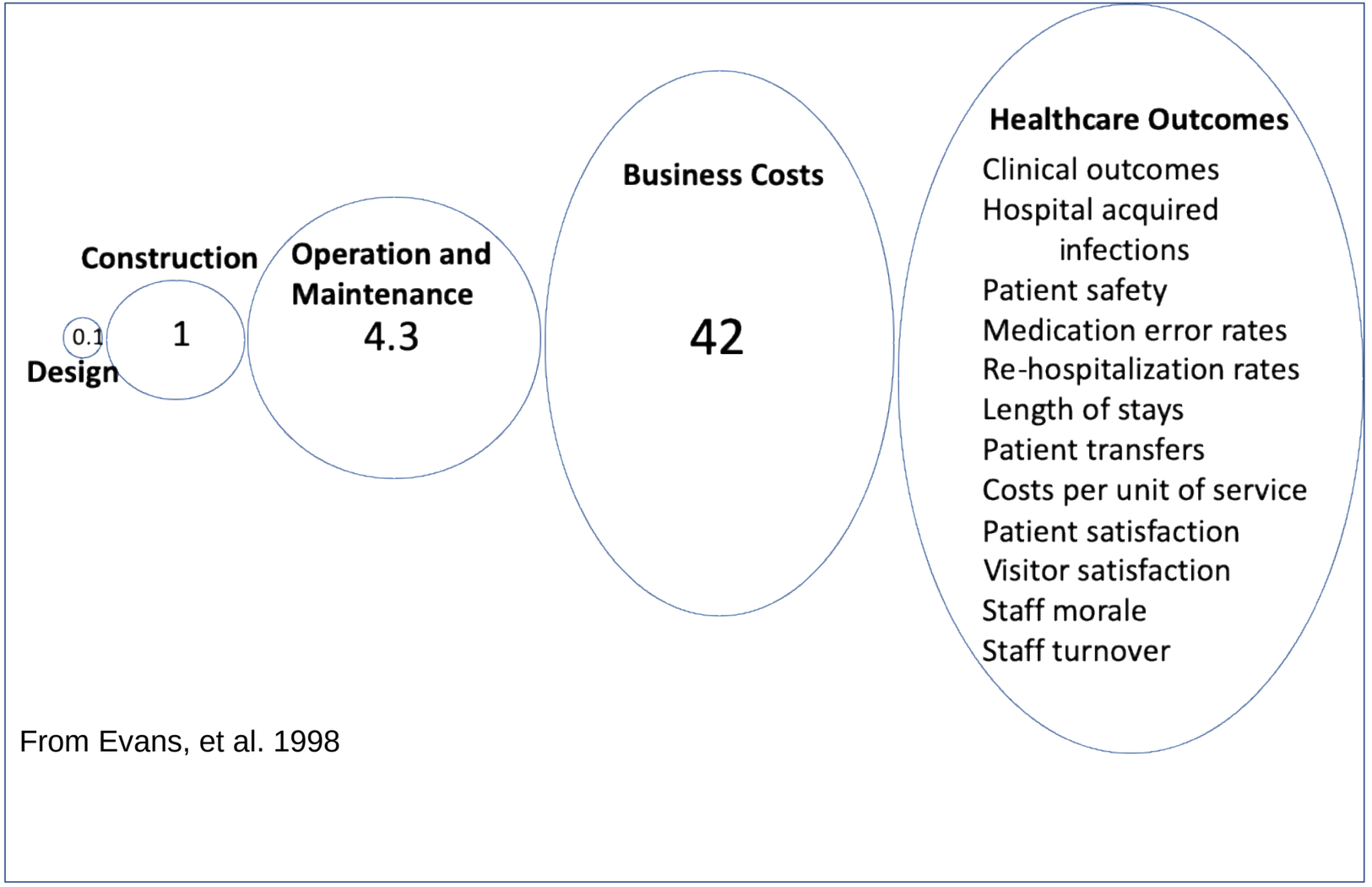
May 27, 2020

Our topics for today

1. **Why** do conflicts need to be managed?
2. **What** are conflicting design requirements?
3. **How** to manage conflicting design requirements?

Benefits and Costs



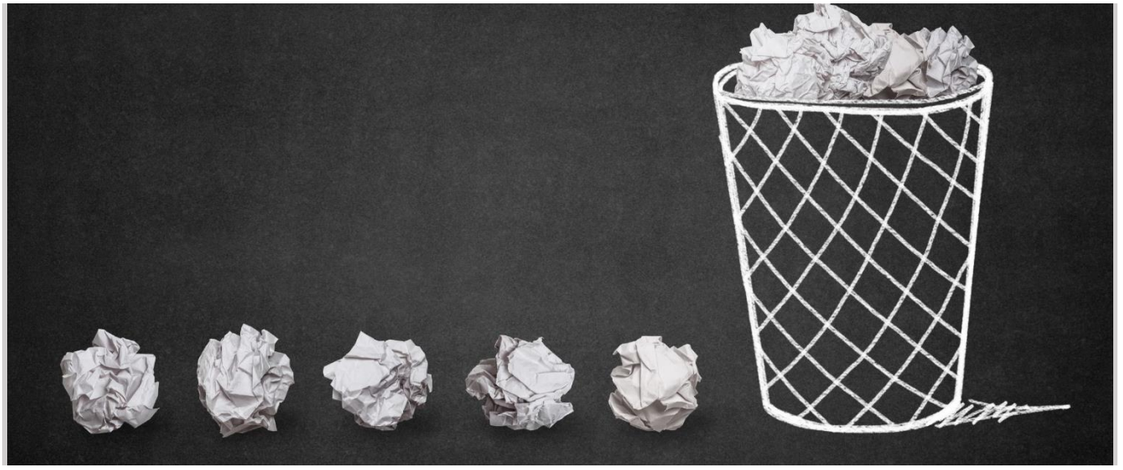
From Evans, et al. 1998

Rework in Design: Its Causes

1. Teams learn something critical late in the development process.

2. Teams make critical decisions too early in the design process, before they develop the knowledge needed.

3. Designers with one expertise paint designers of another expertise into corners that will not work.



Kennedy, Brian M., Durward K. Sobek, and Michael N. Kennedy. "Reducing Rework by Applying Set-Based Practices Early in the Systems Engineering Process." Systems Engineering 17, no. 3 (May 21, 2013): 278–296

Rework in Design: Its Causes and Remedies

- 1st Cause: Teams learn something critical late in the development process.
- Remedy 1: Replace design-then-test with test-before-design to accelerate learning in the early phases.
- Remedy 2: Learn the sets of possibilities rather than single points, capturing set-based knowledge (such as limit curves) that covers the full range of possible designs.

Test before design

Sets of possibilities

Kennedy, Brian M., Durward K. Sobek, and Michael N. Kennedy. "Reducing Rework by Applying Set-Based Practices Early in the Systems Engineering Process." Systems Engineering 17, no. 3 (May 21, 2013): 278–296

Rework in Design: Its Causes and Remedies

- 2nd Cause: Teams make critical decisions too early in the design process, before they develop the knowledge needed.
- Remedy 3: Specify customer and business interests as target ranges, giving the development teams room to explore, innovate, and find the most appealing trade-offs for both the business and customer interests.
- Remedy 4: Use set-based specifications in the early phases of development, and allow the final specifications to emerge from the learning in the convergence process.
- Remedy 5: Investigate alternative ideas in parallel when uncertainty is high or when teams must select from among fundamentally different technologies or design approaches, but do so with a focus on quickly identifying and eliminating the weak alternatives.

Trade-off

Specs emerge

Investigate in parallel

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Rework in Design: Its Causes and Remedies

- 3rd Cause: Designers with one expertise paint designers of another expertise into corners that will not work.
- Remedy 6: Leverage set-based knowledge to communicate the key issues from one area of expertise to another, breaking down the walls.
- Remedy 7: Leverage set-based specifications to minimize the restrictions on later design phases, maximizing the design windows within which they can optimize without risking later rework.

Communicate Across areas

Maximize design window

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Our topics for today

1. Why do conflicts need to be managed?

   IN ORDER TO INCREASE VALUE AND REDUCE WASTE

2. What are conflicting design requirements?

What are design requirements?

- Requirements are a guess about the appropriate compromise between customer desire and engineering feasibility.
- Customers want infinite performance, zero weight, and zero cost; "requirements" are guesses at what we can provide at a profit.

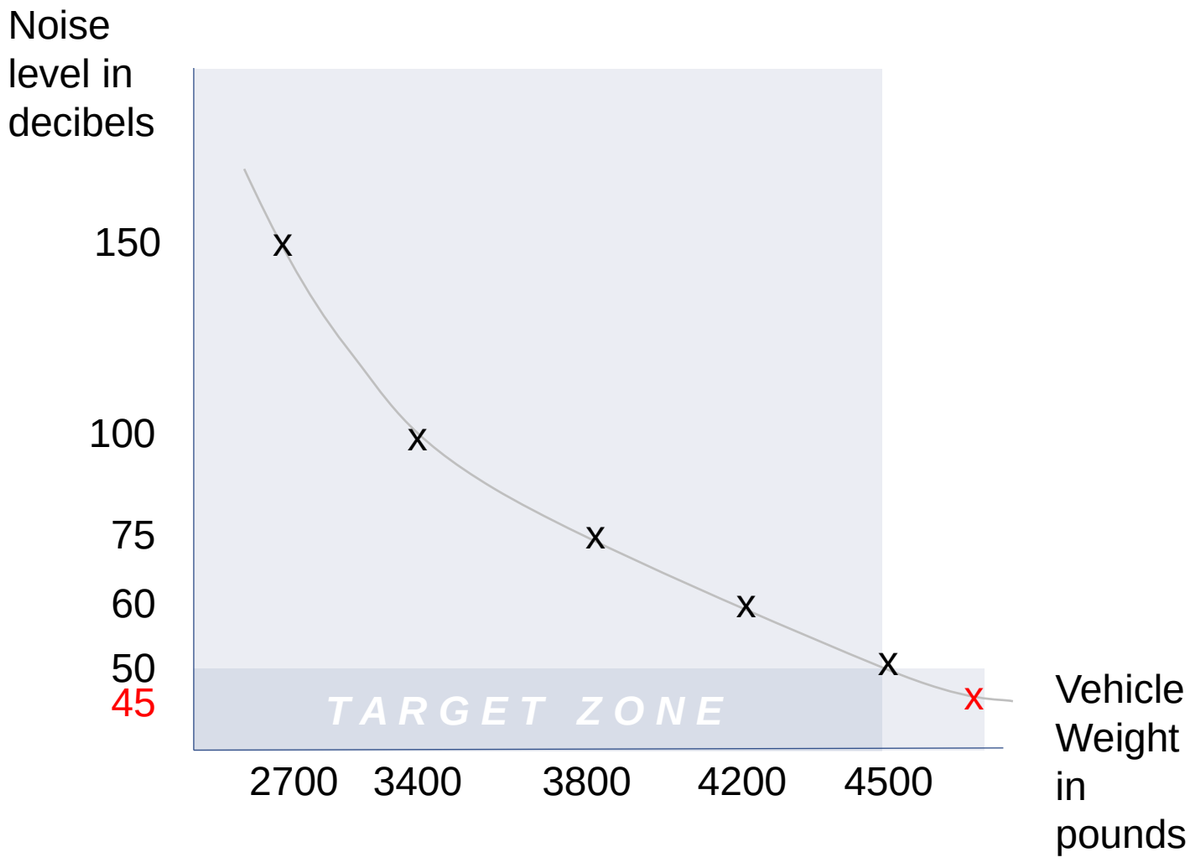
[From Ward, Oosterwaal and Sobek's *Visible Knowledge for Flawless Designs]*

Lexus Chief Engineer Suzuki's YETs

YET

- Great high-speed handling/stability
- Fast and smooth ride
- Super quiet
- Elegant styling
- Warm
- Great stability at high speed
- A pleasant ride
- Low fuel consumption
- Light weight
- Great aerodynamics
- Functional interior
- Low aerodynamic friction

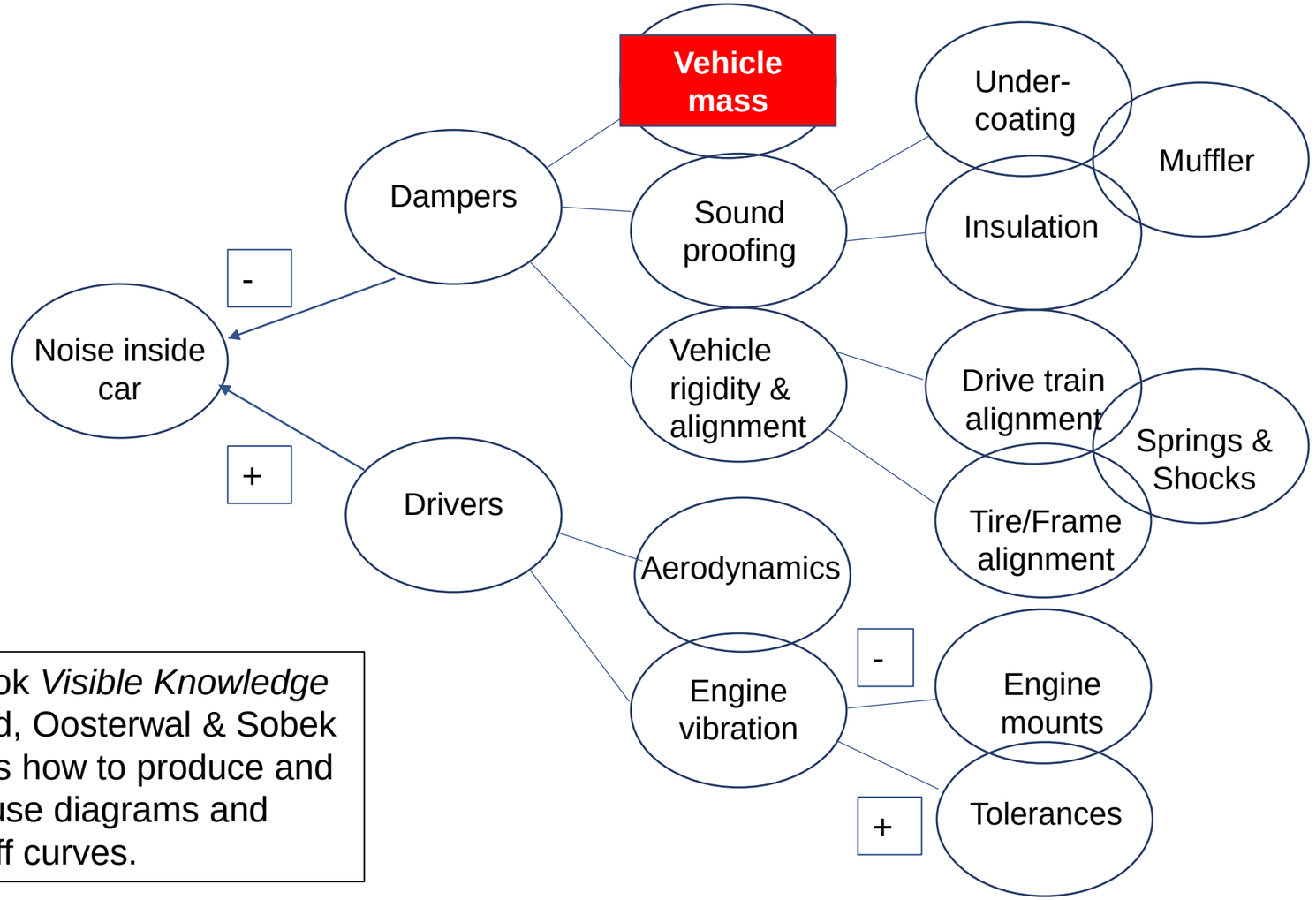
A Trade-Off Curve: Noise vs Weight



Suzuki wants to design a Lexus so its noise level is less than 50 decibels and weight is less than 4500 pounds. That had never been done before. So how to resolve the conflict without relaxing the targets?

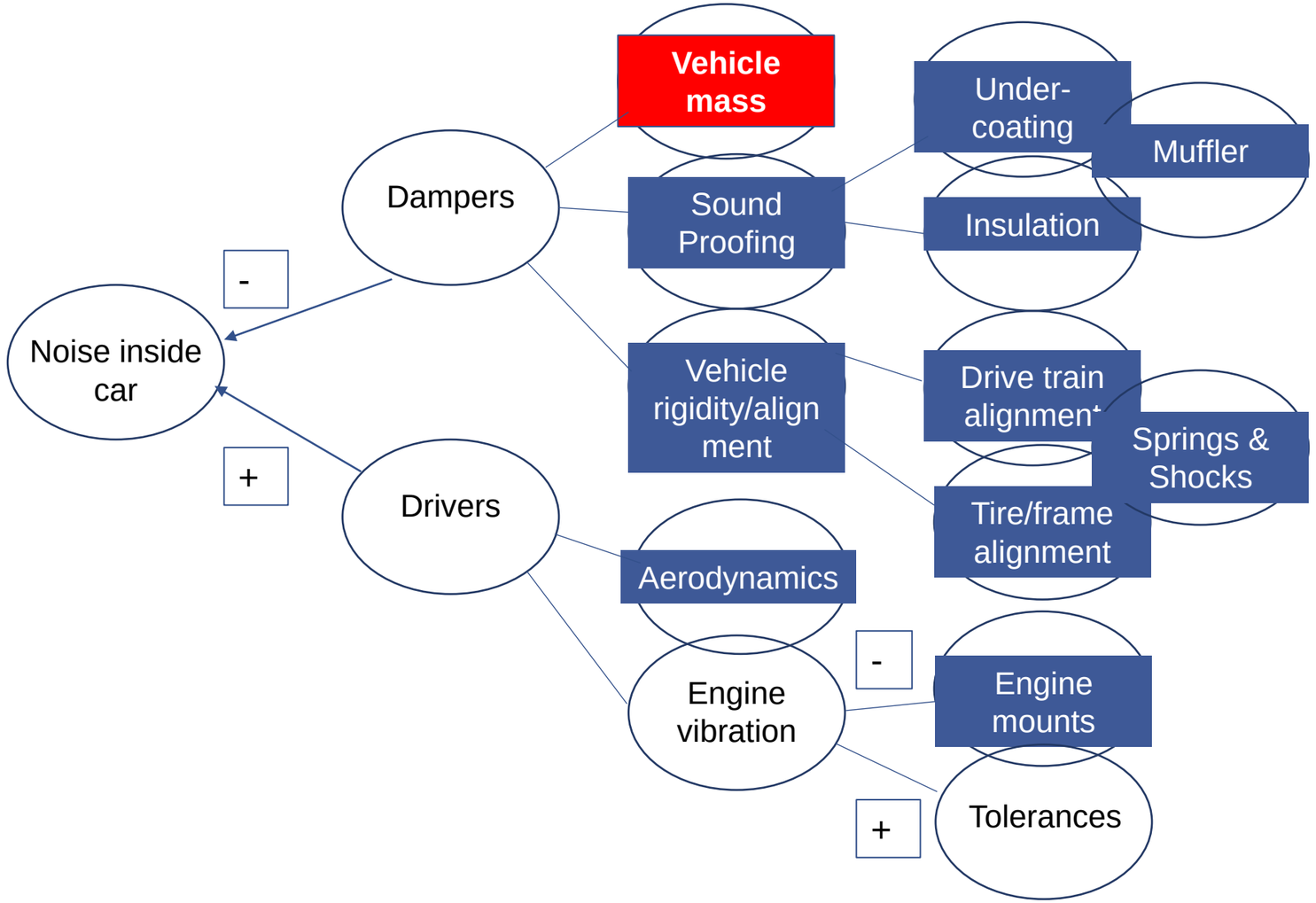
Answer: attack a related variable—in this case, the primary source of vibration, the engine.

Cause diagram



The book *Visible Knowledge* by Ward, Oosterwal & Sobek explains how to produce and use cause diagrams and trade-off curves.

Cause diagram



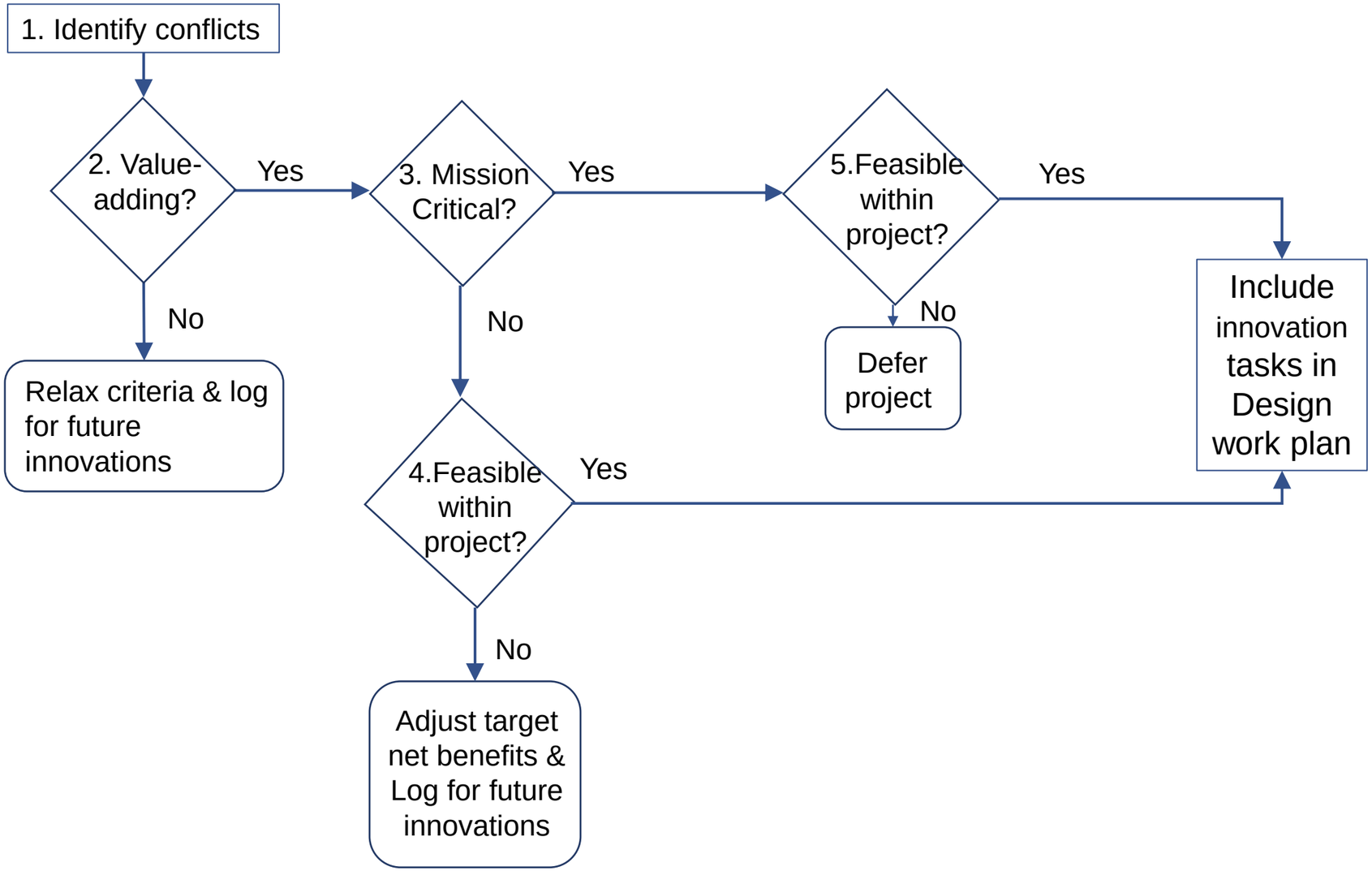
Our topics for today

1. Why do conflicts need to be managed? IN ORDER TO INCREASE BENEFITS (VALUE) AND REDUCE COSTS (WASTE)
2. What are conflicting design criteria? CRITERIA THAT CANNOT BE SATISFIED AT TARGET LEVELS WITHOUT DESIGN INNOVATION
3. How to manage conflicting design criteria?

Find Limits, then Design

We have argued that the design process must be understood to start with deciding how to specify requirements that best deliver customers what they want, balancing desire and feasibility, before “detailed design”. Doing so involves identifying and resolving conflicts between design criteria.

Managing Conflicting Design Criteria



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3. How to manage conflicting design criteria? USE OUR PROCESS FOR MANAGING CONFLICTING DESIGN CRITERIA

Future Research

A. How to do programming that
   1. …specifies customer and business interests as target ranges, giving the project teams room to explore, innovate and find the most appealing trade-offs for both the business and customer interests.
   2. …reveals what is needed to identify and resolve conflicting design criteria:
      - What is mission critical for the project?
      - What are the target benefits in use of the constructed asset?
      - What are the constraints on project delivery?

B. Are we doing set based design as we should in built environment design?
   We plan to do descriptive research to understand current set based design practice, then action research to improve current practice, including the use of Choosing by Advantages.

C. How to ‘innovate on demand’? We propose that specifying where innovation is needed improves innovation efforts and will study recent research on abduction as a possible innovation tool.

Activity

Discuss in each group – 10 min to discuss & 3 min to report out

- What conflicting criteria have you found when designing projects?
  - Make a list in your group (at least 5)
  - Share your experiences
  - Pick one to share back along with the list.

Plus/Delta

PLUS

- great discussion topic and contributions. Successful technology for breakouts
- the presenters did a great job working together
- well organized information and presented succinctly
- excellent graphics
- a good tangible example of solutions to design consflicts are hybrid buildings
- an hour for this topic is a good introduction and well done
- Bravo! Good dru run for Congress

DELTA

- hard to have bigger shared conversations
- need more time to fully cover breakout sharing
- how to get more people talking in breakoutds
- time, you need more to cover anything with a large group like this and fit in discussion
- allocated time is short for part 2
- Dropped Last Responsible Moment Q…answer is to have viable option as baseline to innovate against
- Knowledge management crucial
- How to respond to personal issues in design team?
    - Change team? Leverage CBA for objectivity? Depersonalize?

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MAY 27–28, 2020

In the spirit of continuous improvement, we would like to remind you to complete this session's survey! We look forward to receiving your feedback.

Lean Construction Institute
Transforming the Built Environment

AIA

P2SL