Research Computing Grows Up

(http://www.esp.org/briite/meetings)

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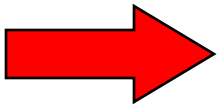
Research Computing Grows Up



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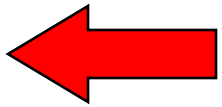

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Research Computing Grows Up

Just grow up, will ya!

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Just Grow Up

IMMATURE	MATURE
dependent	independent

Just Grow Up

IMMATURE	MATURE
dependent	independent
emotional	rational

Just Grow Up

IMMATURE	MATURE
dependent	independent
emotional	rational
impulsive	deliberate

Just Grow Up

IMMATURE	MATURE
dependent	independent
emotional	rational
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impatient	patient

Just Grow Up

IMMATURE	MATURE
dependent	independent
emotional	rational
impulsive	deliberate
impatient	patient
impractical	practical

Just Grow Up

Maturity:

There are attributes that are associated with maturity in people.

Just Grow Up

Maturity:

There are attributes that are associated with maturity in people.

There are also attributes are associated with maturity in information technology.

Just Grow Up

Considering what it means for research computing to grow up is the subject of this meeting.

Just Grow Up

When building production systems, shiny is nice…

Just Grow Up

When building production systems, shiny is nice…

…but reliable is better.

Growing Up

As you grow up, the bar keeps going up:

- Counting
- Simple Math
- Algebra
- Calculus

Growing Up

As you grow up, the bar keeps going up:

- Counting
- Simple Math
- Algebra
- Calculus

So do the stakes:

- No gold star
- Fail the test
- Don’t graduate
- The bridge falls down / people die

The Stakes Go Up

Biomedical research is now dependent upon information technology.

The Stakes Go Up

Biomedical research is now dependent upon information technology.

This dependence is transforming biomedical research.

The Stakes Go Up

Biomedical research is now dependent upon information technology.

This dependence is transforming biomedical research.

It is also transforming research computing.

The Stakes Go Up

Research Computing is Growing Up

The Stakes Go Up

Challenge:

Research computing has rapidly become a *sine qua non* for biomedical research and must be managed accordingly.

The Stakes Go Up

Problem:

Historically, much research computing was developed in an ad hoc manner, rapidly tracking the needs of a particular lab or project.

The Stakes Go Up

Bi… …ent u…

T… b…

It… co…

Problem:

When it worked, that was great. When it didn't, we could do without.

Now, we have to have it, most of the time.

Topics

- Capability Maturity Model
- Background:
  - Why Now?
  - Scalability Insights
- Capacity Management
- Sufficiency as a Requirement
- How Good is Good Enough?

Topics

- Going Forward:
  - Striving for Level 5 Performance
  - Managing Robust, Scalable Infrastructure
  - Understanding our Gear
  - Providing Formal Project Management
  - Offering Informatics as a Discipline
  - Achieving Research Access to Clinical Data
  - Delivering Real Security
  - Developing Service Level Agreements
  - Committing to Long-term Planning
  - Building Architected Solutions
- Summary

Capability Maturity Model

Capability Maturity Model

The capability maturity model was developed by Carnegie Mellon for the Air Force as a method for judging the capabilities of software developers.

Capability Maturity Model

Capability Maturity Model® Integration (CMMI℠), Version 1.1

CMMI℠ for Systems Engineering, Software Engineering, Integrated Product and Process Development, and Supplier Sourcing (CMMI-SE/SW/IPPD/SS, V1.1)

Staged Representation
CMU/SEI-2002-TR-012
ESC-TR-2002-012

Capability Maturity Model

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Staged Representation
CMU/SEI-2002-TR-012
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http://www.sei.cmu.edu/publications/documents/02.reports/02tr012.html

Capability Maturity Model

The CMM model has five levels:

- Maturity Level 1: Initial
- Maturity Level 2: Repeatable
- Maturity Level 3: Defined
- Maturity Level 4: Quantitatively Managed
- Maturity Level 5: Optimizing

Level 1: Initial

At maturity level 1, processes are usually ad hoc and the organization usually does not provide a stable environment. Success in these organizations depends on the competence and heroics of the people in the organization and not on the use of proven processes. In spite of this ad hoc, chaotic environment, maturity level 1 organizations often produce products and services that work; however, they frequently exceed the budget and schedule of their projects.

Maturity level 1 organizations are characterized by a tendency to over commit, abandon processes in the time of crisis, and not be able to repeat their past successes again.

Level 2: Repeatable

At maturity level 2, software development successes are repeatable. The organization may use some basic project management to track cost and schedule.

Process discipline helps ensure that existing practices are retained during times of stress. When these practices are in place, projects are performed and managed according to their documented plans.

Project status and the delivery of services are visible to management at defined points (for example, at major milestones and at the completion of major tasks).

Basic project management processes are established to track cost, schedule, and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications.

Level 3: Defined

At maturity level 3, processes are well characterized and understood, and are described in standards, procedures, tools, and methods.

The organization's set of standard processes is established and improved over time. These standard processes are used to establish consistency across the organization. Projects establish their defined processes by the organization's set of standard processes according to tailoring guidelines.

The organization's management establishes process objectives based on the organization's set of standard processes and ensures that these objectives are appropriately addressed.

A critical distinction between level 2 and level 3 is the scope of standards, process descriptions, and procedures. At level 2, the standards, process descriptions, and procedures may be quite different in each specific instance of the process (for example, on a particular project). At level 3, the standards, process descriptions, and procedures for a project are tailored from the organization's set of standard processes to suit a particular project or organizational unit.

Level 4: Quantitatively Managed

Using precise measurements, management can effectively control the software development effort. In particular, management can identify ways to adjust and adapt the process to particular projects without measurable losses of quality or deviations from specifications.

Sub-processes are selected that significantly contribute to overall process performance. These selected sub-processes are controlled using statistical and other quantitative techniques.

A critical distinction between maturity level 3 and maturity level 4 is the predictability of process performance. At maturity level 4, the performance of processes is controlled using statistical and other quantitative techniques, and is quantitatively predictable. At maturity level 3, processes are only qualitatively predictable.

Level 5: Optimizing

Maturity level 5 focuses on continually improving process performance. Quantitative process-improvement objectives are established and used as criteria in managing improvement. The effects of deployed improvements are measured and evaluated against the objectives. Both the defined processes and the organization's set of standard processes are targets of measurable improvement activities.

Improvements to address common causes of variation and to improve the organization's processes are identified, evaluated, and deployed.

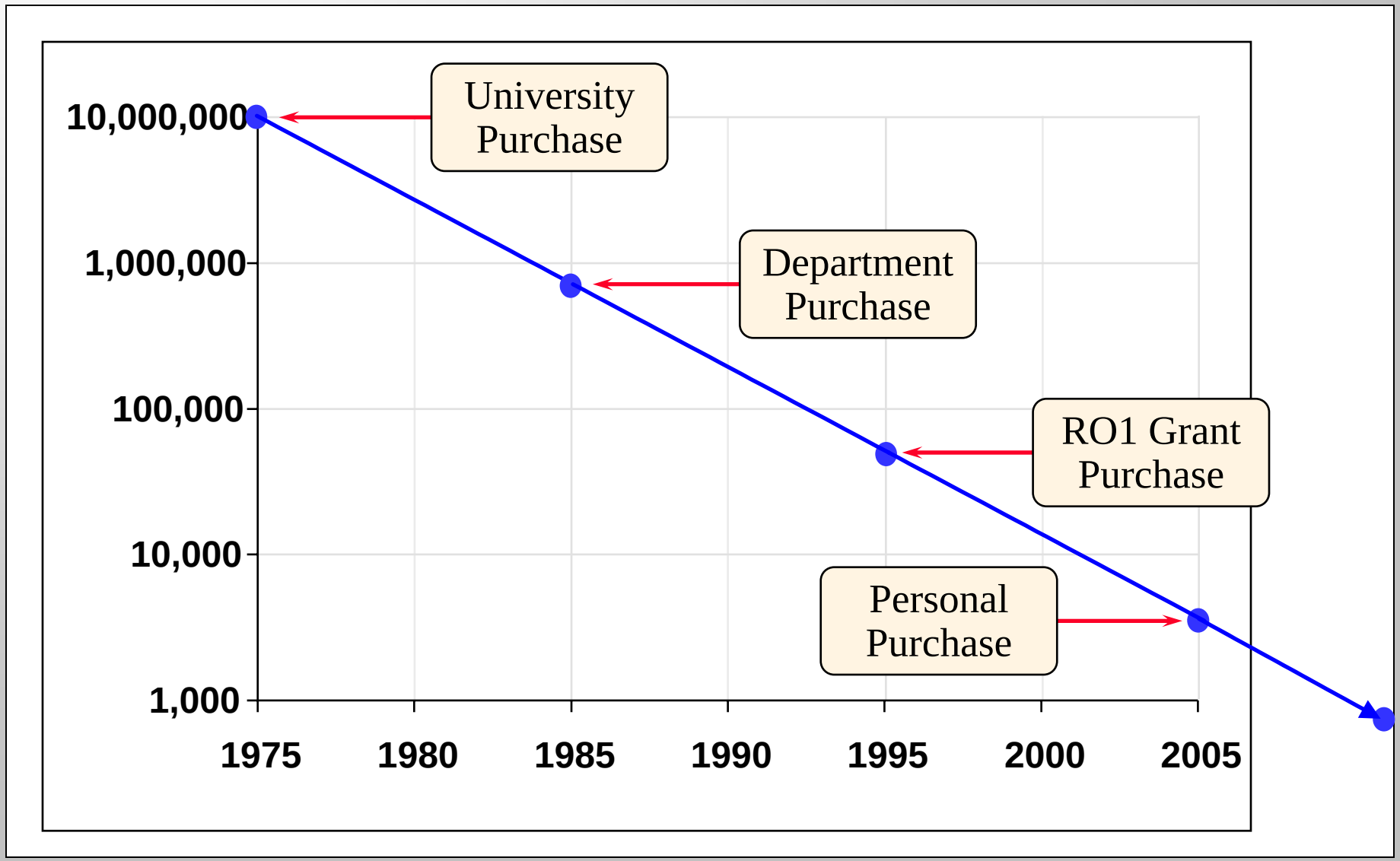
A critical distinction between maturity levels 4 and 5 is the type of process variation addressed. At level 4, processes are designed to address special causes of process variation and to provide statistical predictability of the results. Though processes may produce predictable results, the results may be insufficient to achieve the established objectives.

At level 5, processes are concerned with addressing common causes of process variation and with changing the process to improve performance (while maintaining statistical probability).

Background

Why Now?

Cost (constant performance)

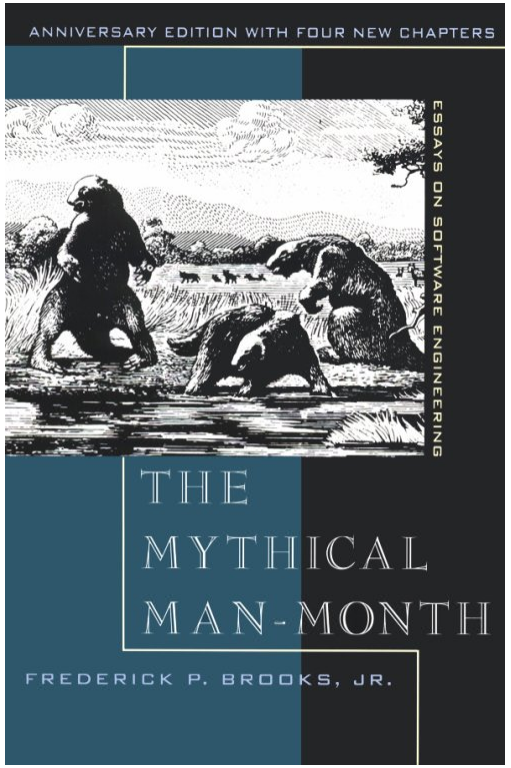


Background

Scalability Insights

Scalability Insights

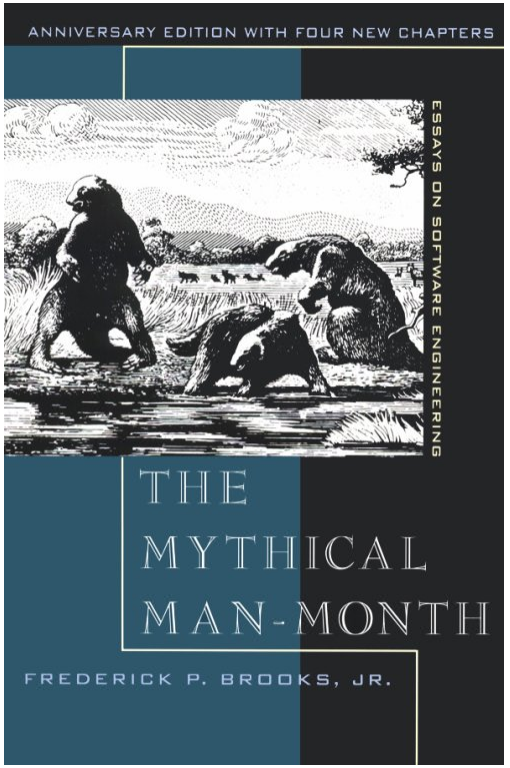
- Optimize for Growth
- Understand Scaling Problems
- Read *The Mythical Man Month*



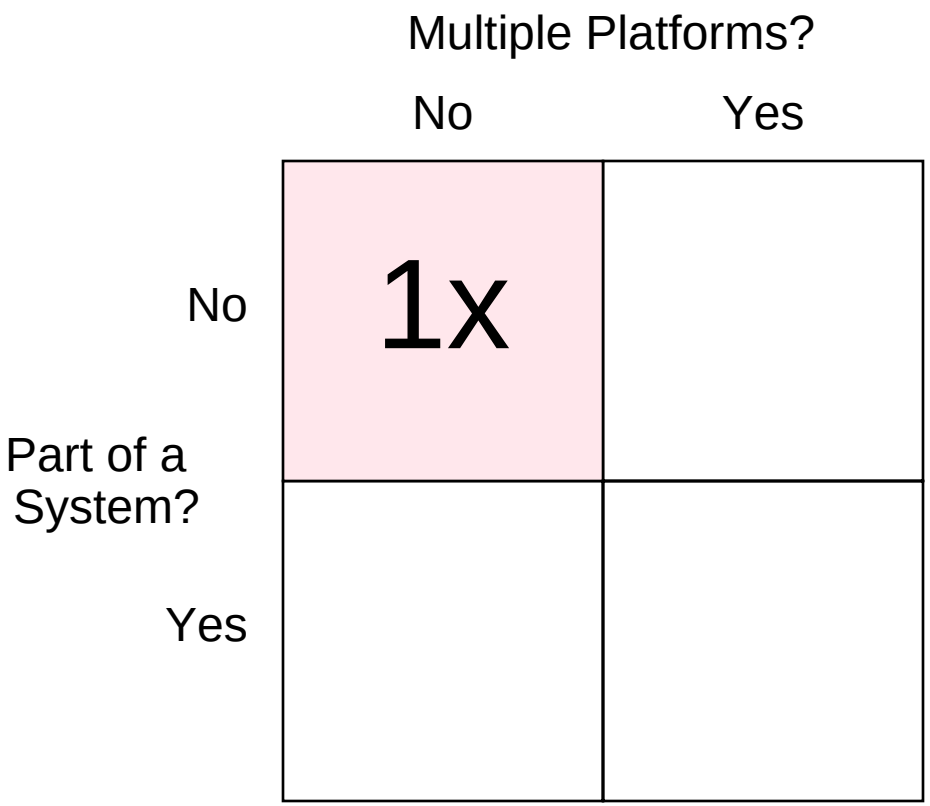
Scalability Insights

- Optimize for Growth
- Understand Scaling Problems
- Read *The Mythical Man Month*

  More than once



Mythical Man Month



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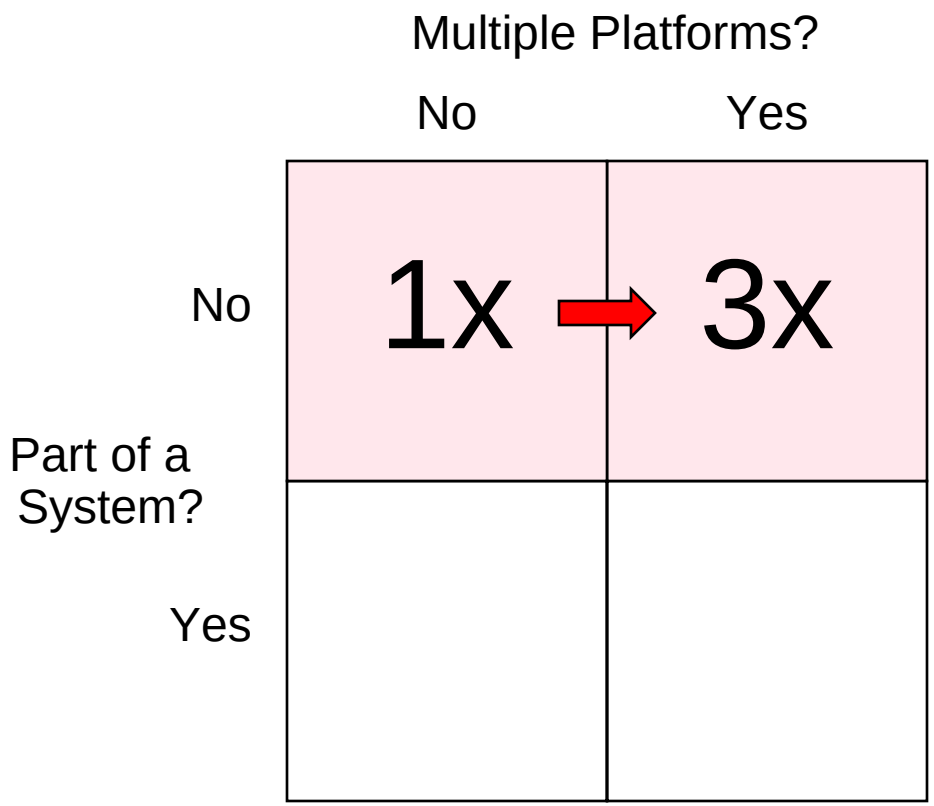

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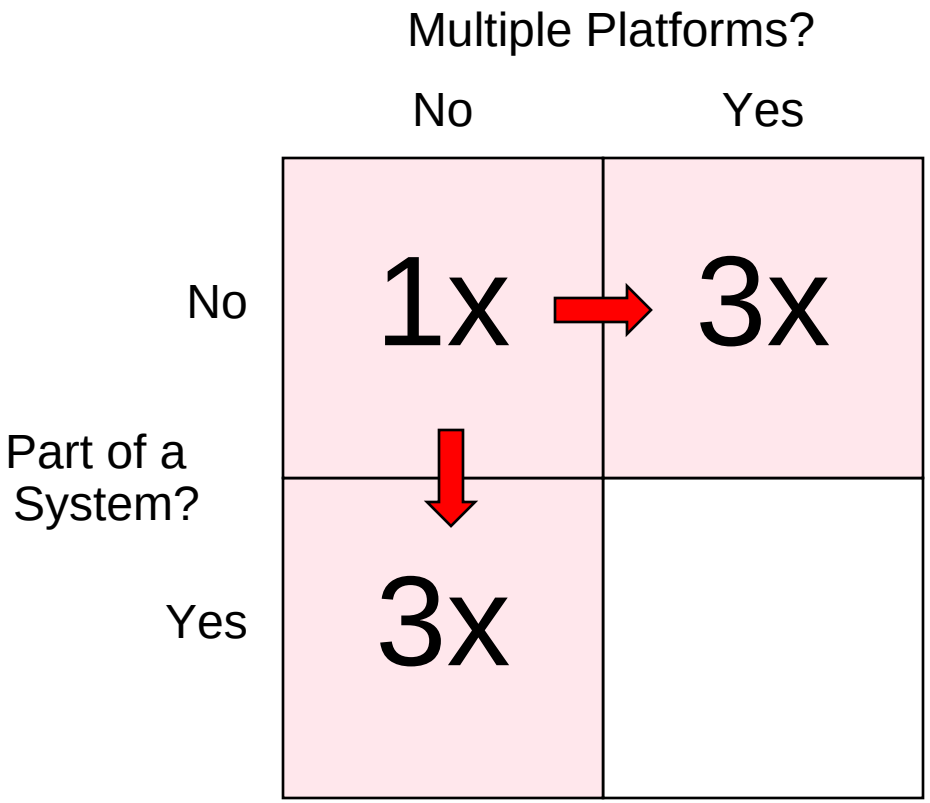

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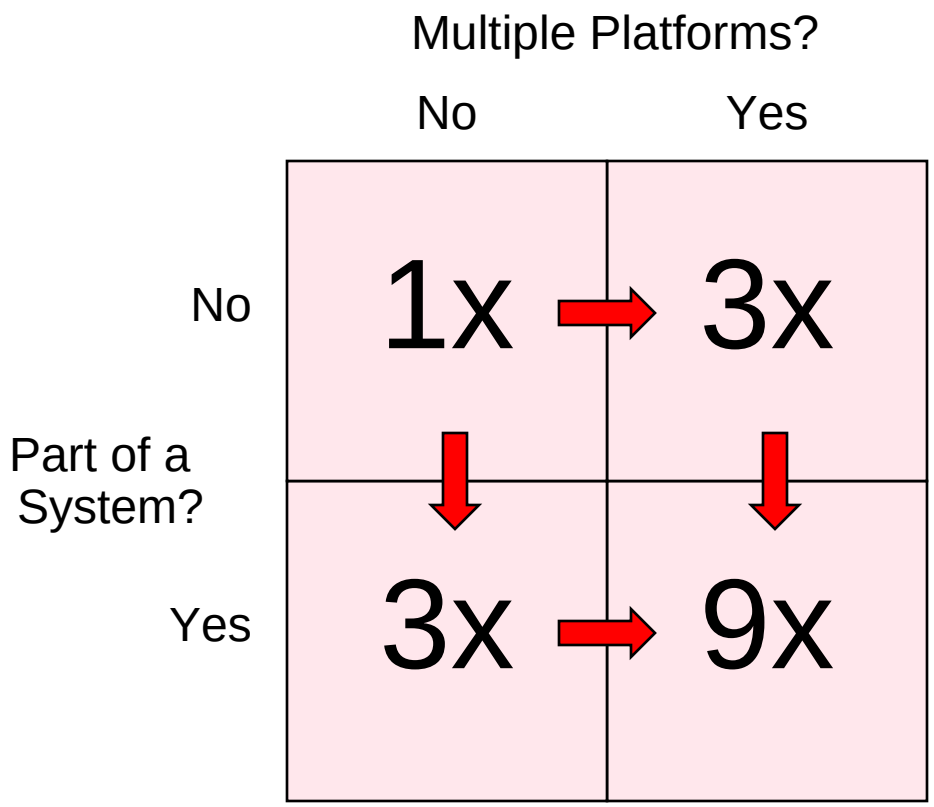

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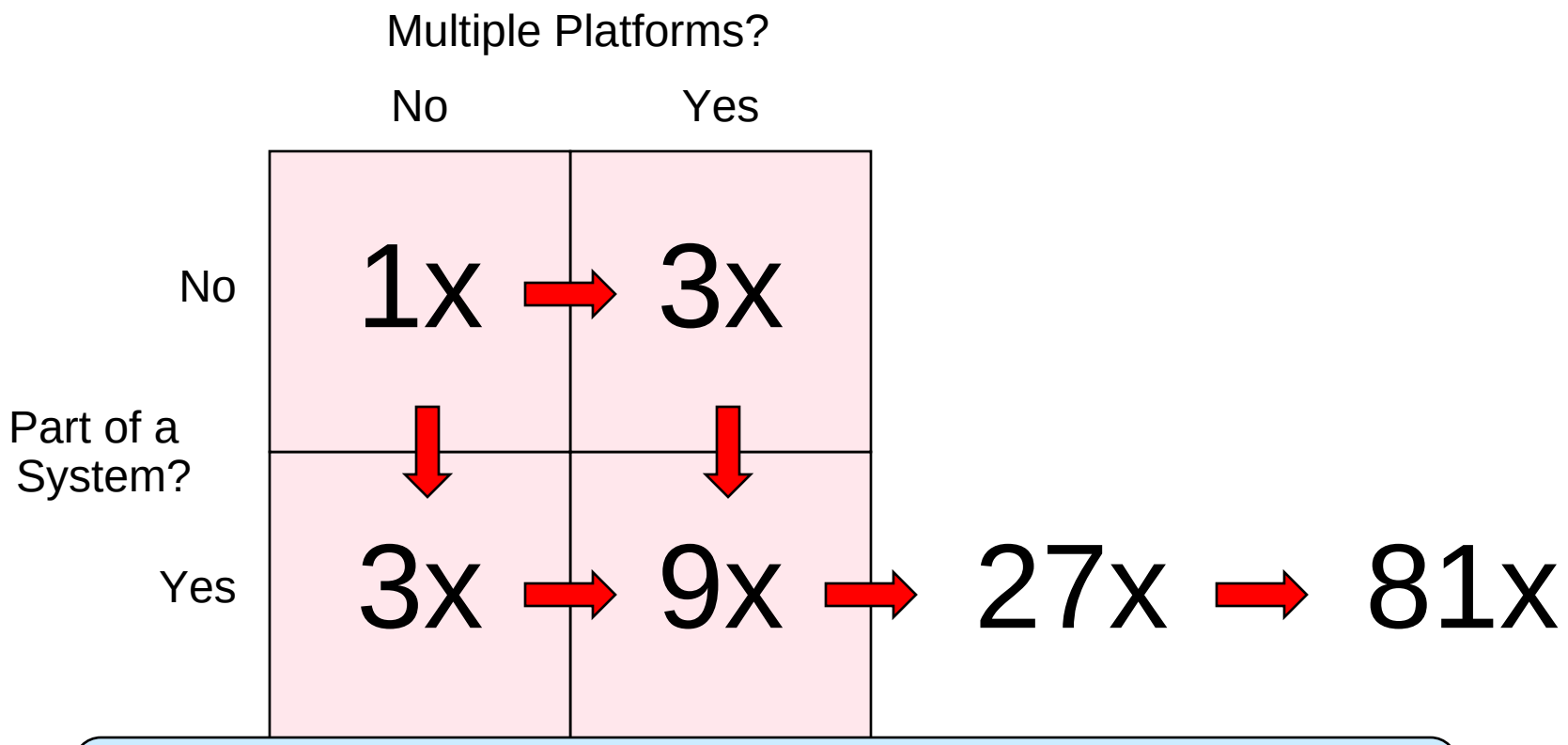
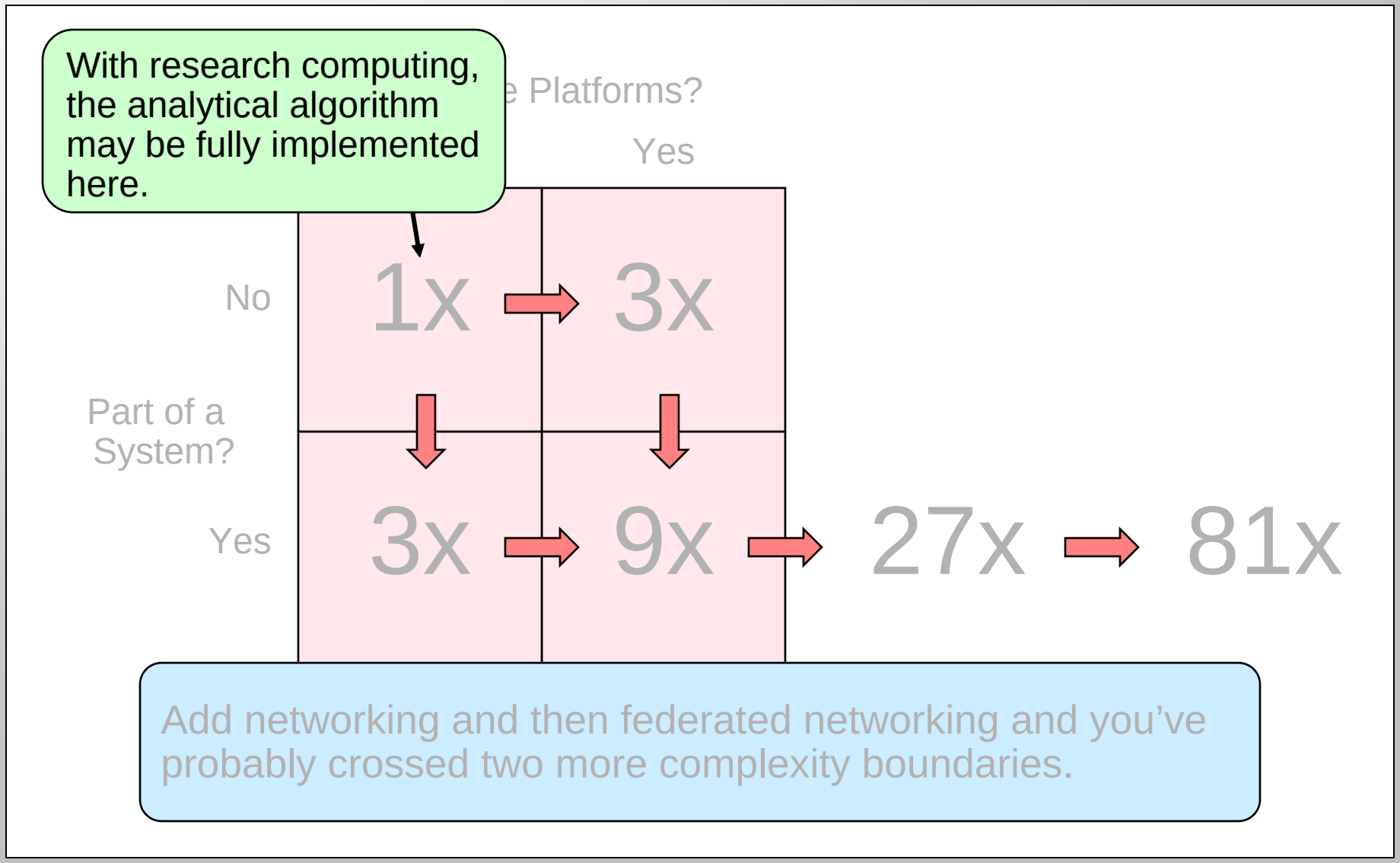


Add networking and then federated networking and you've probably crossed two more complexity boundaries.

Mythical Man Month



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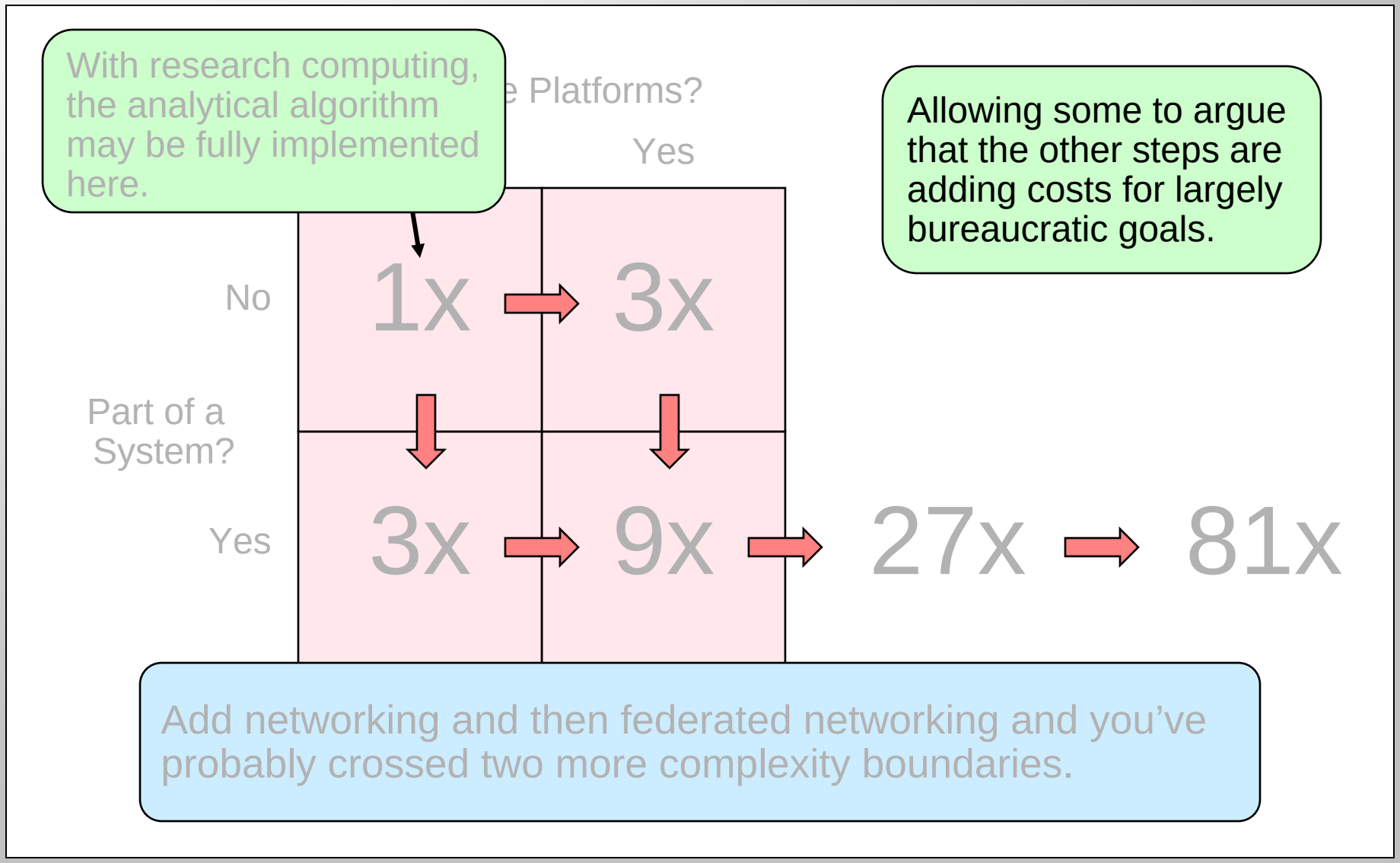

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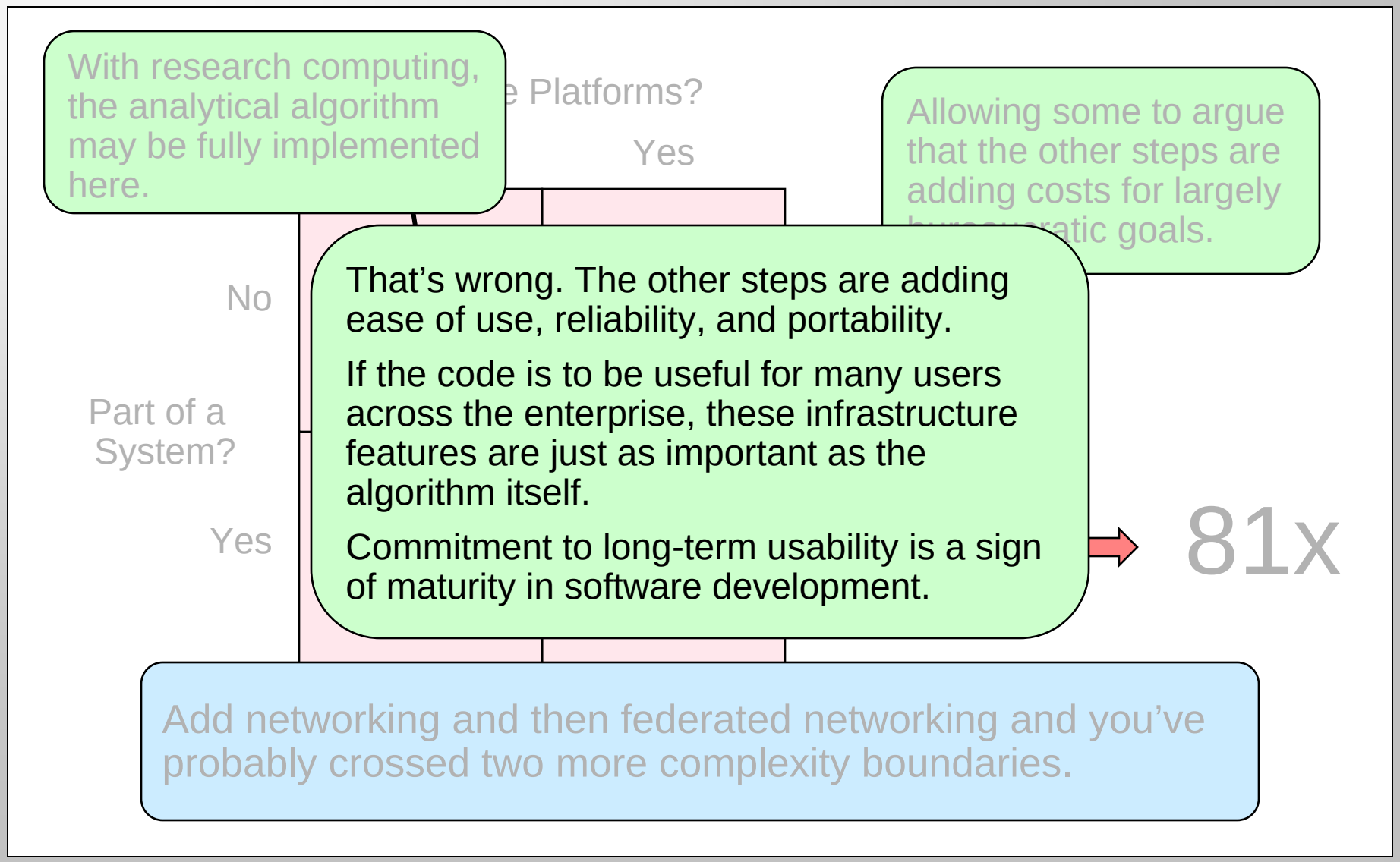


Capacity Management I

What is it?

What is it?

- A glass that’s half empty.

What is it?

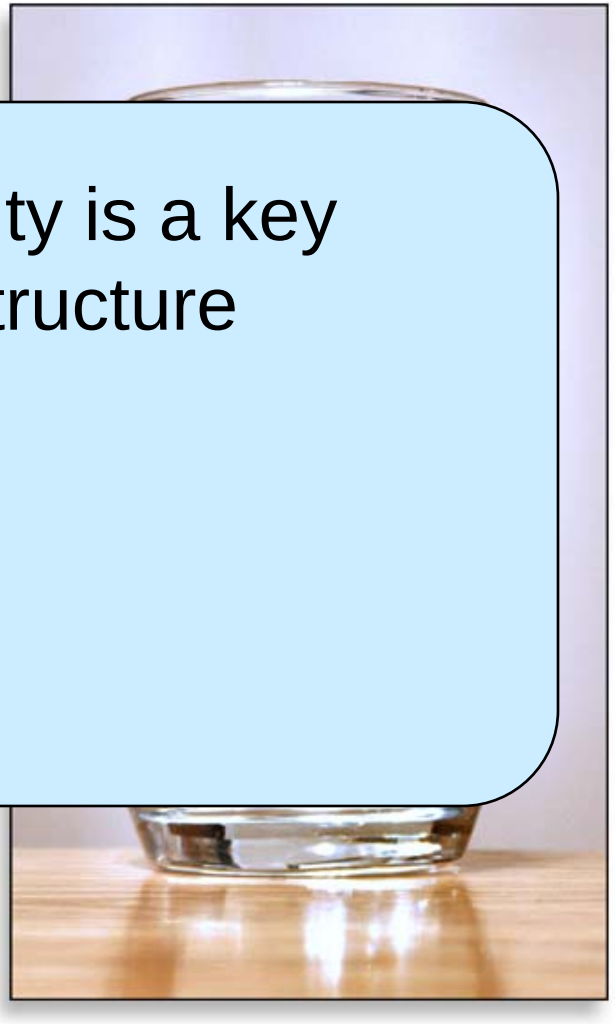
- A glass that's half empty.
- A glass that's half full.

What is it?

- A glass that's half empty.
- A glass that's half full.
- A glass with wasteful, excess unused capacity.

What is it?

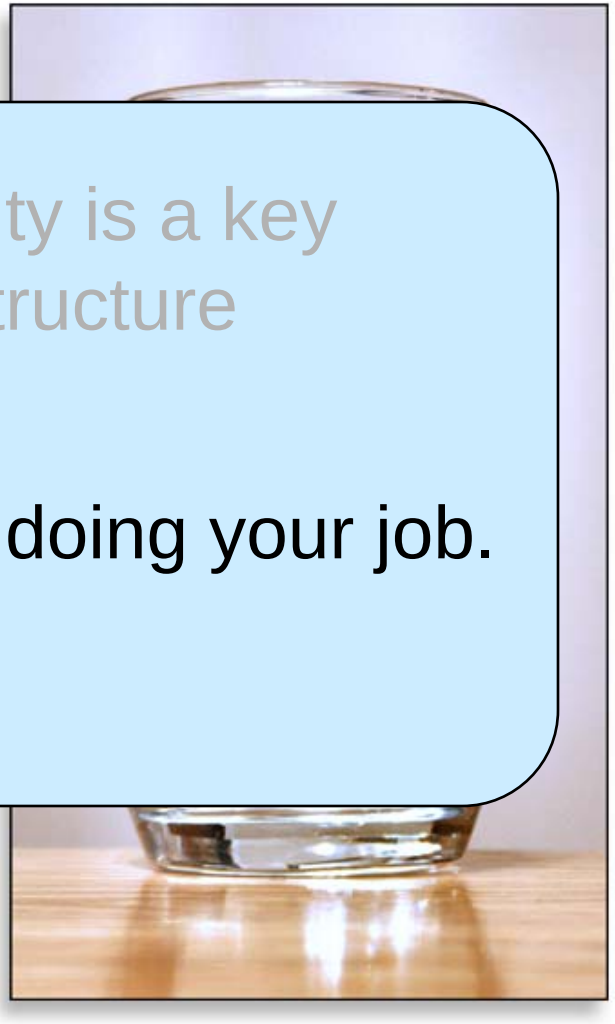
Delivering appropriate capacity is a key requirement for quality infrastructure management.



What is it?

Delivering appropriate capacity is a key requirement for quality infrastructure management.

Not enough, and you are not doing your job.

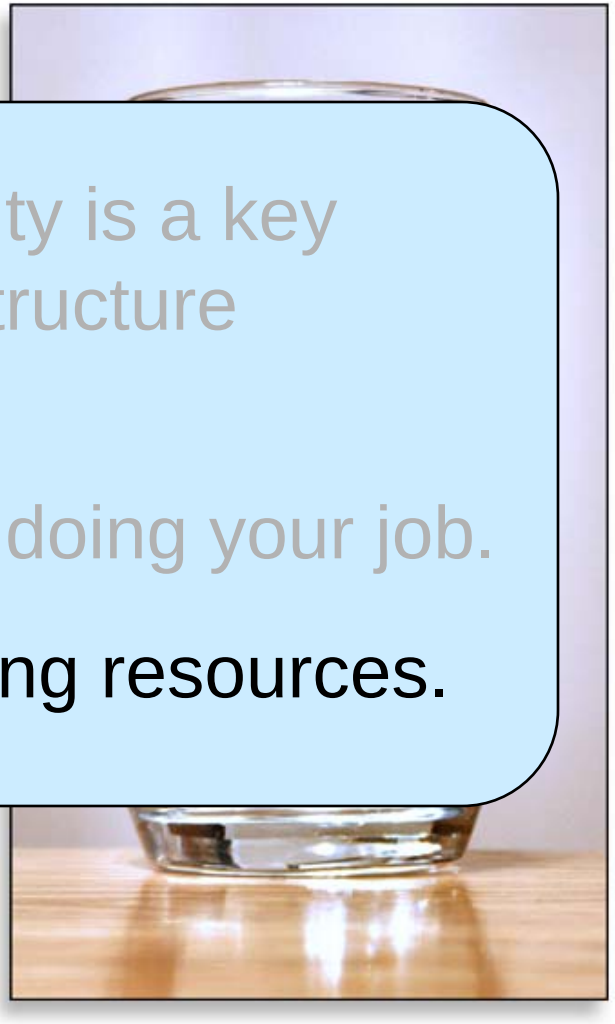


What is it?

Delivering appropriate capacity is a key requirement for quality infrastructure management.

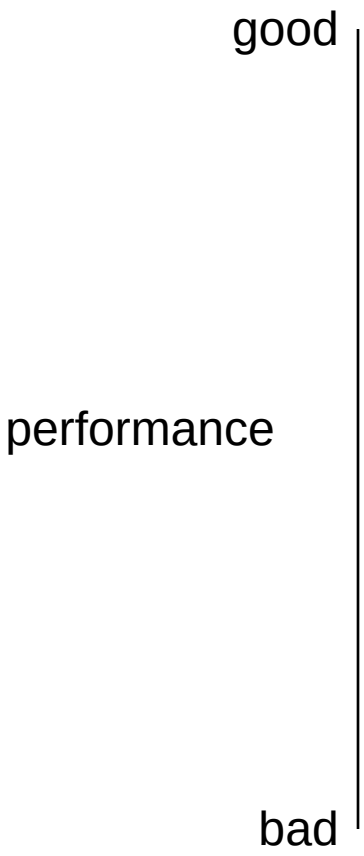
Not enough, and you are not doing your job.

Too much, and you are wasting resources.



Capacity Management II

Infrastructure Excellence



The performance measures for any piece of infrastructure can usually be arrayed on some kind of numeric scale, with good performance at the top and bad performance at the bottom.

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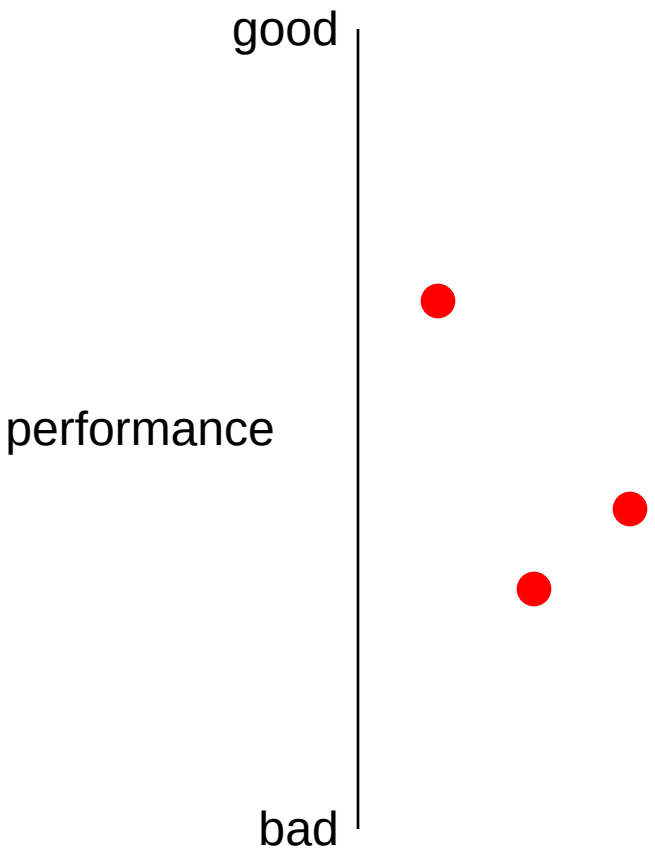
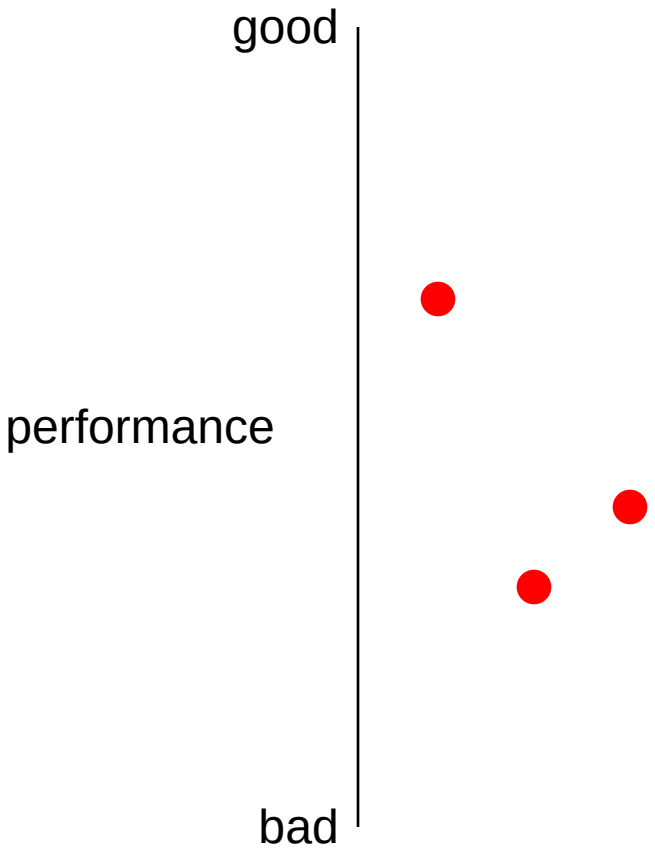


Actual performance can be measured and placed on this scale.

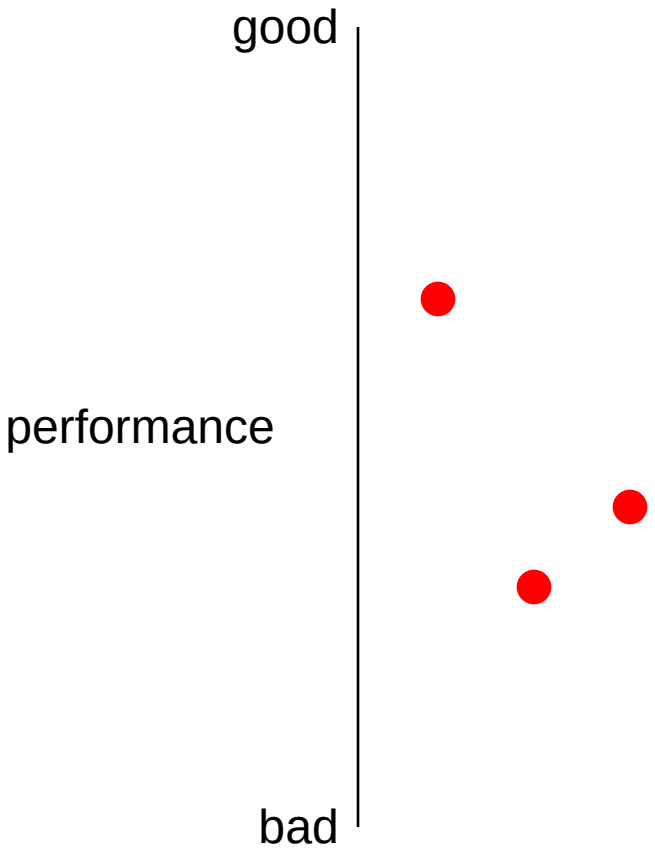
Infrastructure Excellence



Actual performance can be measured and placed on this scale.

But, with no further information it is impossible to tell whether this performance needs improvement, or is good enough, or even is too good and should be reduced to save resources.

Infrastructure Excellence

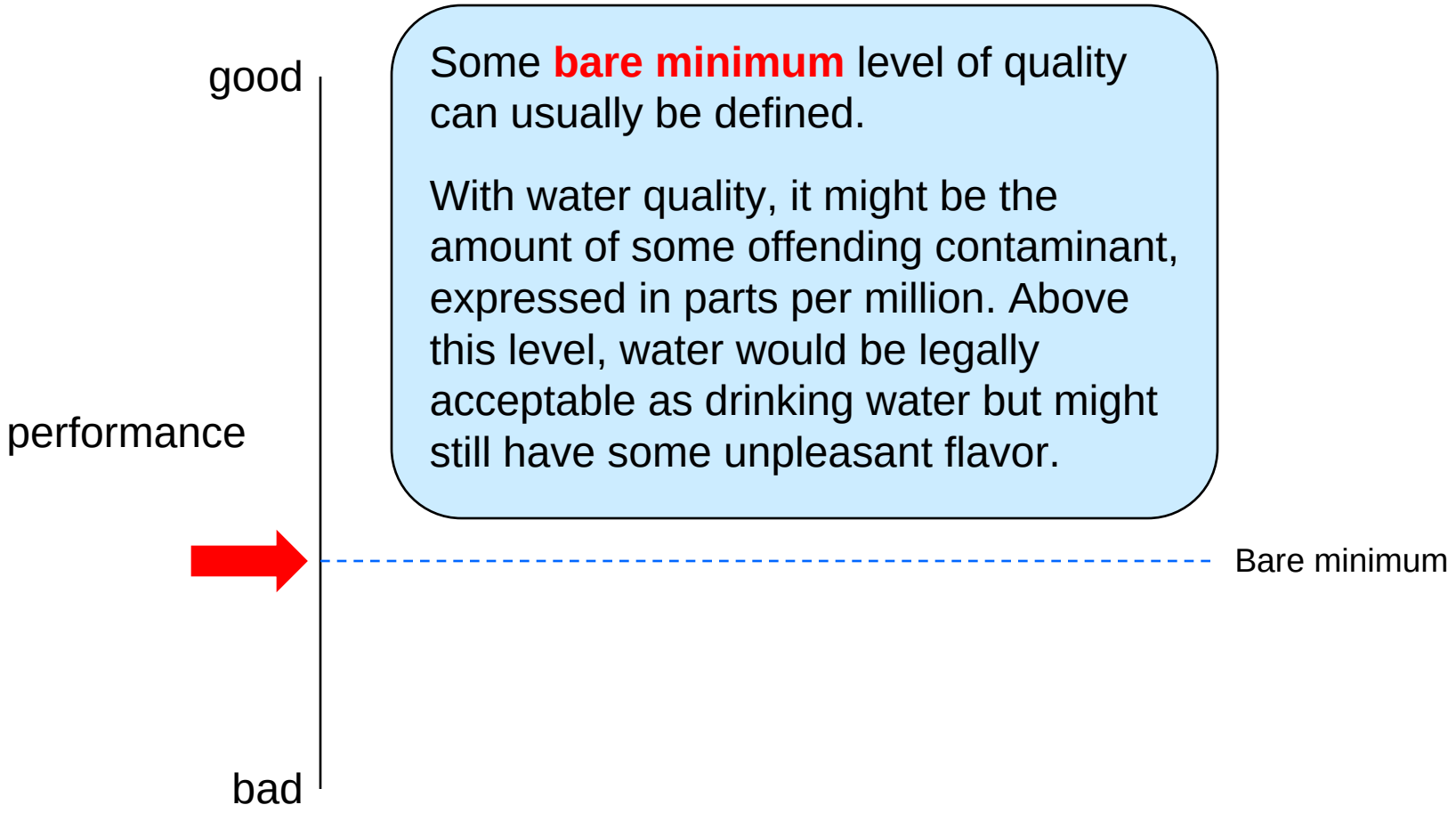


Actual performance can be measured and placed on this scale.

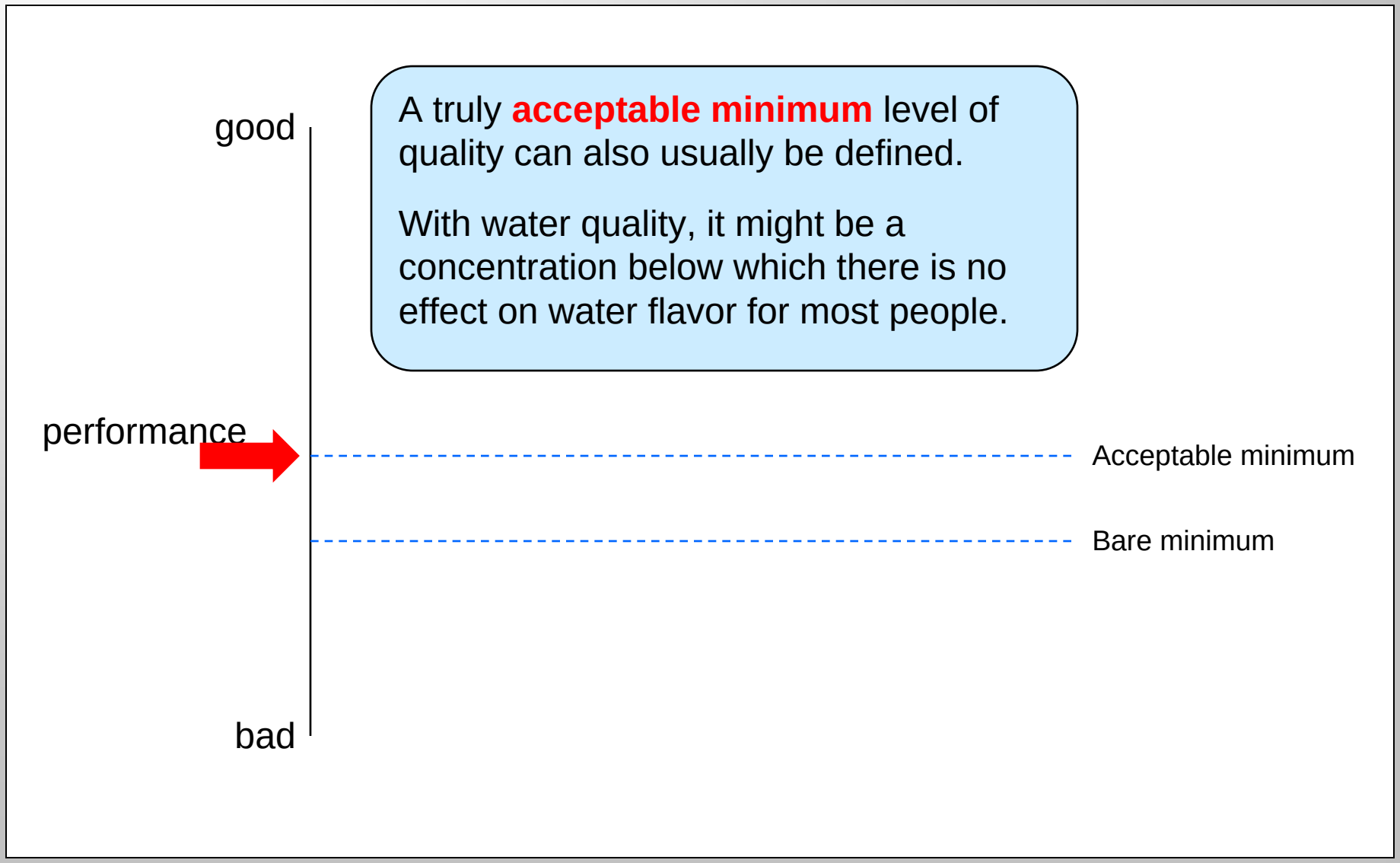
But, with no further information it is impossible to tell whether this performance needs improvement, or is good enough, or even is too good and should be reduced to save resources.

To better understand performance, we must define various quality thresholds of performance.

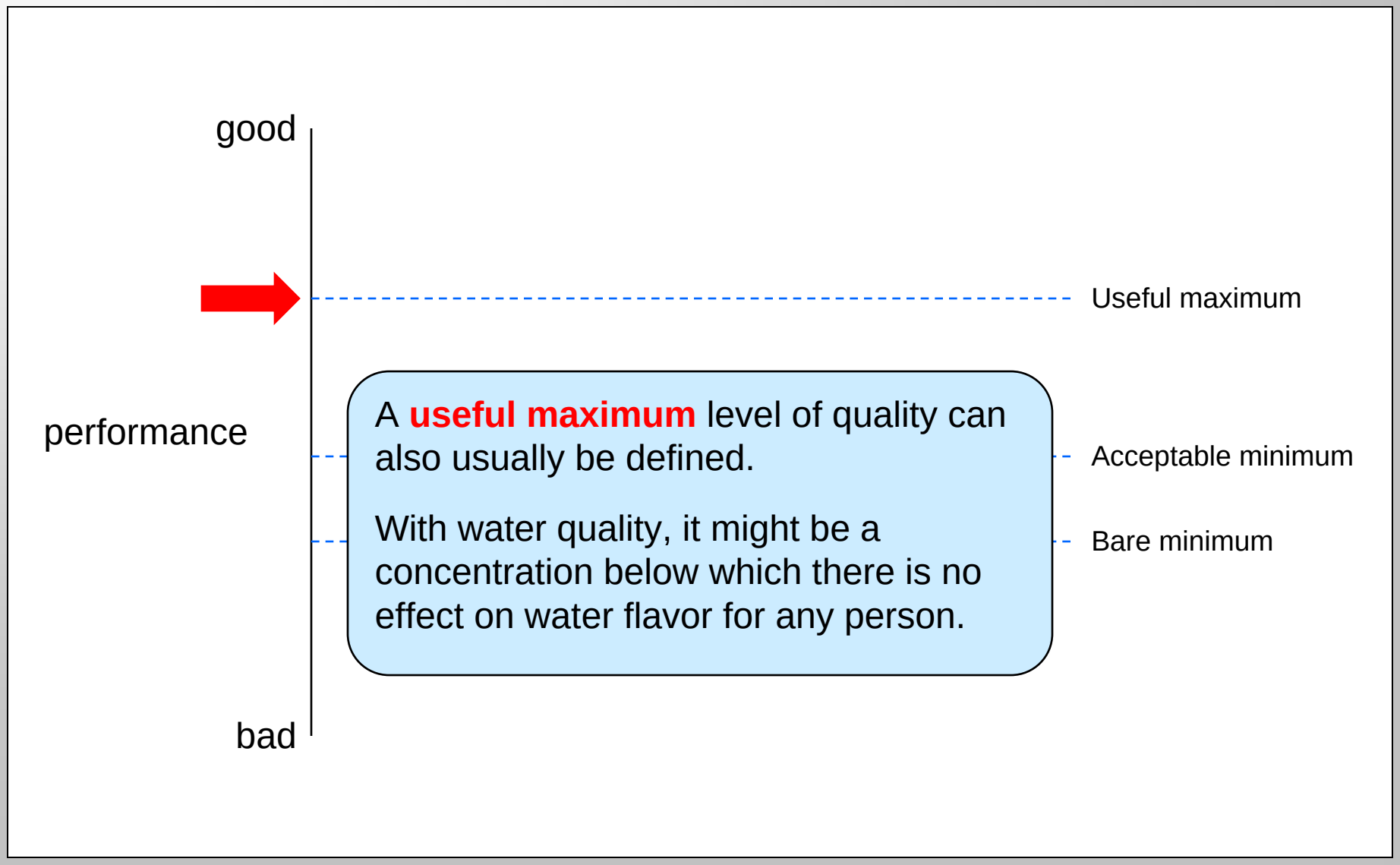
Infrastructure Excellence



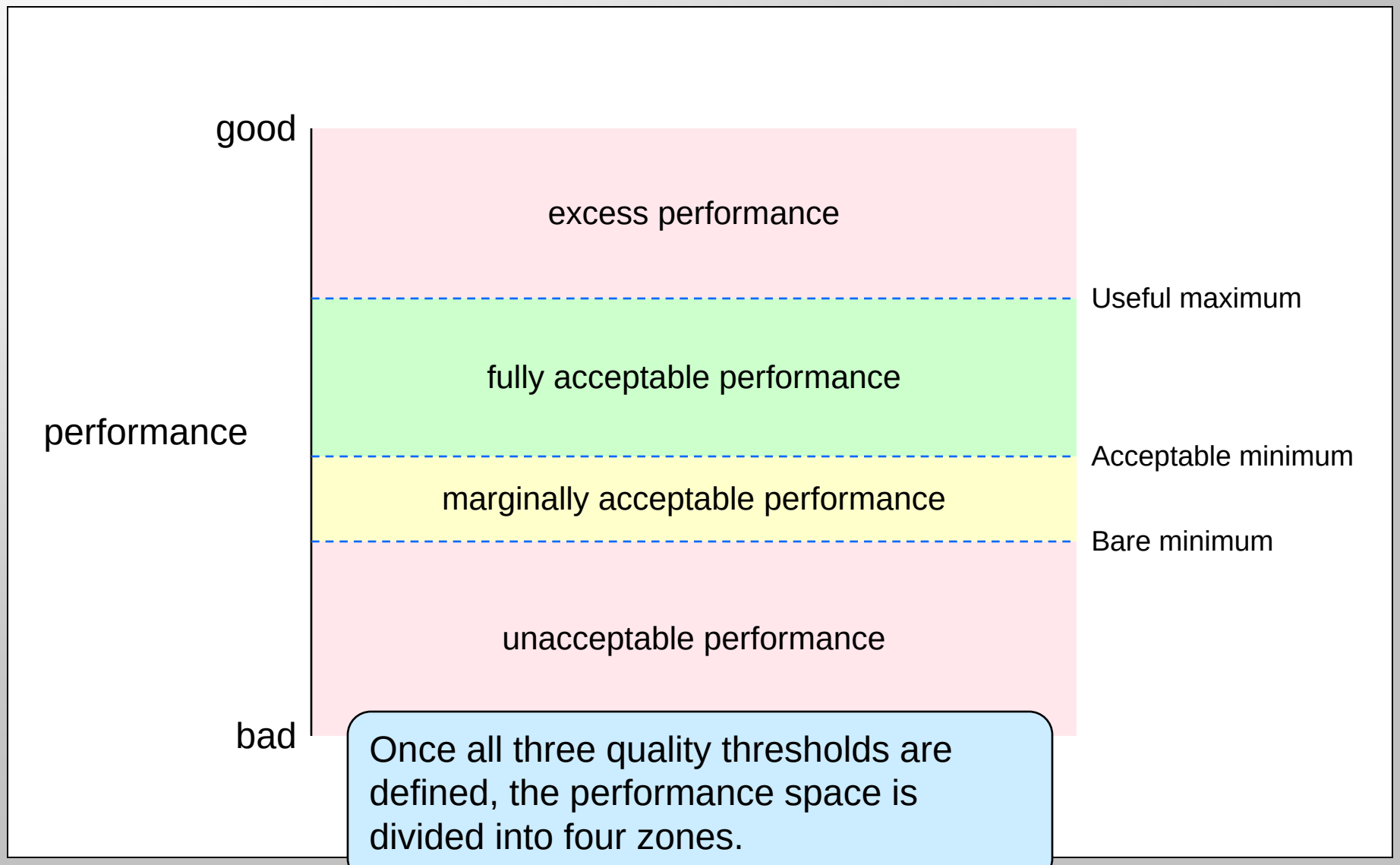
Infrastructure Excellence



Infrastructure Excellence



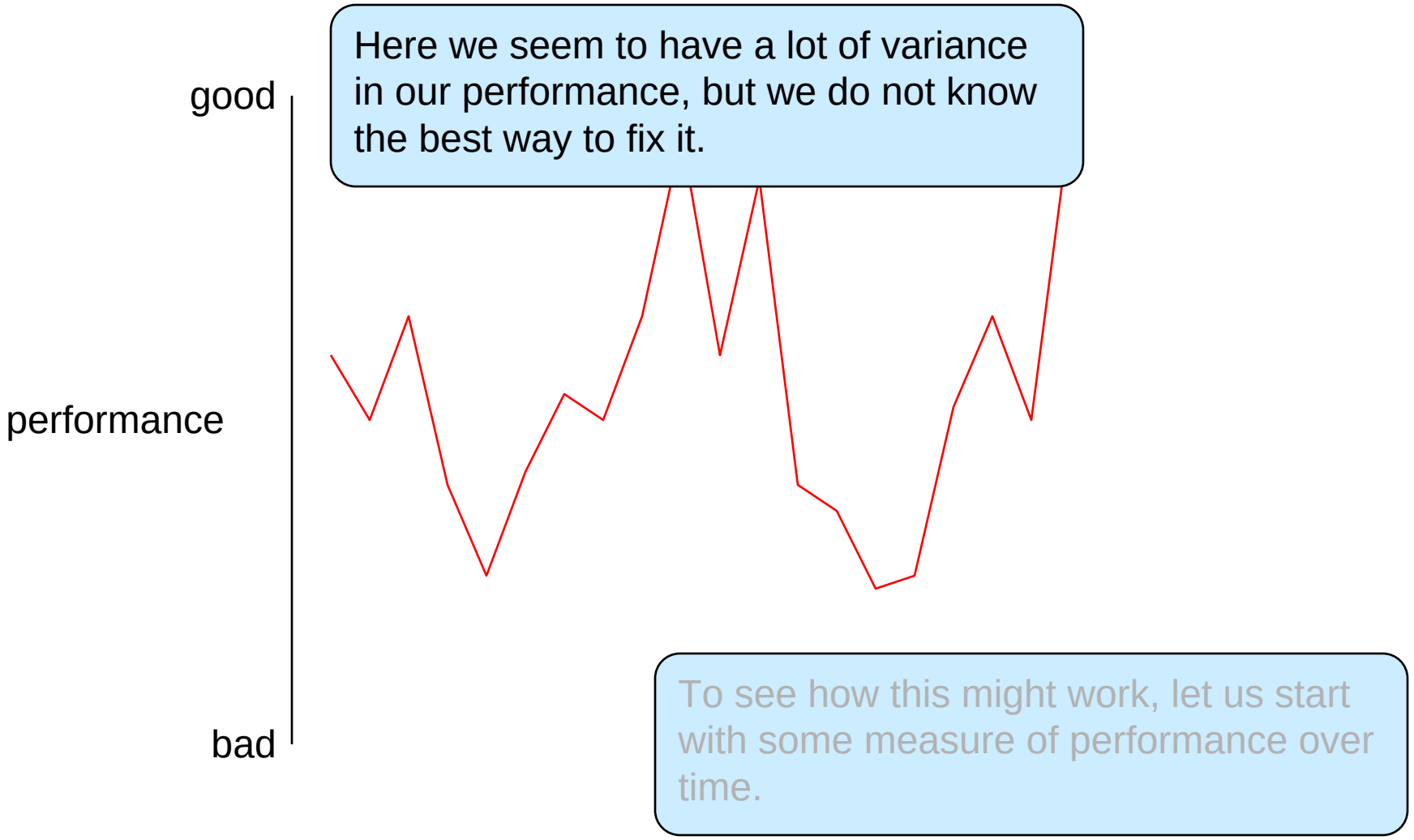
Infrastructure Excellence



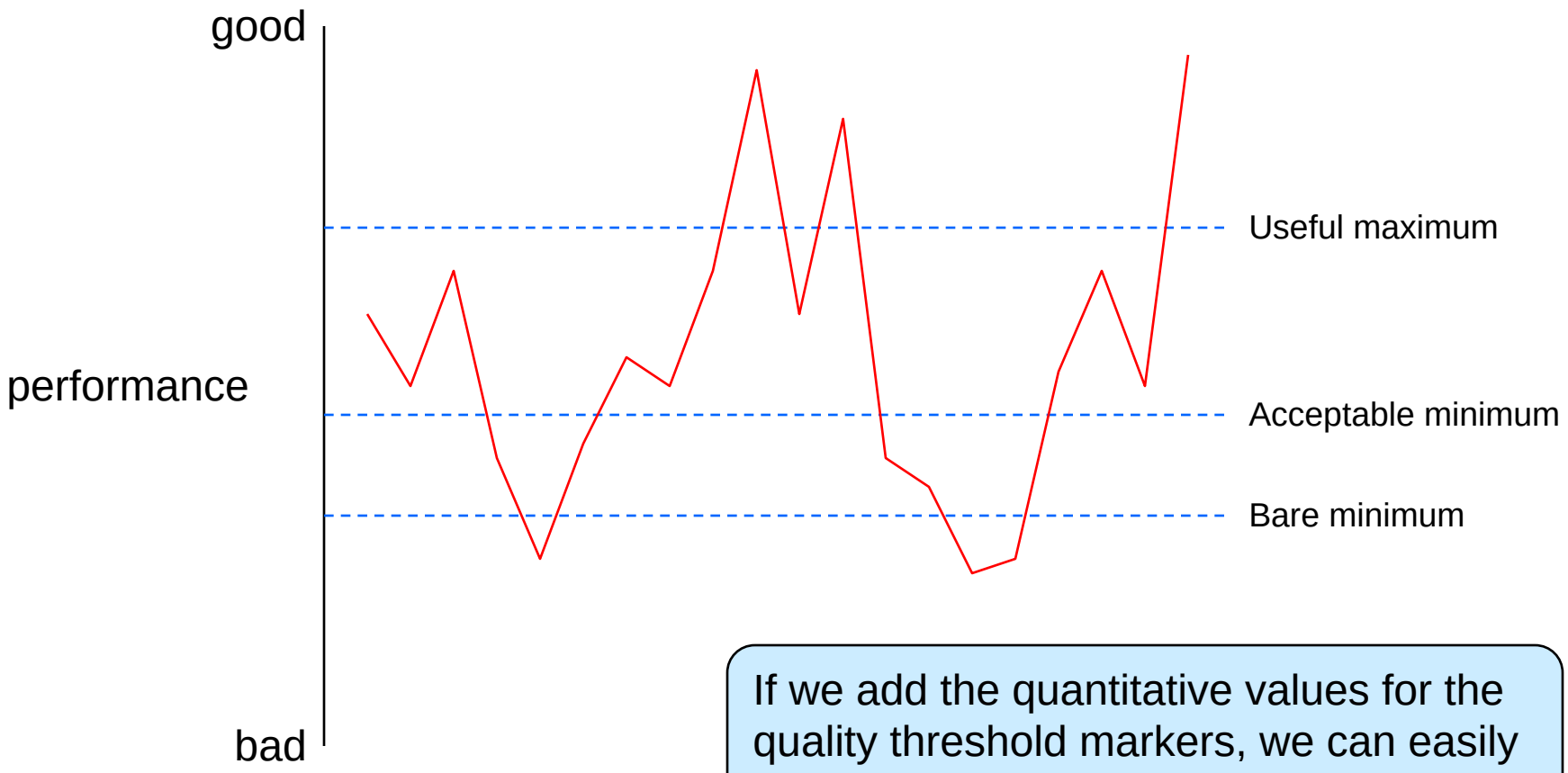
Infrastructure Excellence

To see how this might work, let us start with some measure of performance over time.

Infrastructure Excellence

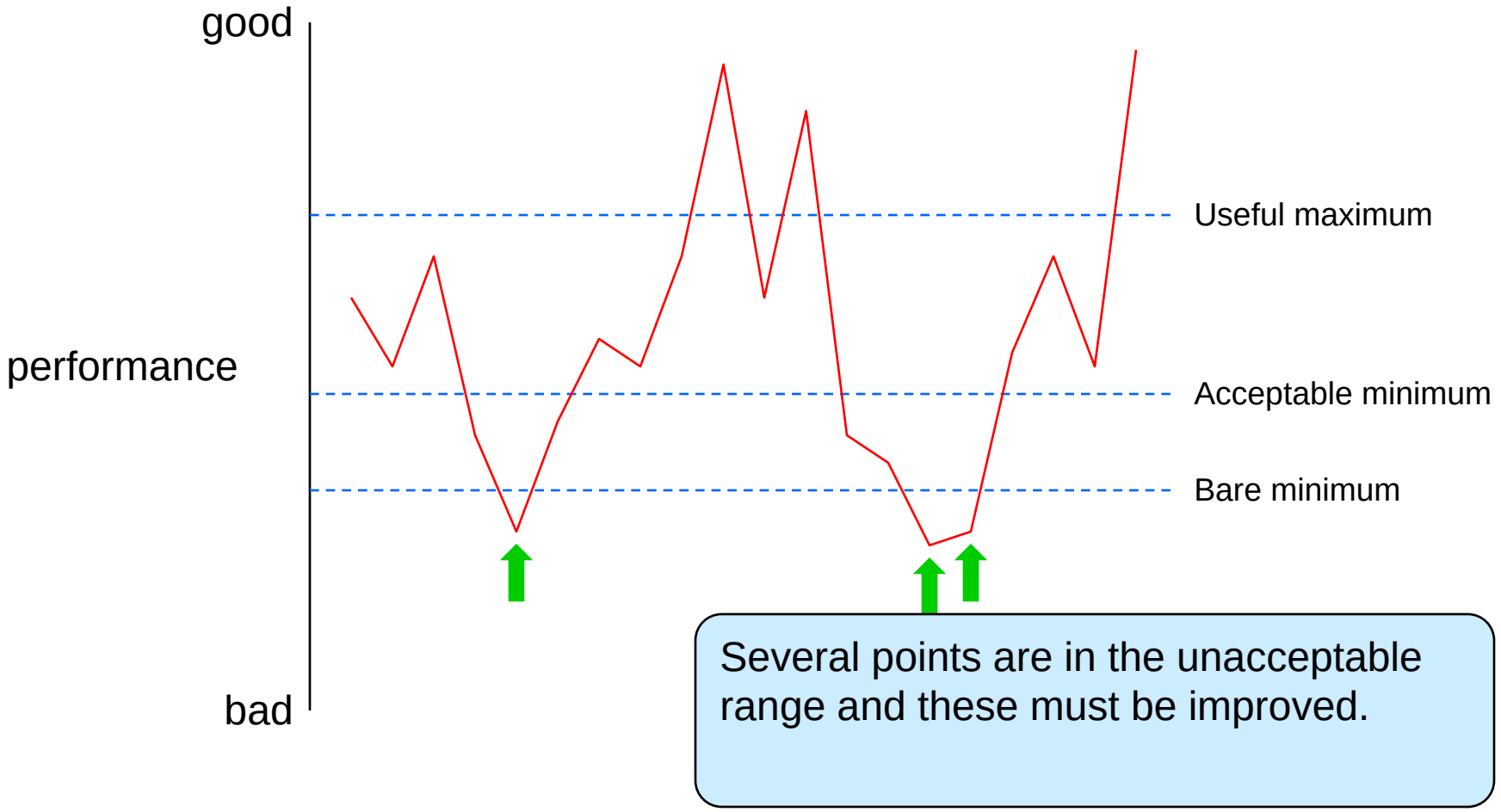


Infrastructure Excellence

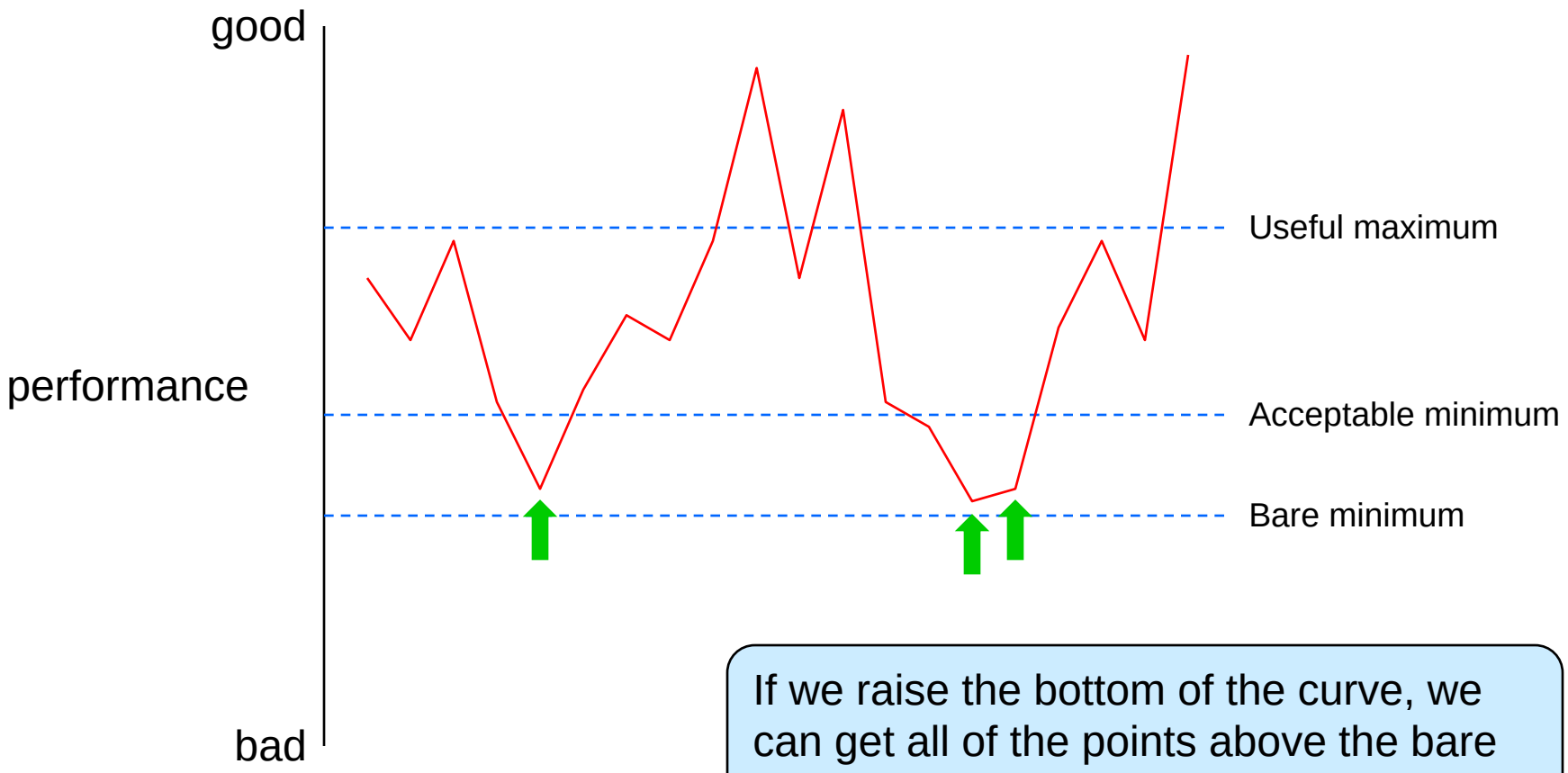


If we add the quantitative values for the quality threshold markers, we can easily see what needs to be done.

Infrastructure Excellence

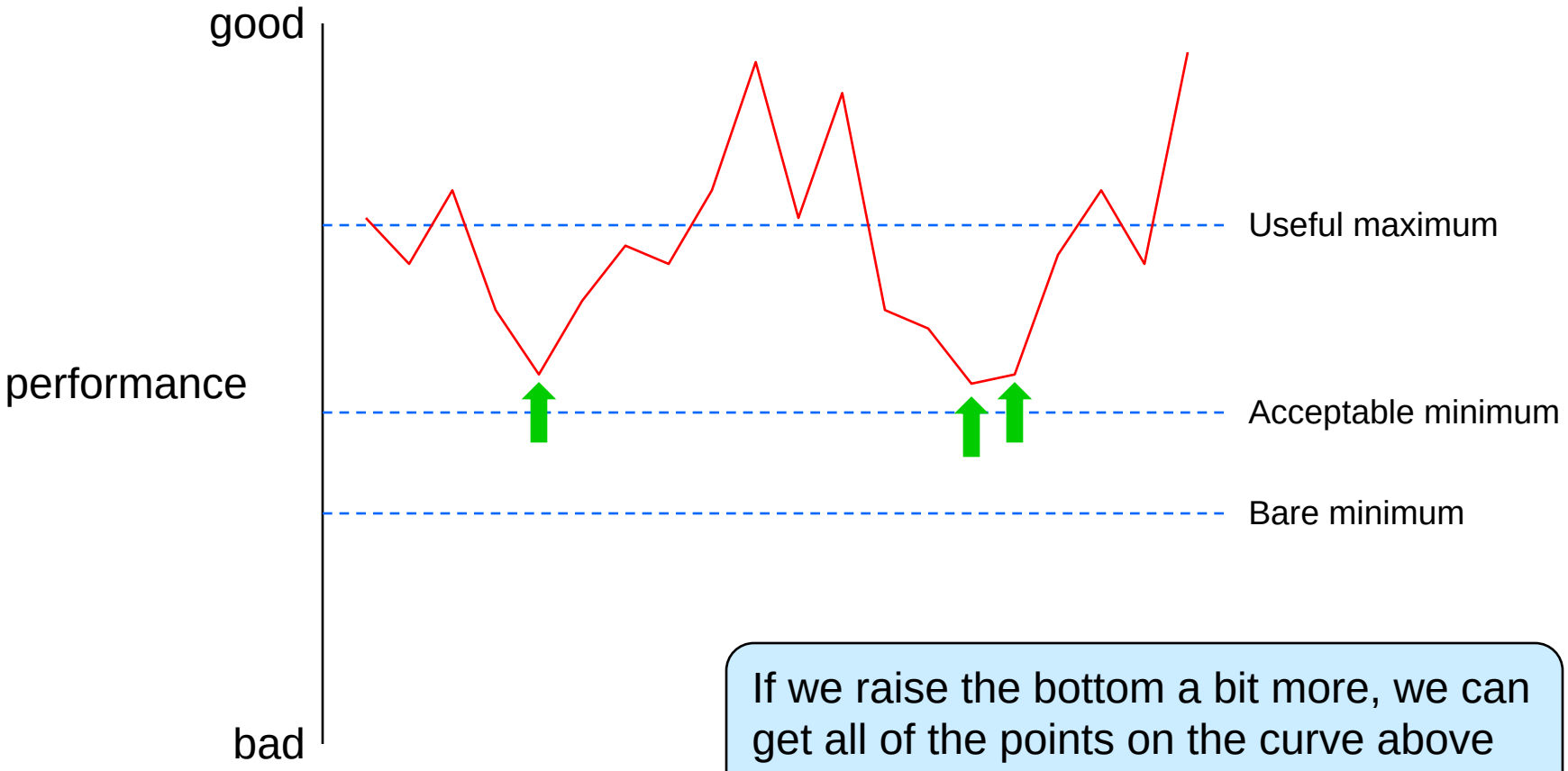


Infrastructure Excellence



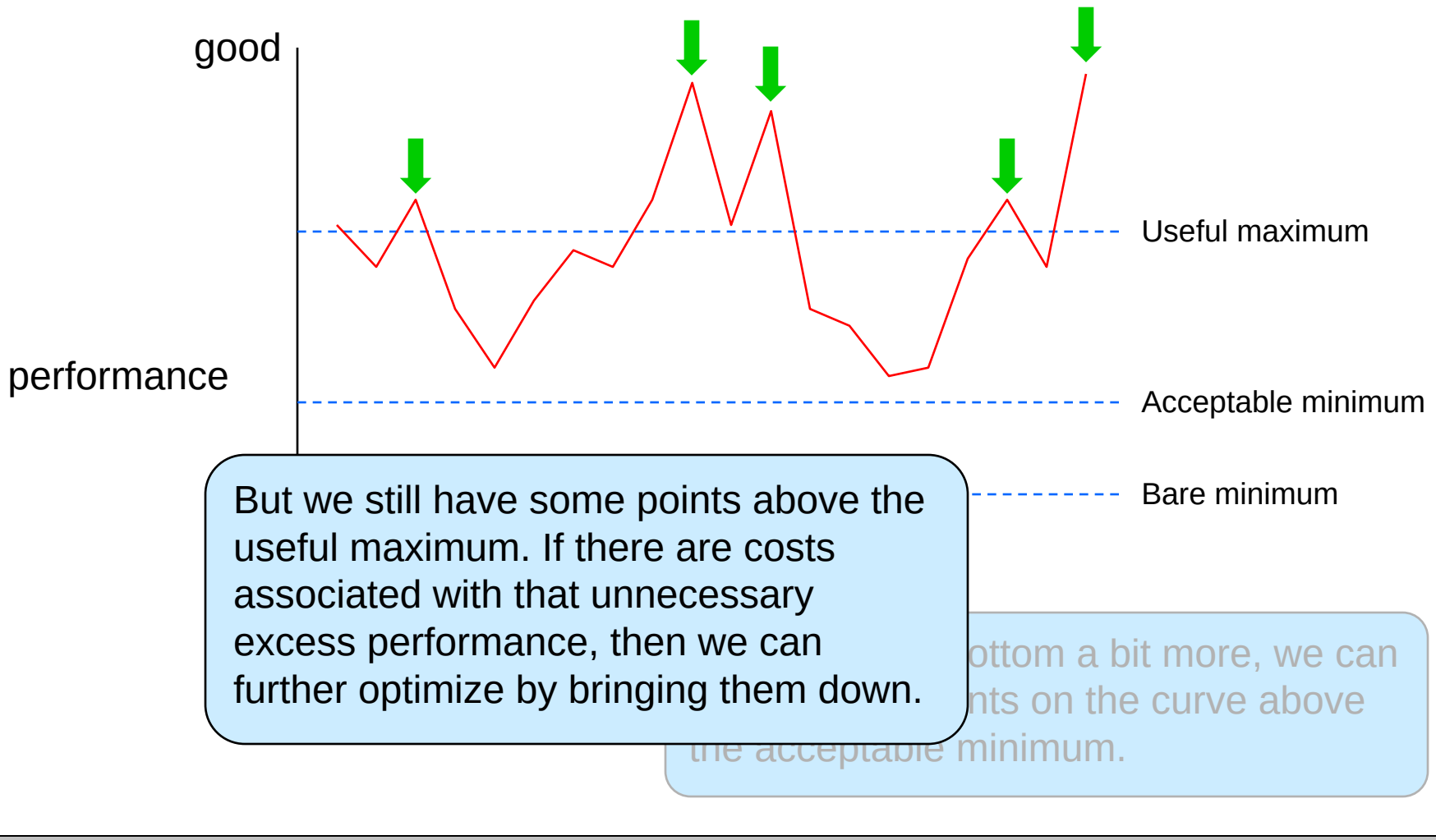
If we raise the bottom of the curve, we can get all of the points above the bare minimum.

Infrastructure Excellence

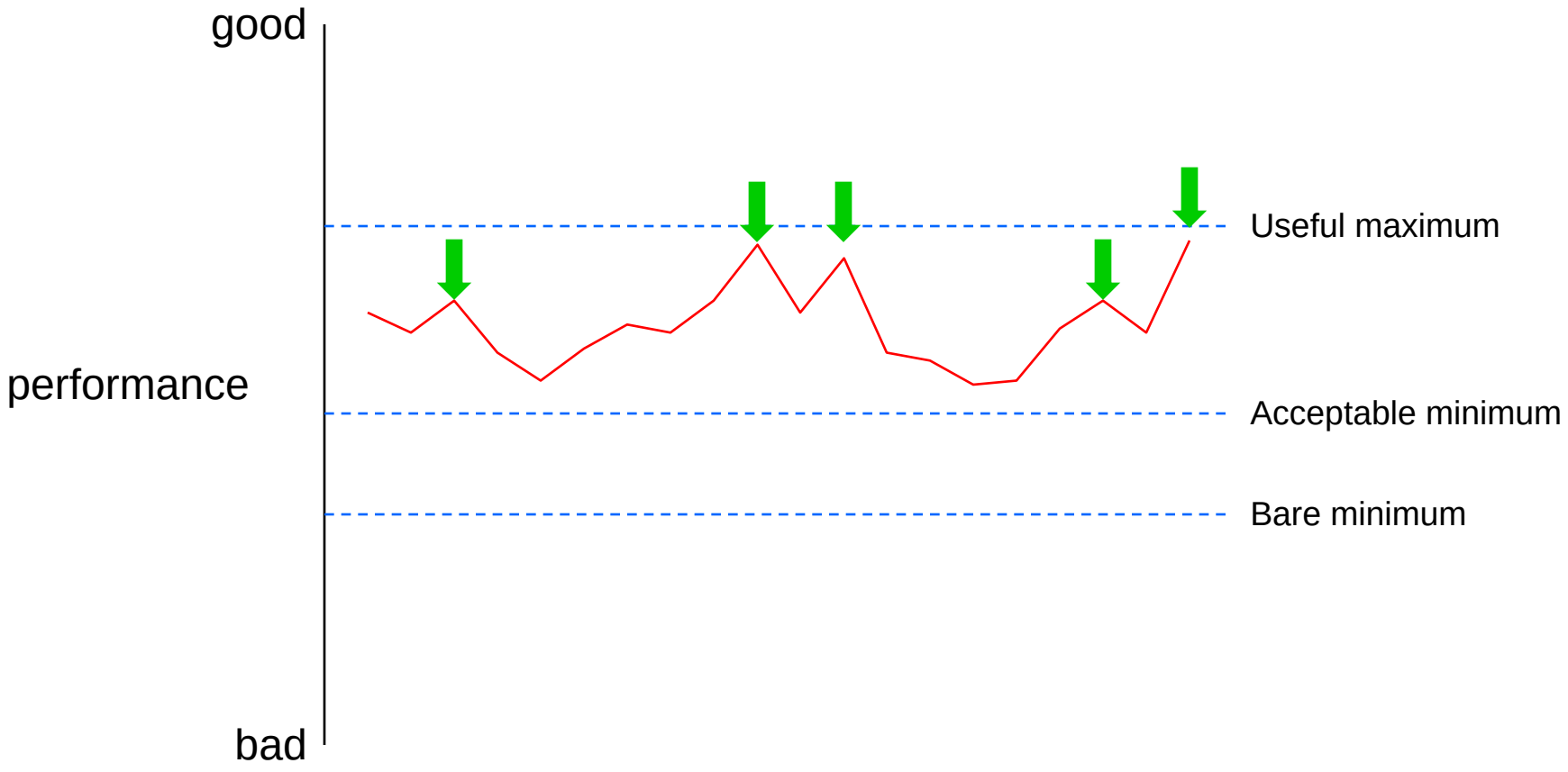


If we raise the bottom a bit more, we can get all of the points on the curve above the acceptable minimum.

Infrastructure Excellence



Infrastructure Excellence



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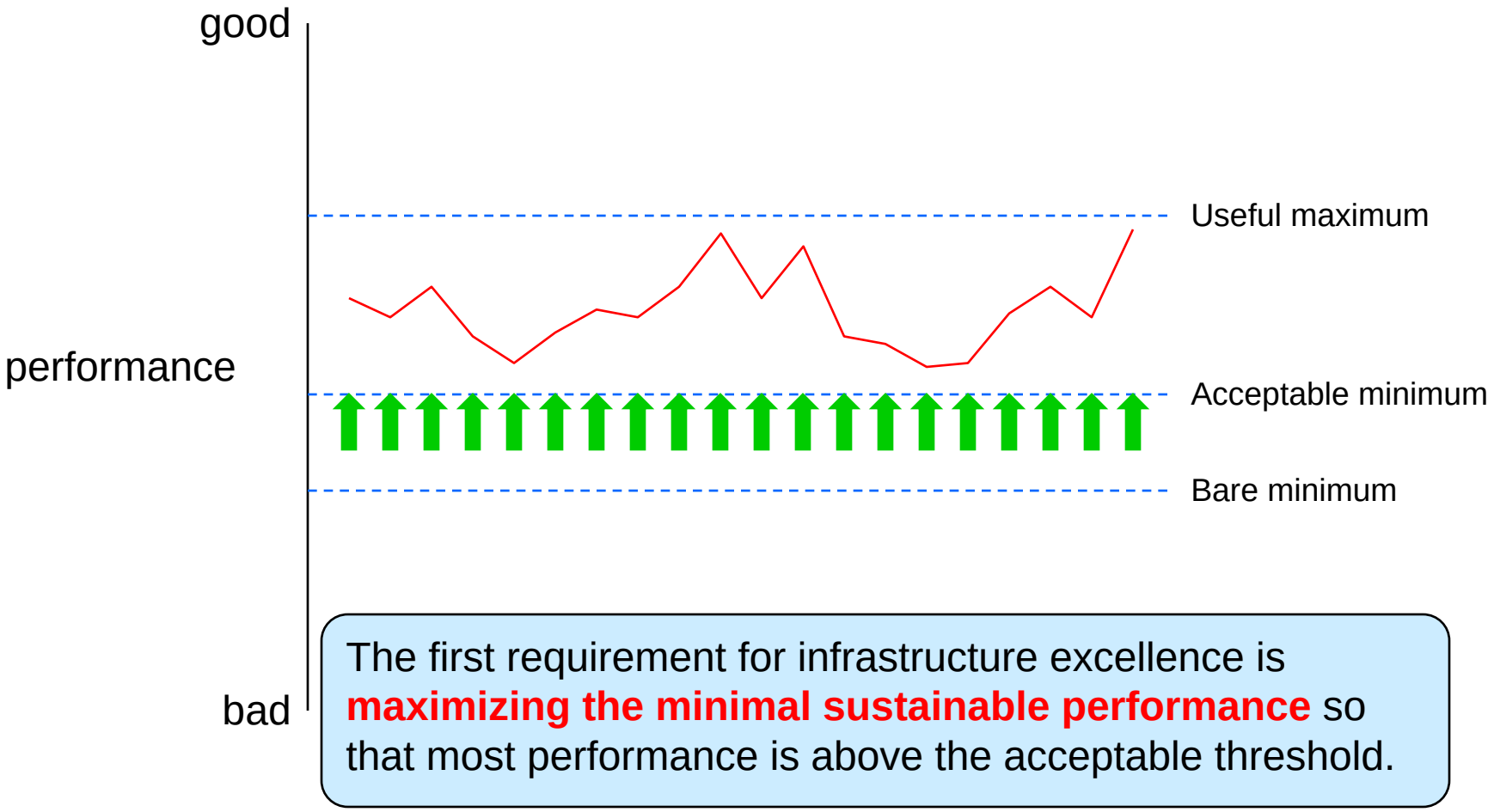
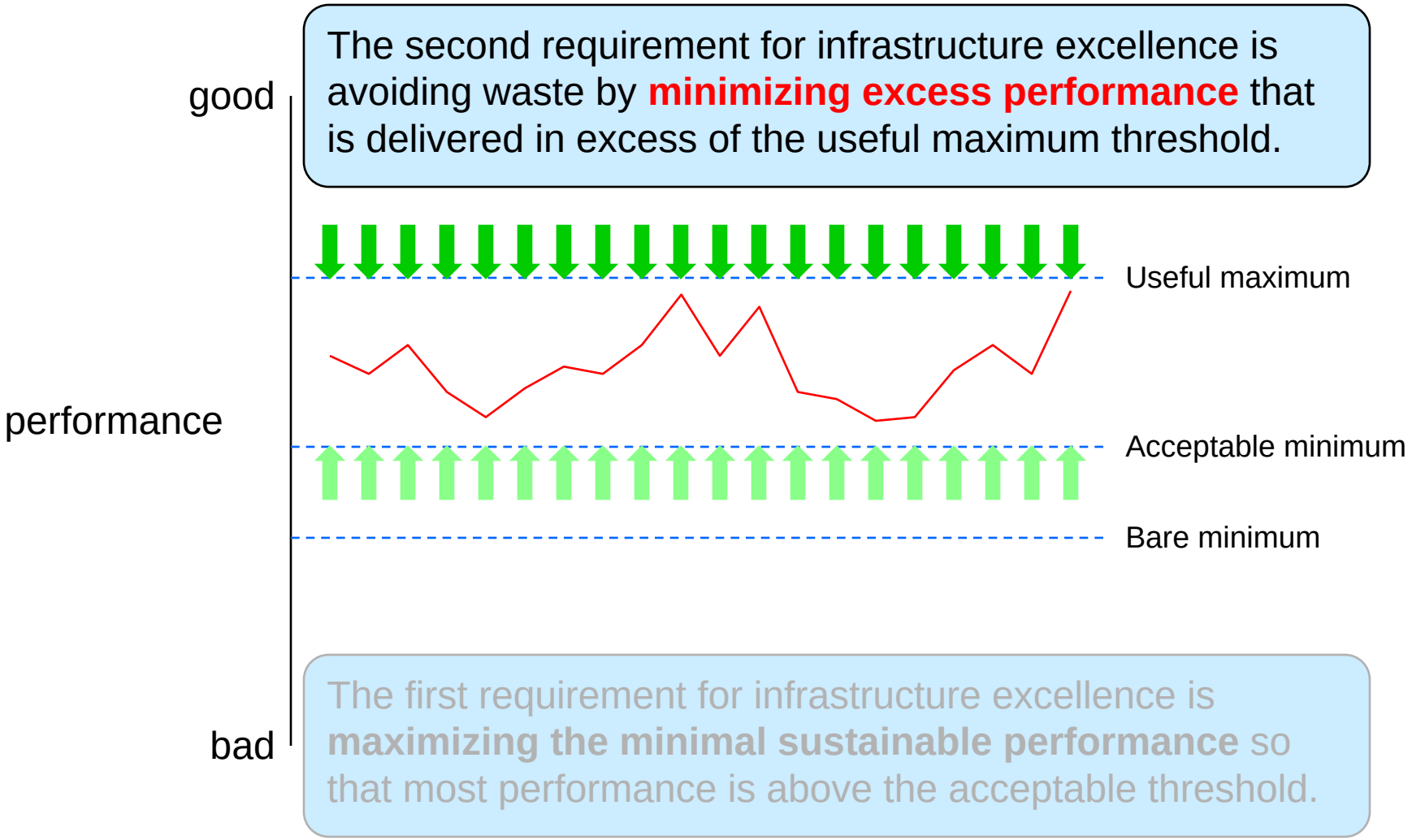


The first requirement for infrastructure excellence is **maximizing the minimal sustainable performance** so that most performance is above the acceptable threshold.

Infrastructure Excellence



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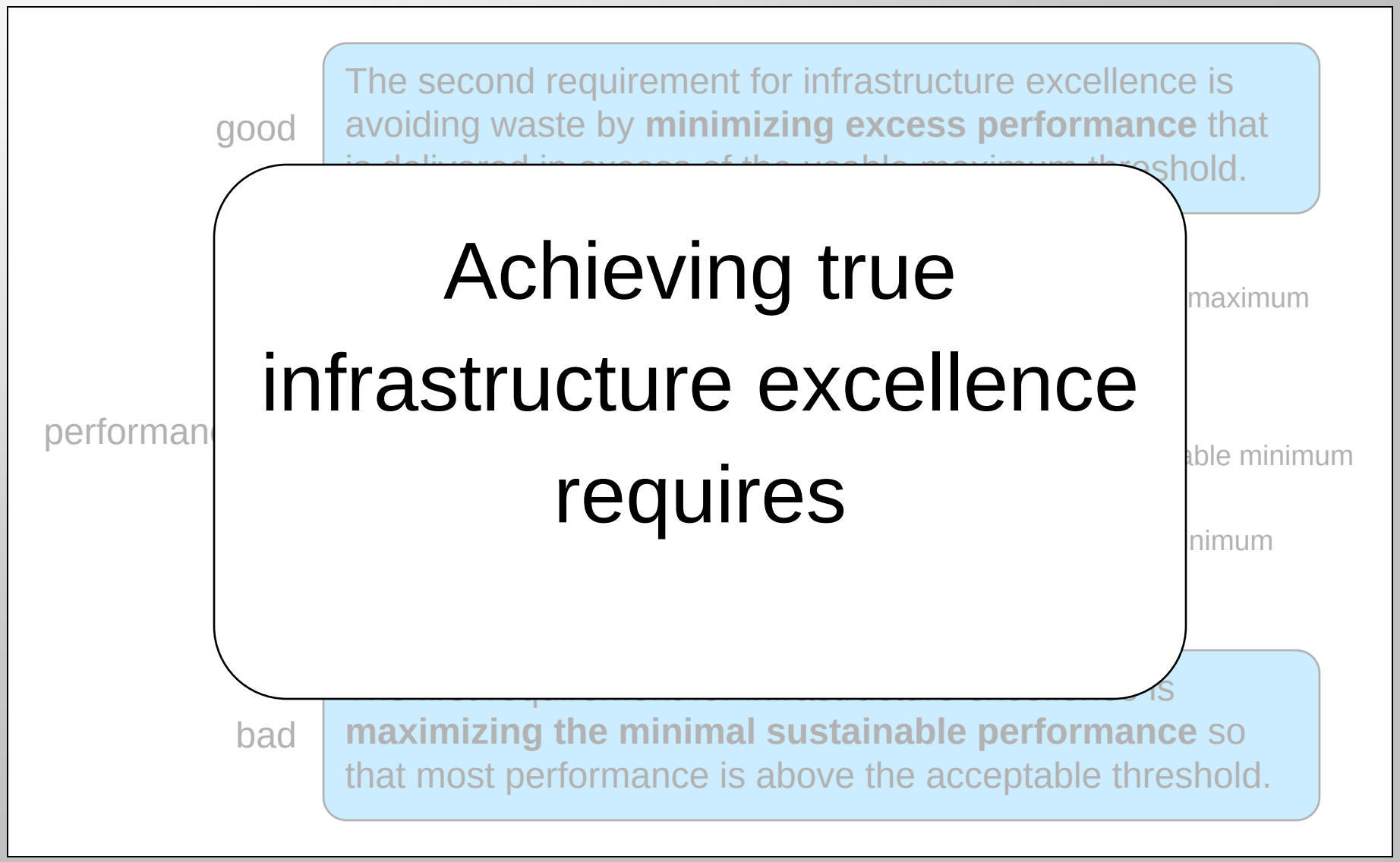

Achieving true infrastructure excellence requires

Infrastructure Excellence

Achieving true infrastructure excellence requires striving for adequacy.

Sufficiency as a Requirement

Adequacy

To some, striving for adequacy sounds like settling for less than the best.

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That’s a wrong interpretation.

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With infrastructure, striving for adequacy is often the best path to the best solution.

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This requires that you know the true quantitative requirements and that you can provide an optimal quantitative solution.

Adequacy

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With infrastructure, striving for adequacy is often the best path to the best solution.

This requires that you know the true quantitative requirements and that you can provide an optimal quantitative solution.

Anybody can throw money at pursuit of excellence.

Adequacy

PROBLEM:

You have two expensive hanging lamps and you must lengthen the chains on which they hang.

Adequacy

PROBLEM:

You have two expensive hanging lamps and you must lengthen the chains on which they hang.

What should you do:

Adequacy

PROBLEM:

You have two expensive hanging lamps and you must lengthen the chains on which they hang.

What should you do:

Add the strongest new piece of chain possible?

Adequacy

PROBLEM:

You have two expensive hanging lamps and you must lengthen the chains on which they hang.

What should you do:

Add the strongest new piece of chain possible?

Add chain of the same strength as the original chain?

Adequacy

SOLUTION:

Clearly, adding links that match (or slightly exceed) the strength of the weakest link in the original chain is the best approach.

Adequacy

SOLUTION:

Clearly, adding links that match (or slightly exceed) the strength of the weakest link in the original chain is the best approach.

The new chain should be strong enough not to be the weakest link, but no stronger.

Adequacy

SOLUTION:

Clearly, adding links that match (or slightly exceed) the strength of the weakest link in the original chain is the best approach.

The new chain should be strong enough not to be the weakest link, but no stronger.

When selecting the type of chain to add, you get the best solution by striving for adequacy.

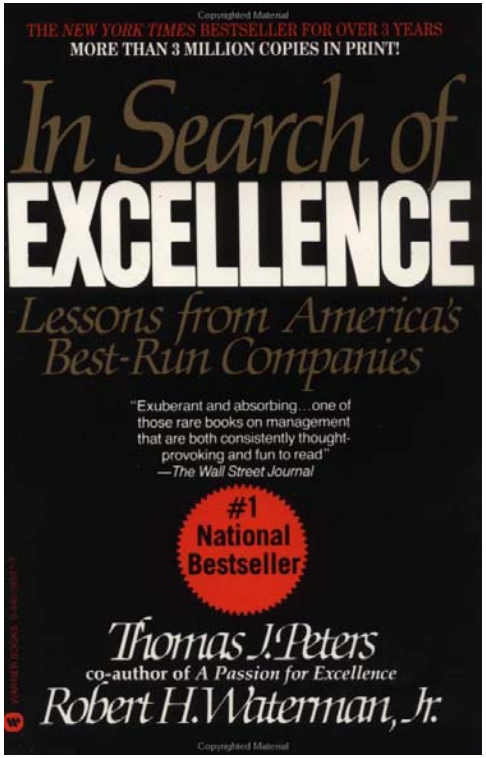
Definitions of Adequacy

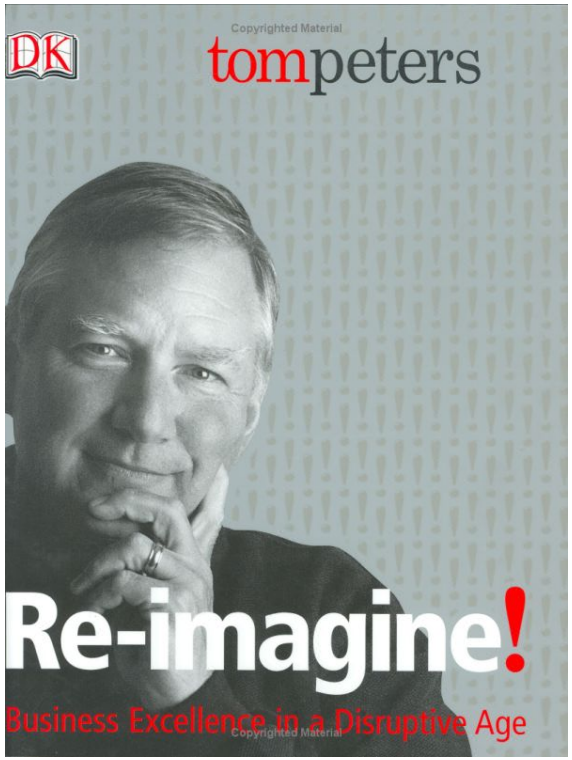
- Adequacy n. [See Adequate.] The state or quality of being adequate, proportionate, or sufficient; a sufficiency for a particular purpose; as, the adequacy of supply to the expenditure. (Webster's Unabridged, 1913)
- Adequate a. Equal to some requirement; proportionate, or correspondent; fully sufficient; as, powers adequate to a great work; Syn: Proportionate; commensurate; sufficient; suitable; competent; capable.

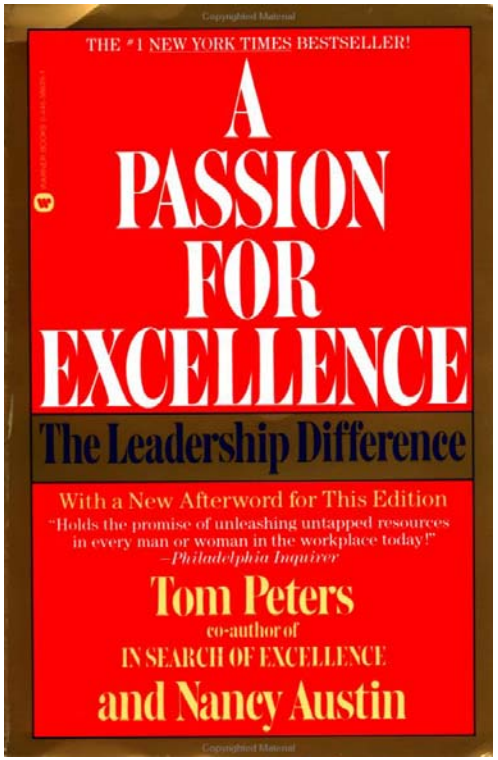
Definitions of Sufficient

- Suffice v. i. To be enough, or sufficient; to meet the need (of anything); to be equal to the end proposed; to be adequate. Chaucer. (Webster's Unabridged, 1913)
- Sufficient a. 1. Equal to the end proposed; adequate to wants; enough; ample; competent; as, provision sufficient for the family; an army sufficient to defend the country. 2. Possessing adequate talents or accomplishments; of competent power or ability; qualified; fit. 3. Capable of meeting obligations; responsible. (Webster's Unabridged, 1913)

How About Excellence







How About Excellence

- The "Greatest Business Book of All Time" (Bloomsbury UK), *In Search of Excellence* has long been a must-have for the boardroom, business school, and bedside table.
- Based on a study of forty-three of America's best-run companies from a diverse array of business sectors, *In Search of Excellence* describes eight basic principles of management — action-stimulating, people-oriented, profit-maximizing practices — that made these organizations successful.
- Advanced search on Amazon returns 5065 books with “excellence” in the title, 811 of which are business books, 930 are nonfiction, and 1159 are professional or technical.

Definition of Excellence

- Excellence n. [F. excellence, L. excellentia.] The quality of being excellent; state of possessing good qualities in an eminent degree; exalted merit; superiority in virtue. (Webster's Unabridged, 1913) Syn: Superiority; preëminence; perfection; worth; goodness; purity; greatness.
- Excellent a. Excelling; surpassing others in some good quality or the sum of qualities; of great worth; eminent, in a good sense; superior; as, an excellent man, artist, citizen, husband, discourse, book, song, etc.; excellent breeding, principles, aims, action. (Webster's Unabridged, 1913) Syn. Worthy; choice; prime; valuable; select; exquisite; transcendent; admirable; worthy.

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Is achieving PERFECTION really a good business goal?

Adequacy

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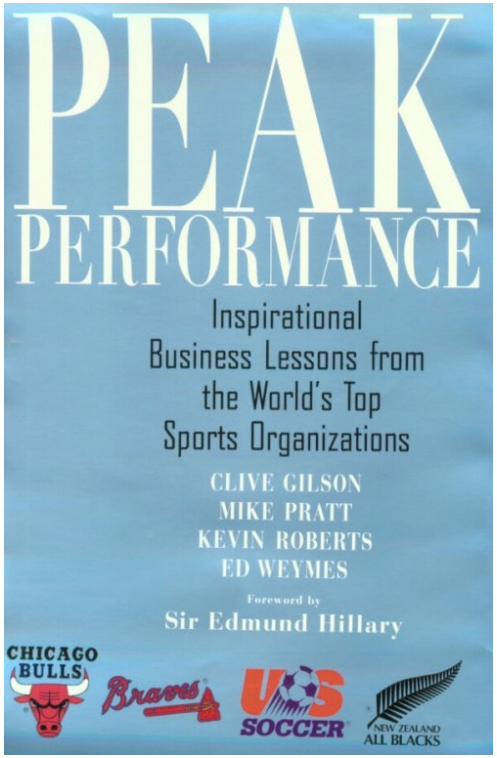

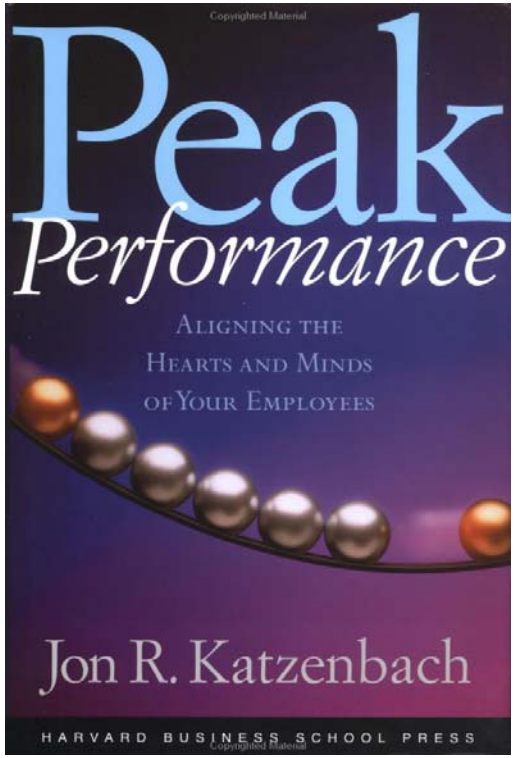

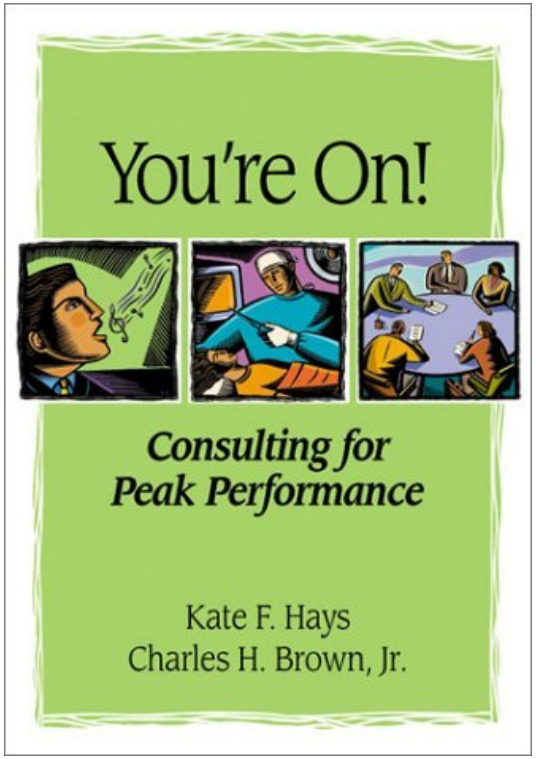

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- Pursuit of (local) excellence — meaning pursuit of improved peak performance — is a fallacy for guiding the behavior of individual workers in a complex, interacting environment.
- Local excellence can better be defined as the minimization of resource consumption while delivering sustainable performance above some (minimal) criterion – i.e., adequacy.

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Sustainable sufficiency is the true goal.

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Peak performance is, by definition, not sustainable.

Achieving true adequacy requires level 4 or 5 performance, since delivering sustainable sufficiency involves quantitative optimization.

n

Adequacy

- What's the right amount of vitamin C in your diet?
- What's the best car for your family?
- What's the best hotel for your vacation?
- What's …

How Good is Good Enough?

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- Simply trying to be the best that you can be is pure level 1 performance – non-quantitative heroics.
- Delivering quantitative optimization — achieving level 5 performance — requires knowing how good is good enough.
- Once you *know* how good is good enough — what is adequate — you can strive for sustainable sufficiency, even as the bar keeps going up and the stakes get higher.

Going Forward

Requirements Going Forward

- Striving for Level 5 Performance
- Managing Robust, Scalable Infrastructure
- Understanding our Gear
- Providing Formal Project Management
- Offering Informatics as a Discipline
- Achieving Research Access to Clinical Data

Requirements Going Forward

- Delivering Real Security
- Developing Service Level Agreements
- Committing to Long-term Planning
- Building Architected Solutions
- ???

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Building Architected Solutions

Information Architecture for Translational Research

Summary

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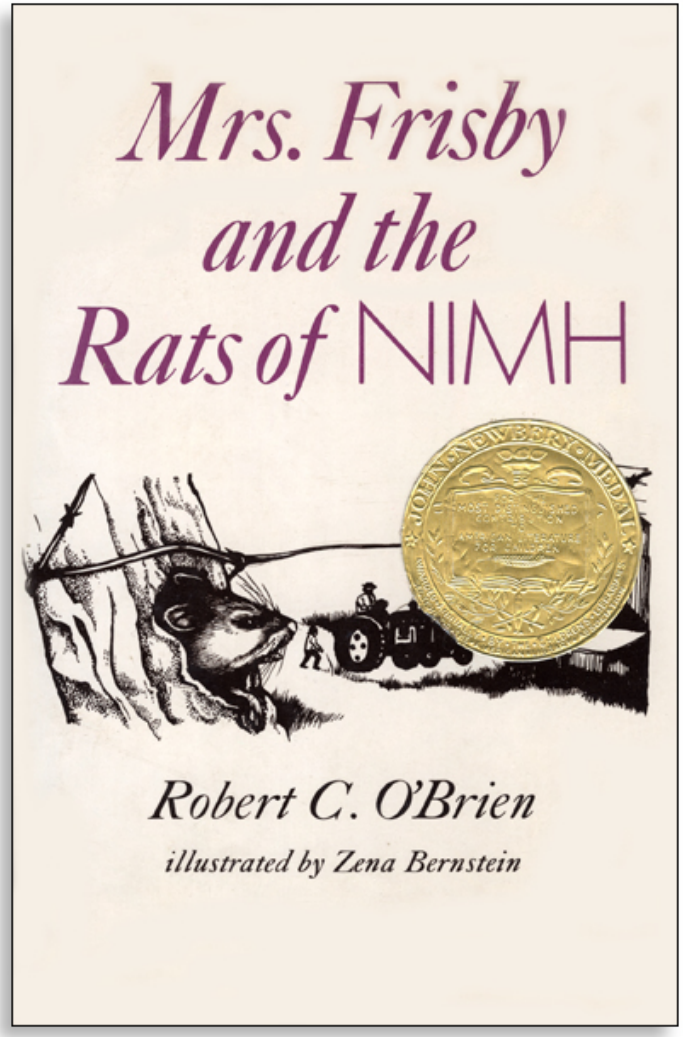
- To grow up we must achieve maturity. .
- Maturity in information technology requires quantitative optimization, not mere heroics.
- To deliver quantitative optimization you must know how good is good enough.
- And then you must deliver sustainable sufficiency. Day after day after day…

A
LESSON

Jeremy's Experience



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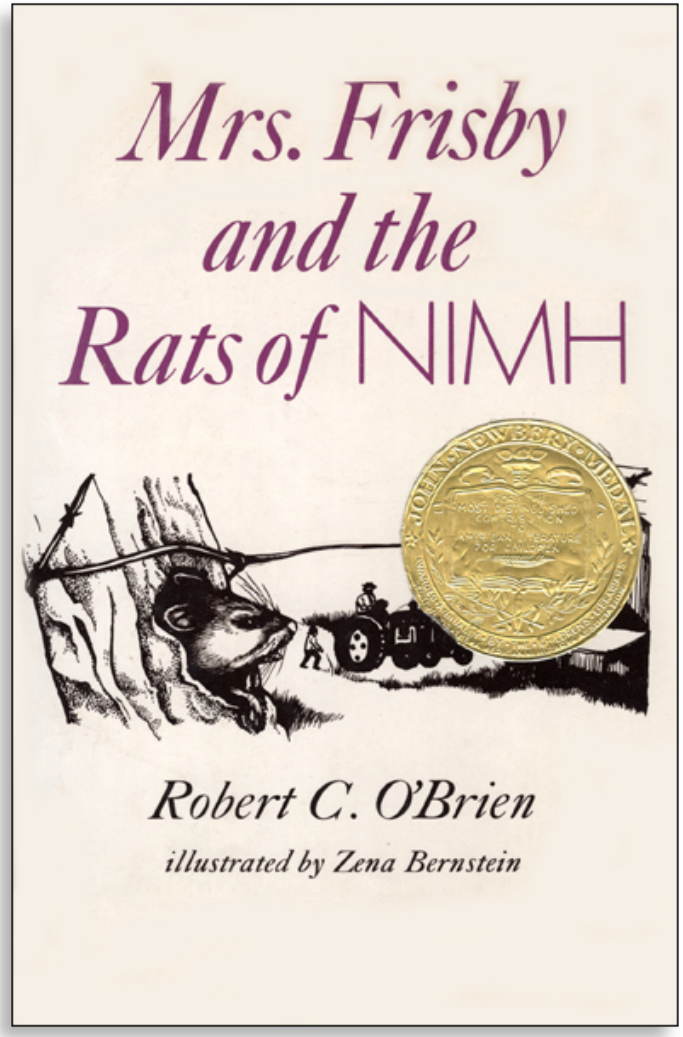
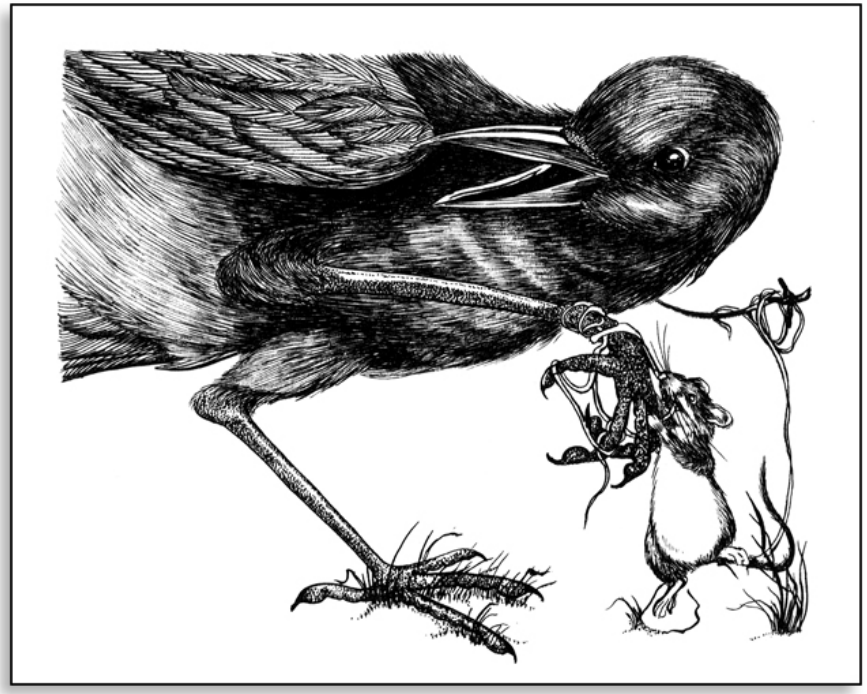
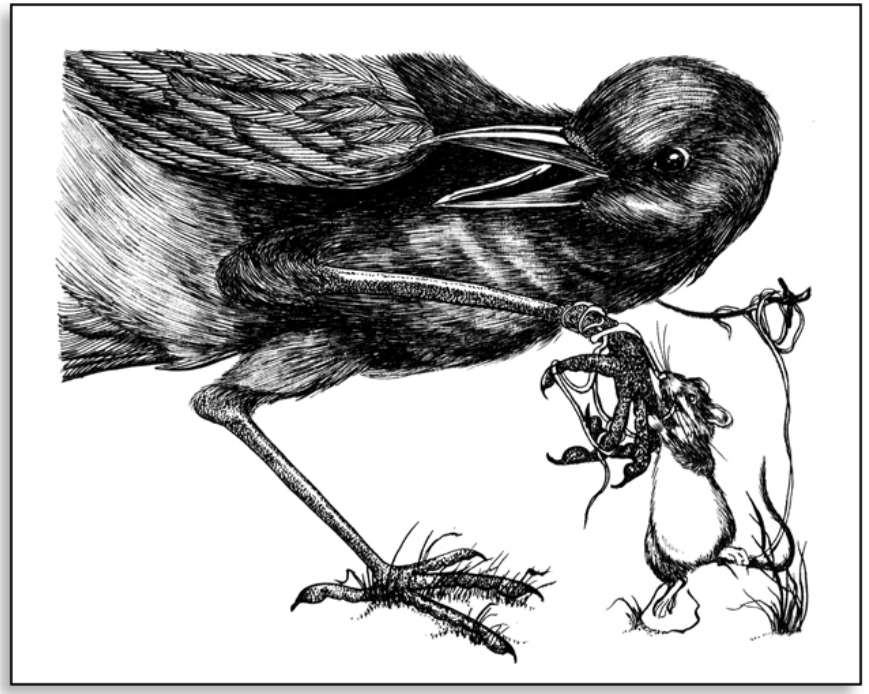




In which Mrs. Frisby rescues Jeremy, a young crow...

Jeremy's Experience

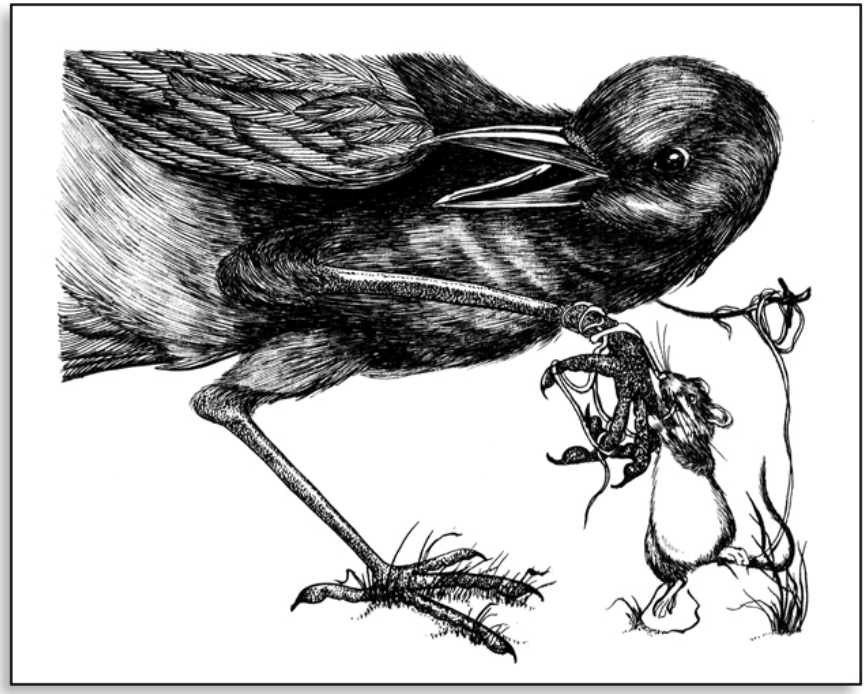


Upon hearing a commotion, Mrs. Frisby discovers a young crow who is apparently tied to a fence.

The crow – Jeremy – is flapping and squawking as he tries to escape.

Jeremy's Experience

A conversation ensues:



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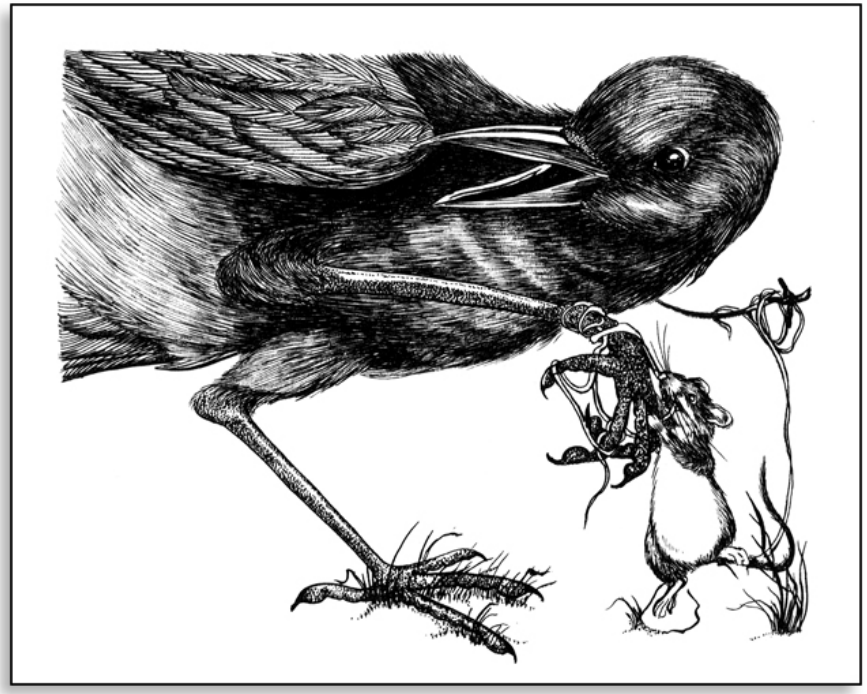

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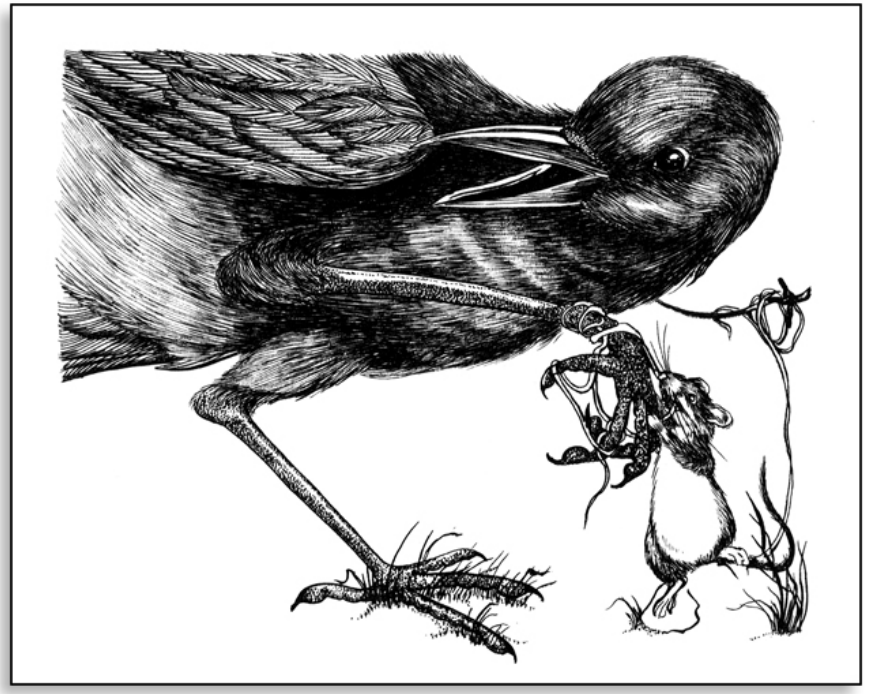
J: I picked up the string. It got tangled with my foot. I sat on the fence to try to get it off, and it caught on the fence.



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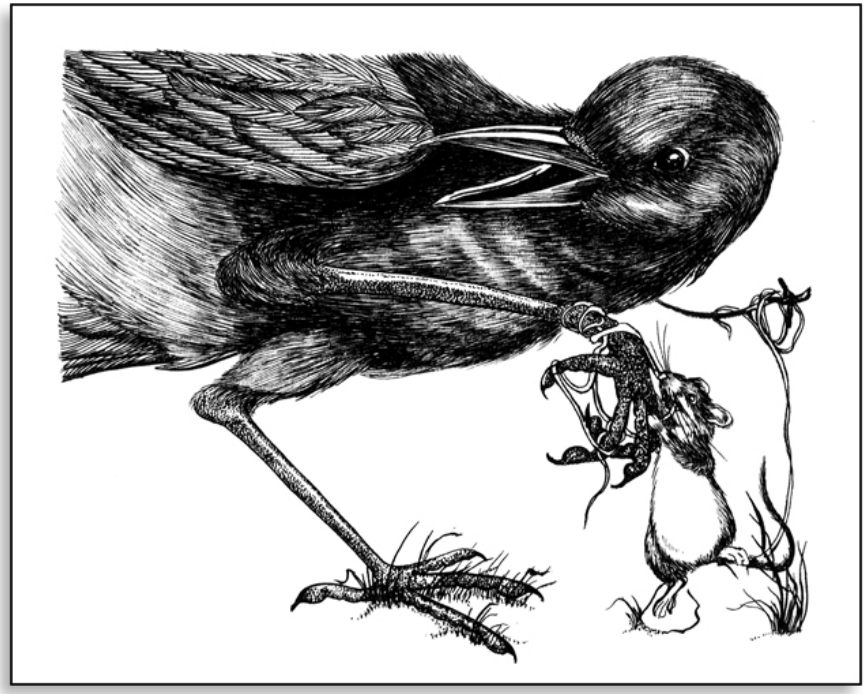

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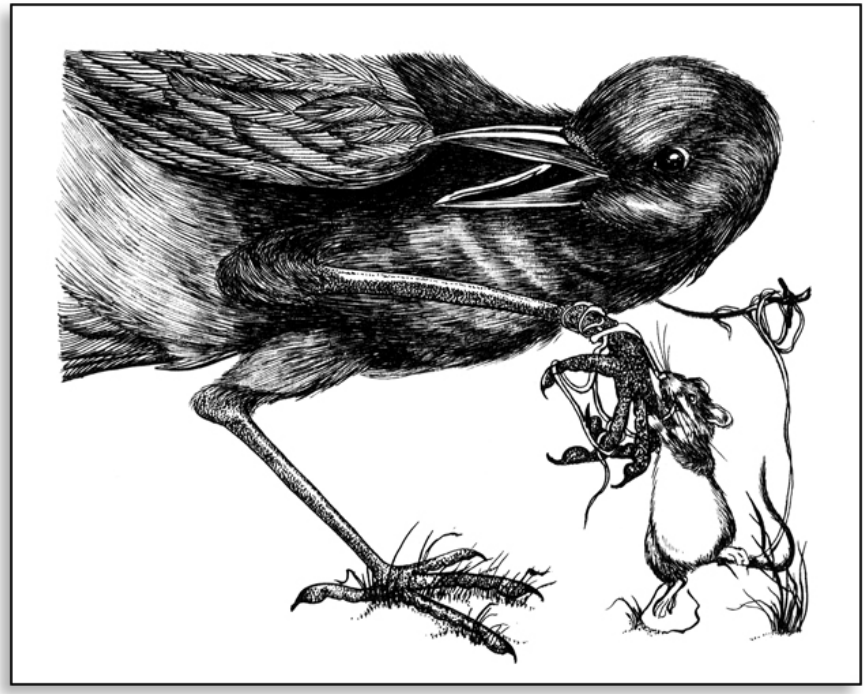
F: *Why* did you pick up the string?

J: Because it was shiny.



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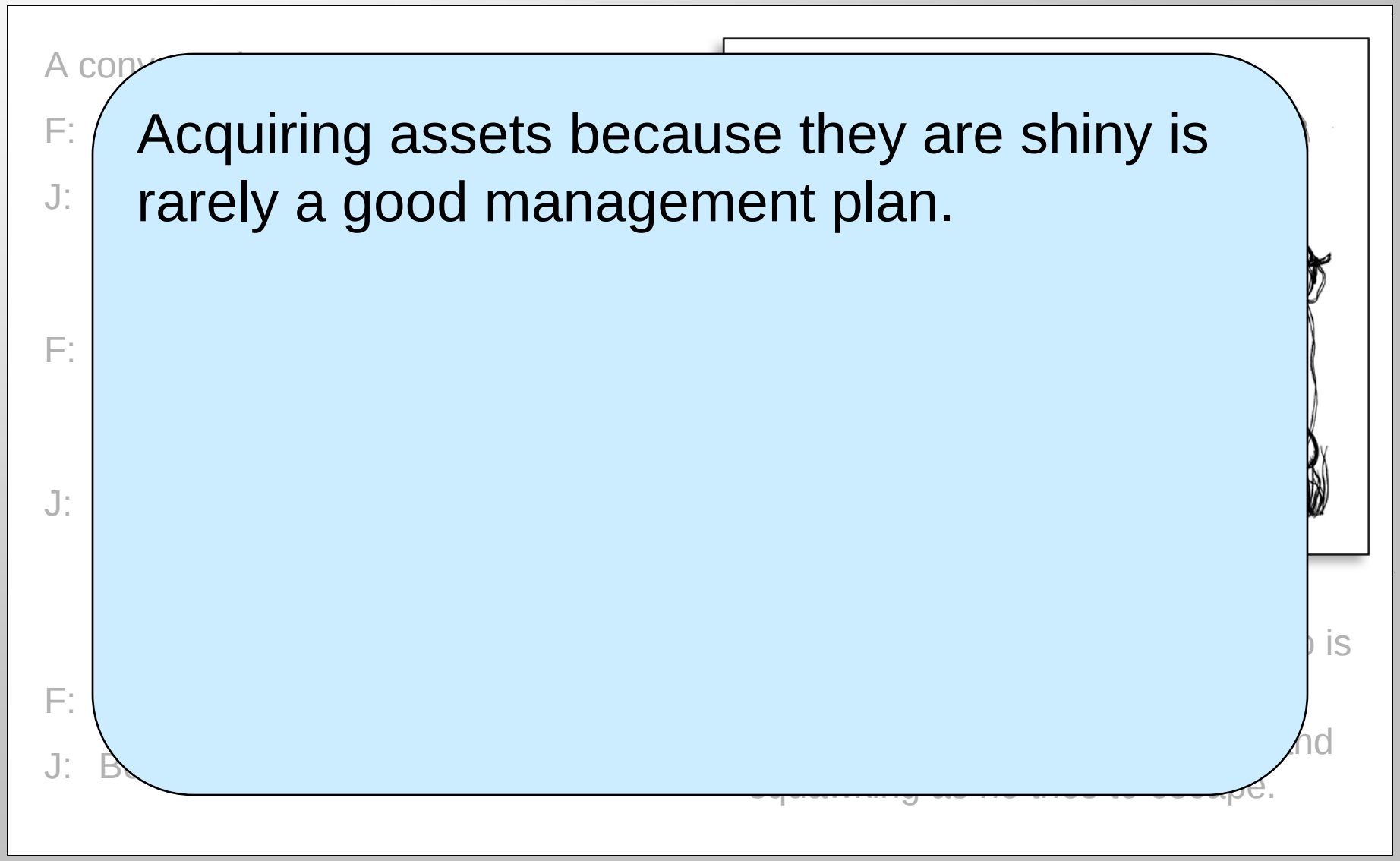
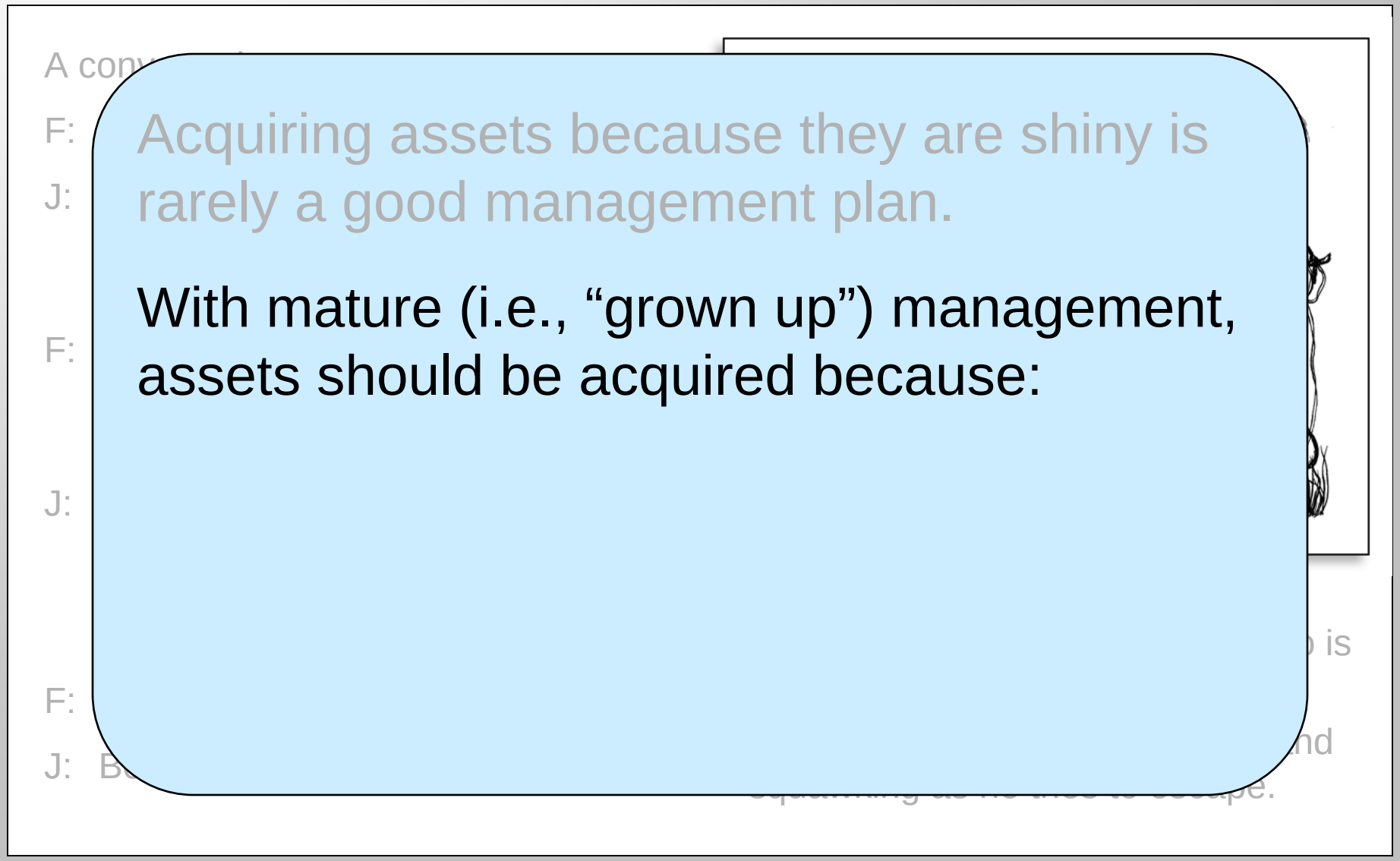


Acquiring assets because they are shiny is rarely a good management plan.

Jeremy's Experience



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With mature (i.e., "grown up") management, assets should be acquired because:

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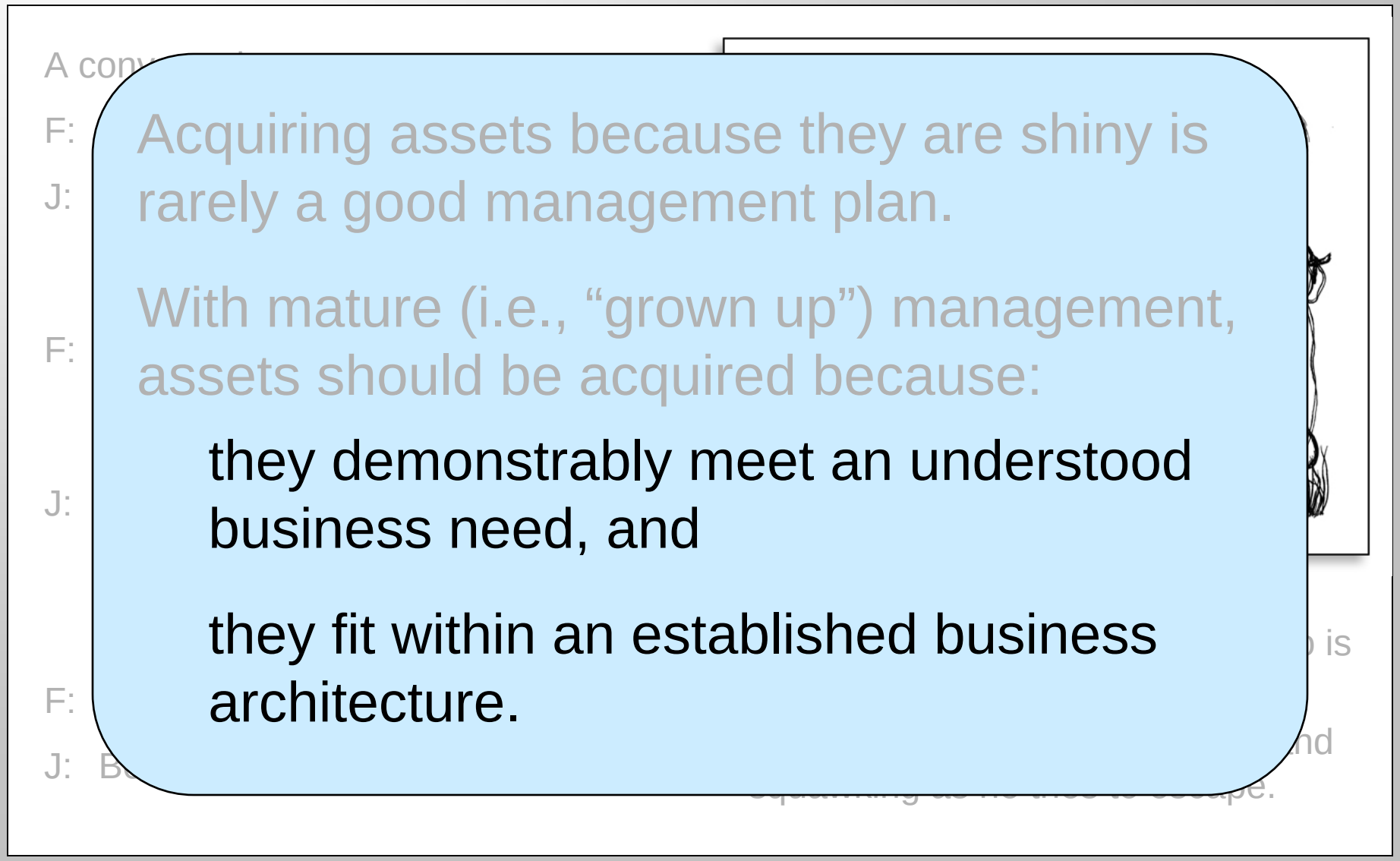
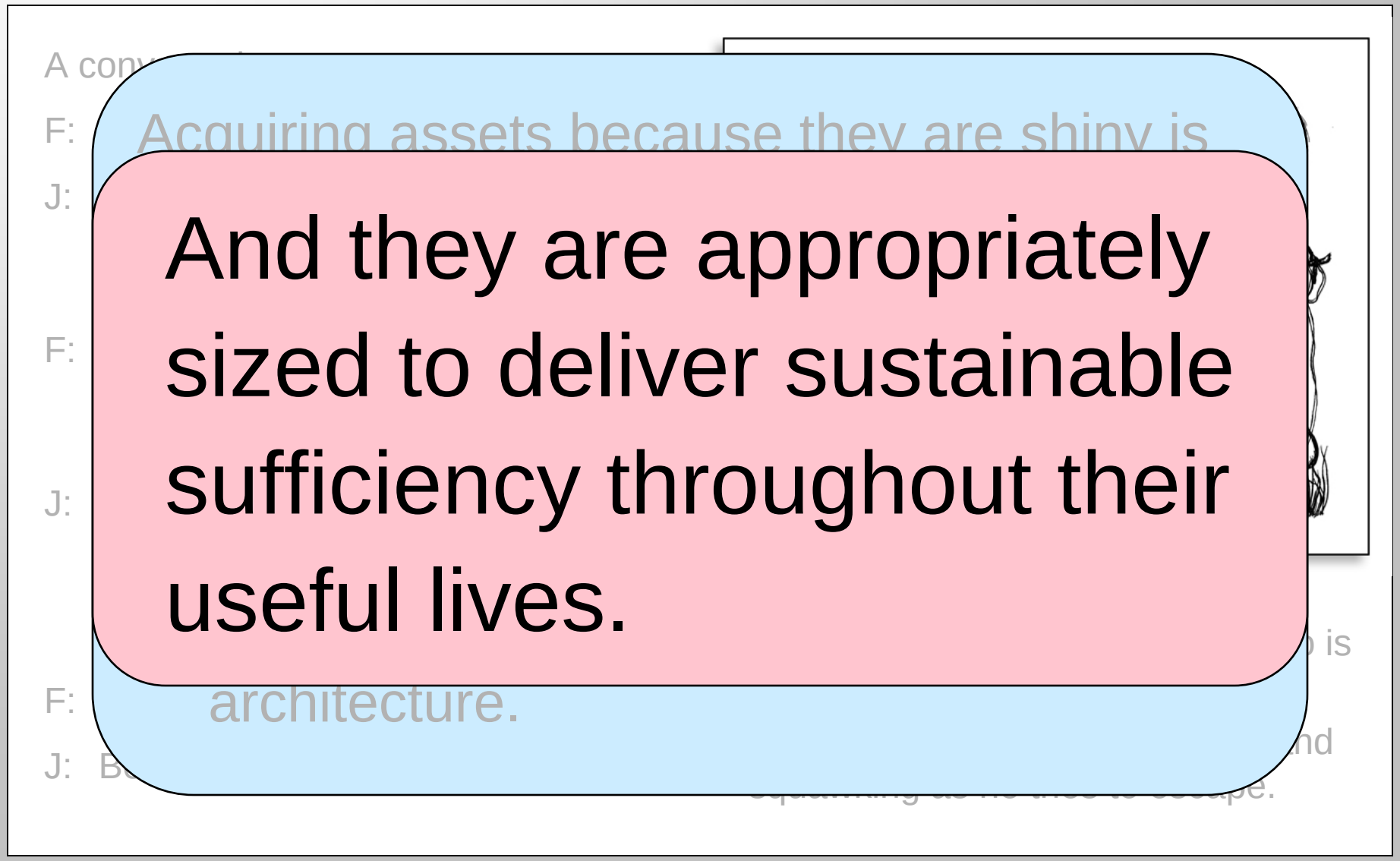


Acquiring assets because they are shiny is rarely a good management plan.

With mature (i.e., "grown up") management, assets should be acquired because:

- they demonstrably meet an understood business need, and
- they fit within an established business architecture.

Jeremy's Experience



And they are appropriately sized to deliver sustainable sufficiency throughout their useful lives.

END