PPM Deep Dive:
Variability examples
Variability terminology
Links to VDC elements

Martin Fischer

Learning Objectives:

1. You have refreshed and strengthened your understanding of variability.
2. You have learned the language to talk about the most important variabilities with your project team.
3. You are able to identify important variabilities on your project and determine how to use VDC to manage them.

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Why bother with variability?

- If you want to **produce** (design, build, maintain) your project **fast**, variability will be the main factor slowing you down.
- If you want to be efficient, i.e., produce at **low cost**, variability will be the main factor causing inefficiencies.

- Unless you understand and manage variability, you won't be able to produce your work and your project fast and at low cost with high reliability.

- We need a language to talk about variability.

Moses holds up the path to work for the fish

Who's perspective:
The fish trying to get to work

The source, cause, reason for the variability:
Moses parting the water, disrupting the swimming path for the fish

The variability:
The time required to get to work is longer than expected

Impact of the variability:
Reprimand of the boss,
loss of promotion,
loss of client, etc.
(depends on the context)

"Oh, great. Now I'll be late for work."

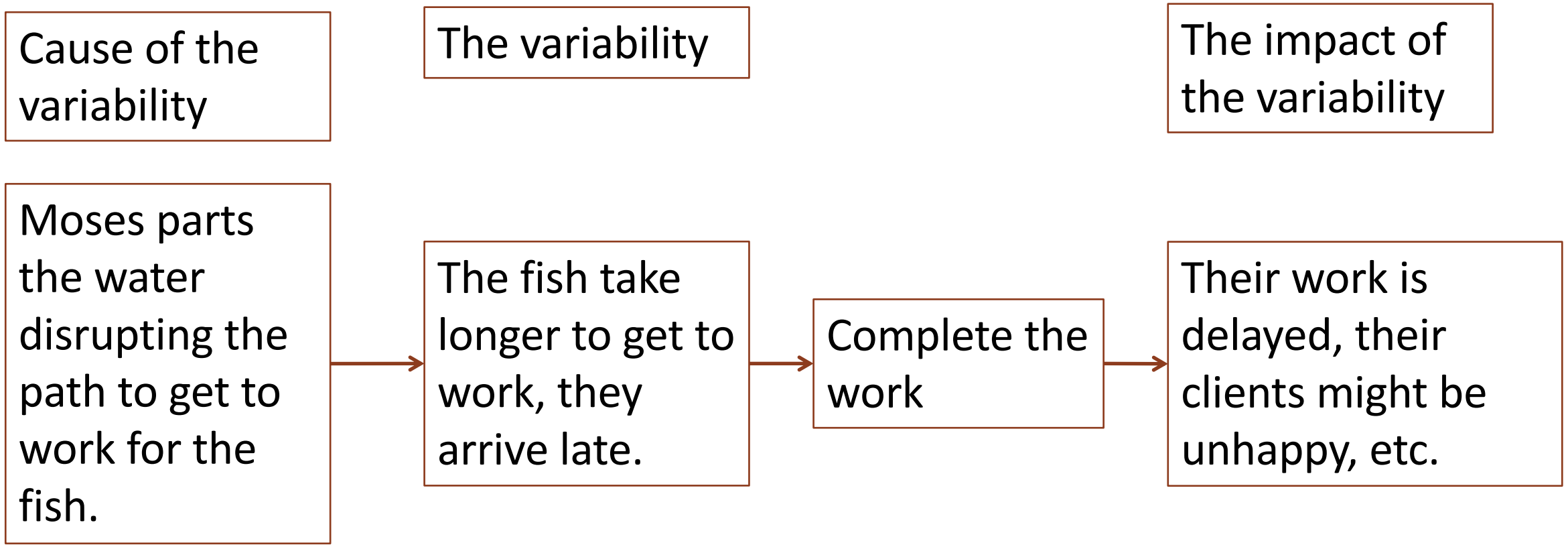
CartoonStock.com

How to reduce the variability:
Learn to swim faster so that when there is a disruption you can catch up
Work from home

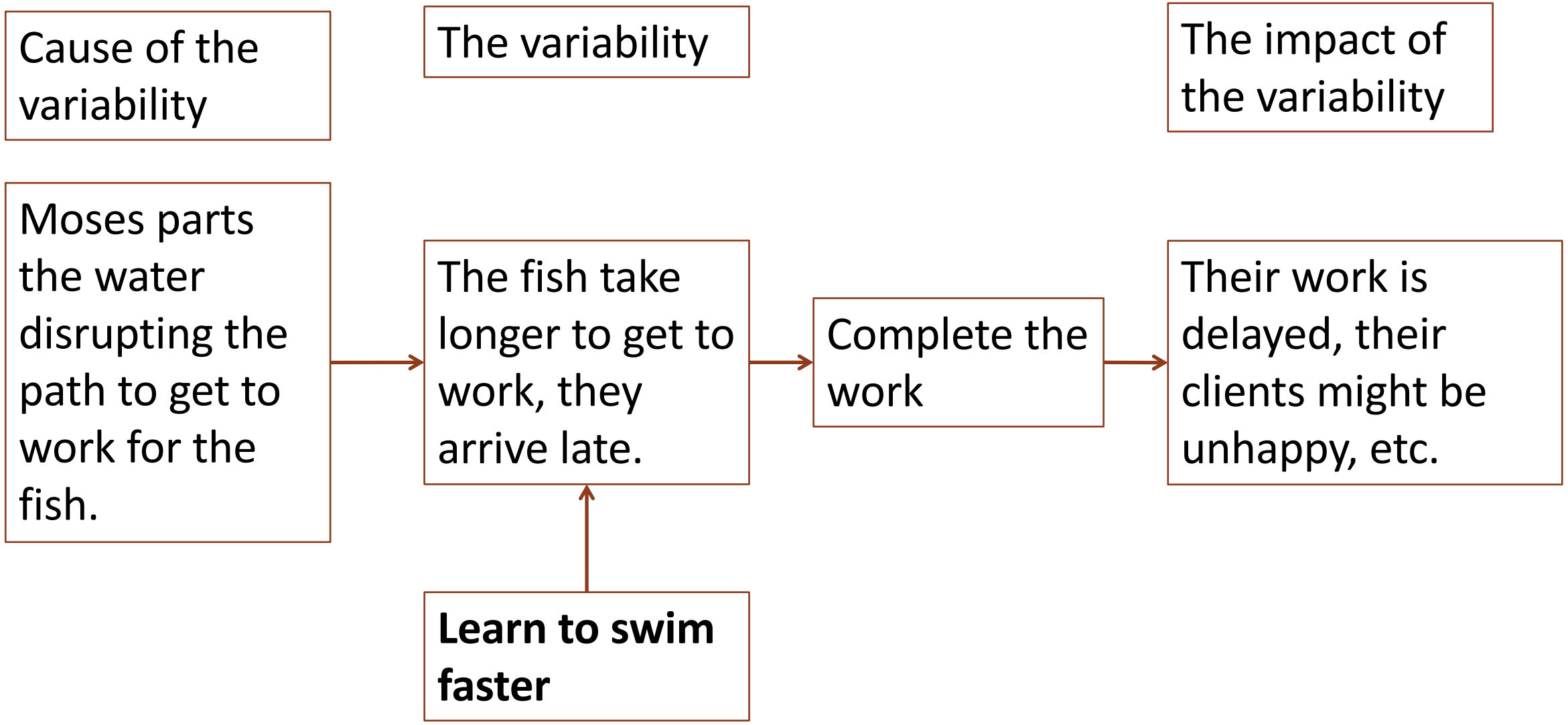
How to buffer the variability:
Time buffer:
Leave earlier
Commit to later deadlines
Capacity buffer:
Make sure a colleague can handle the work
Plan to stay later in the evening

Used with permission

The fish are going to work



Reducing this variability for the fish



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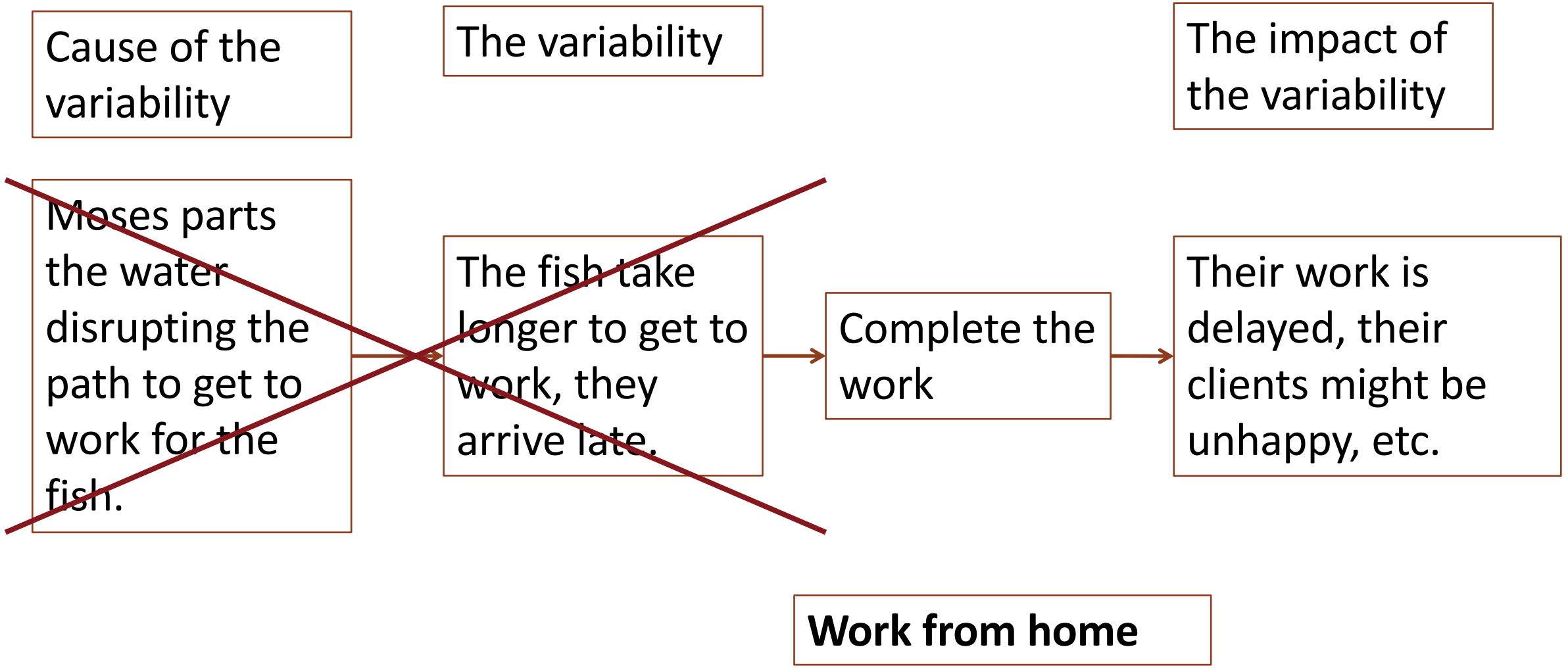
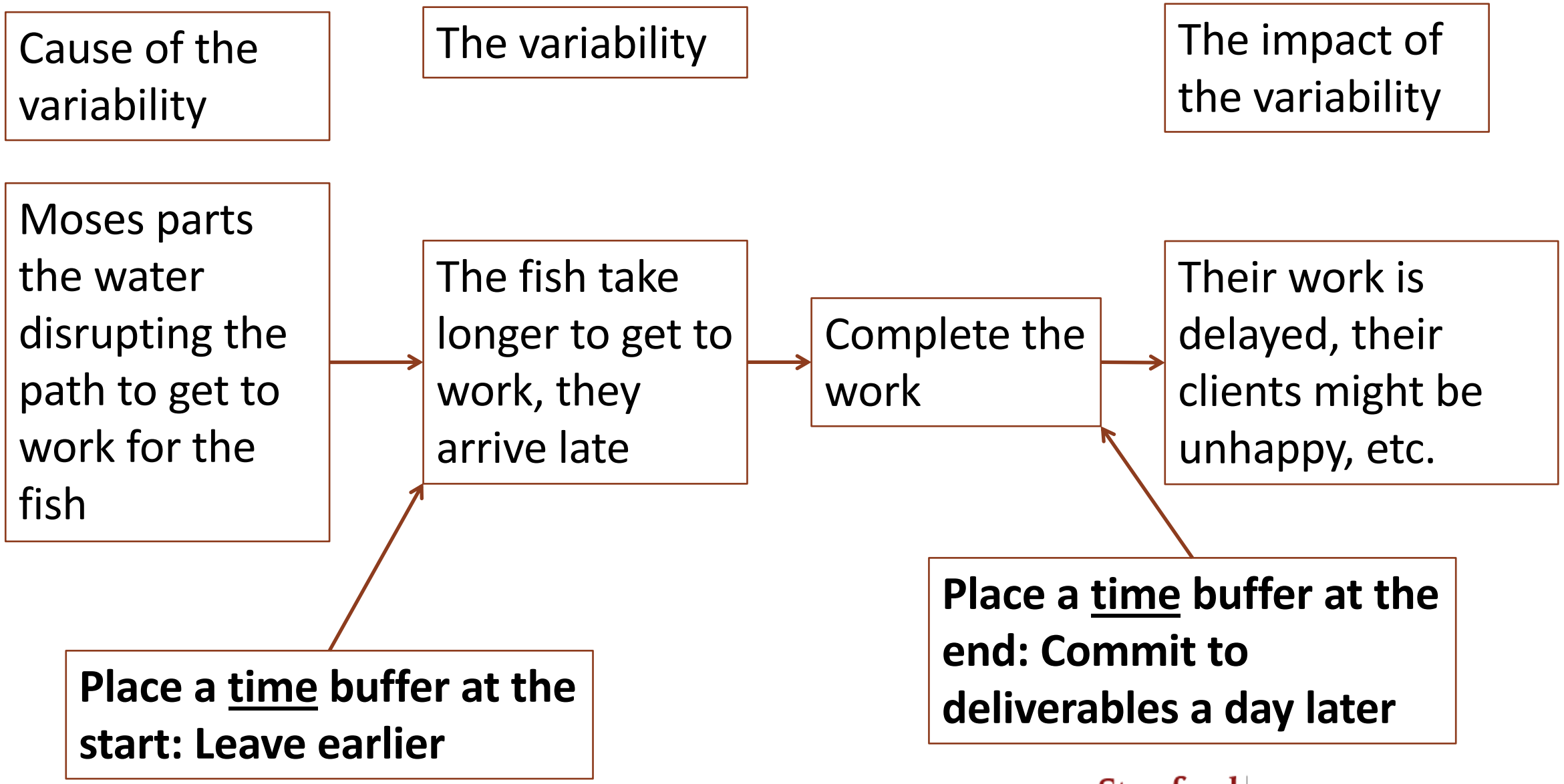


Buffering this variability for the fish



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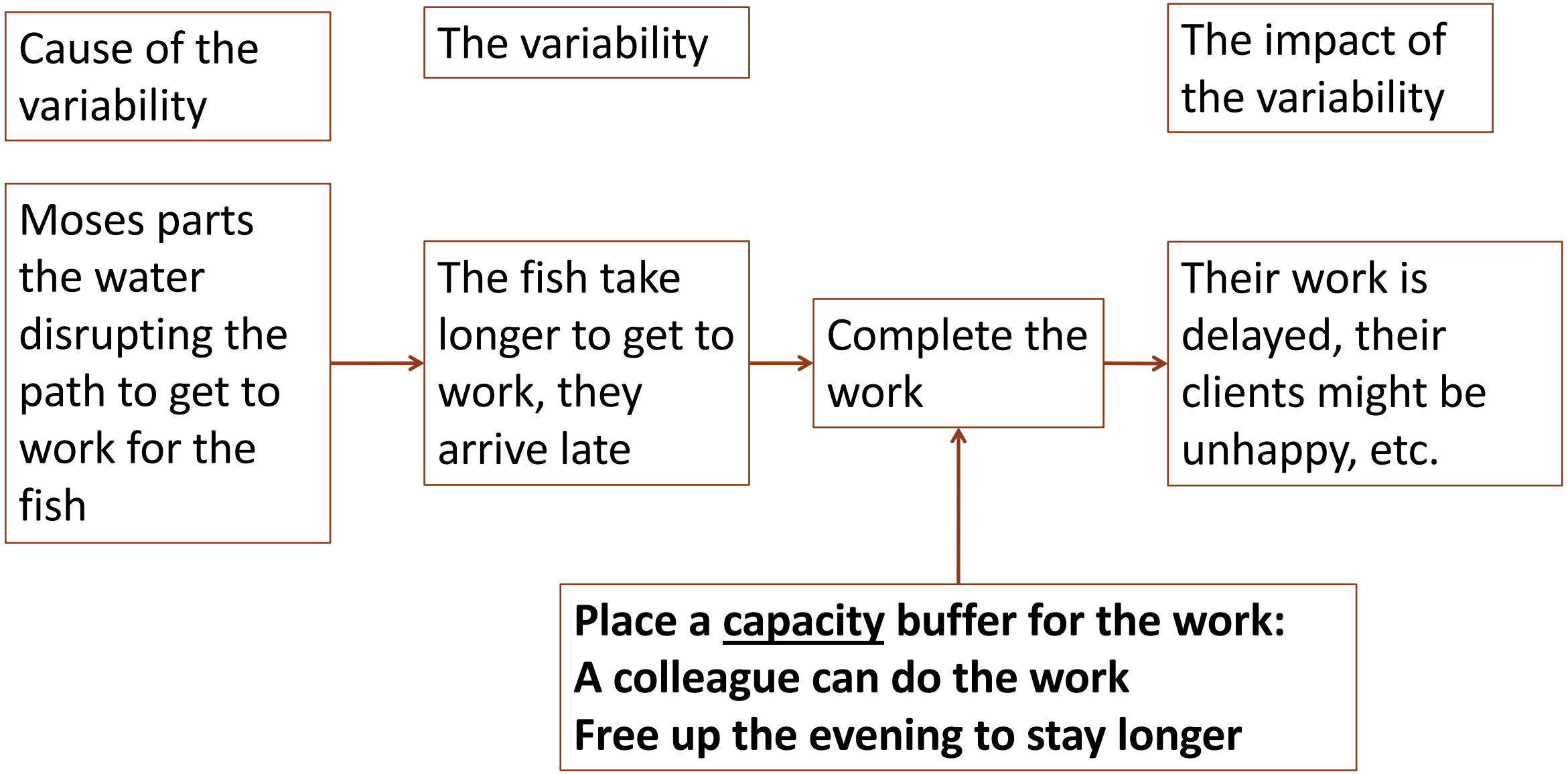


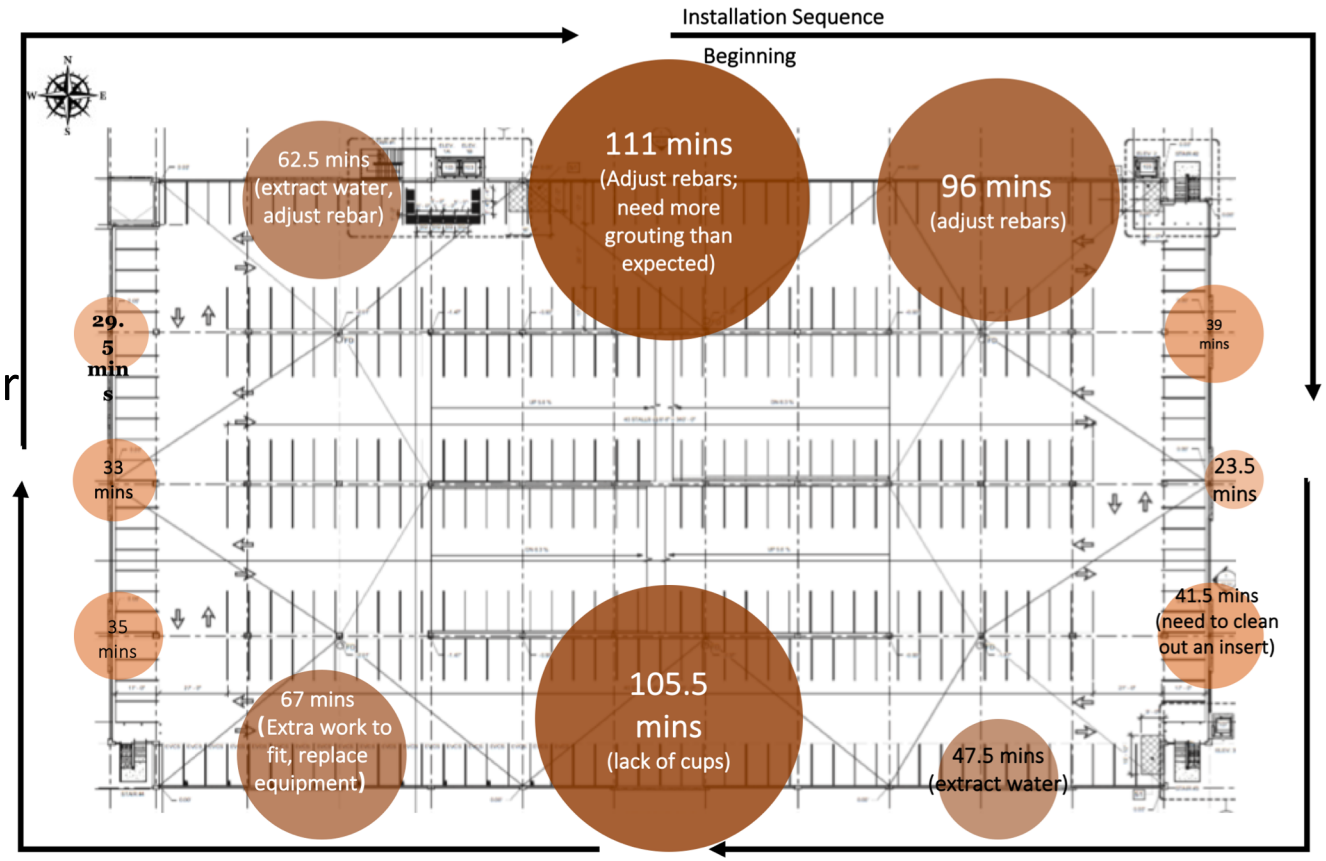
Installing precast shear walls

Who's perspective:
Precast installation crew

The source, cause, reason for the variability:
Cast-in-place (CIP) rebar is out of tolerance

The variability:
The time required to install a shear wall

Impact of the variability:
Additional crane and crew costs
Extra storage cost for elements not installed



Work by Yan-Ping Wang in collaboration with Rui Liu, Clark Pacific, and Versatile

How to reduce the variability:
Scan the cast-in-place work
Design a more flexible connection between the CIP and precast components

How to buffer the variability:
Time buffer:
Start the work an hour earlier on the first day of precast installation
Leave Friday afternoon open for catch-up work
Capacity buffer:
Have a second crane ready
Inventory:
Have additional work ready for the members of the installation crew that are not busy when an installation takes longer

Quantity takeoff for cost estimating

Who's perspective:
Cost estimator

The source, cause, reason for the variability:
The drawings had more conflicting information than typical and the design included more different components than normal

The variability:
Quantity take-off (QTO) took 8 hours longer than expected

Impact of the variability:
Cost feedback on the design version was a day late missing the ICE session with the client

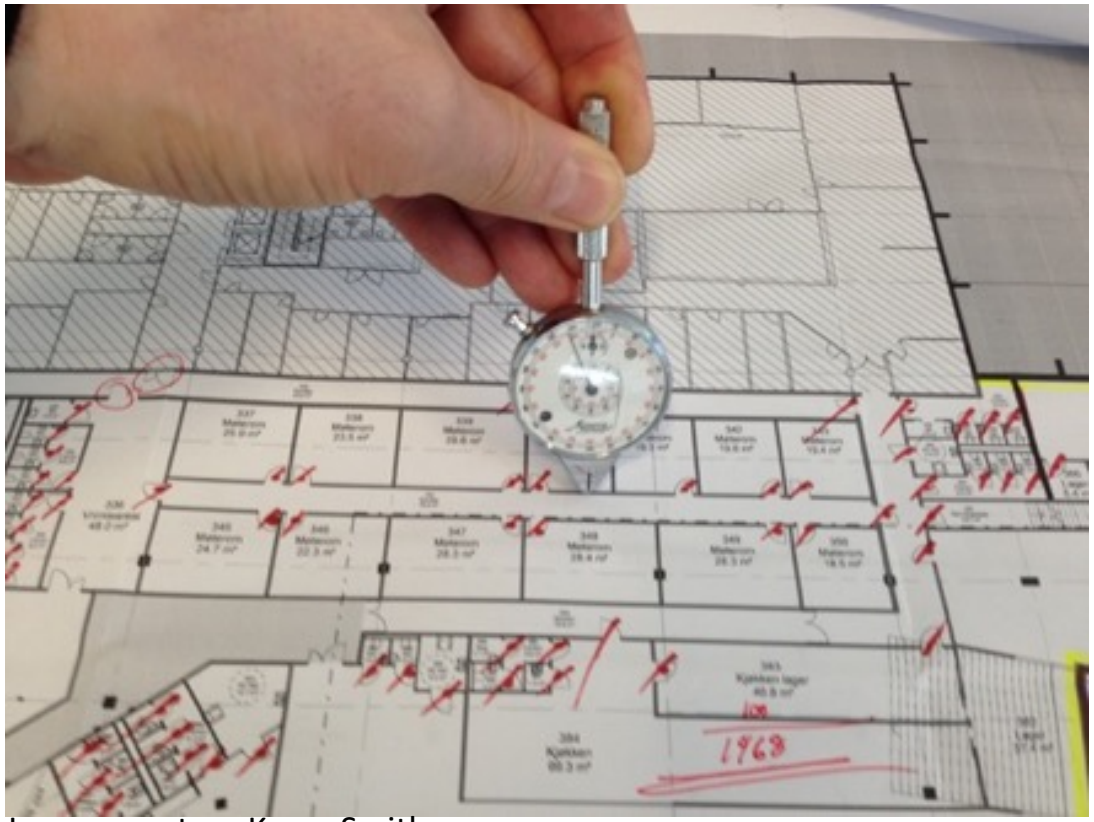


Image courtesy Kruse Smith

How to reduce the variability:
Use a BIM instead of drawings as the basis for takeoff to automate most of the takeoff process and make the duration of the takeoff process less variable

How to buffer the variability:
Time buffer:
Start a day earlier
Capacity buffer:
Have extra pricing experts available to make up the QTO delay
Inventory:
Use smaller batches to hand over partial QTOs and allow the pricing experts to start working on the estimate sooner

Client has a late change request (during construction)

Who's perspective:
Prefab wall panel fabricator/installer

The source, cause, reason for the variability:
The nurses wanted to move the electrical outlets in the patient rooms after the interior walls had already been fabricated

The variability:
Rework to move the electrical outlets

Impact of the variability:
Extra cost for the rework, delay of installation of the interior walls

Image courtesy DPR Construction

How to reduce the variability:
Use Virtual Reality (VR) to give the nurses thorough experiences of using a patient room before fabrication

How to buffer the variability:
Time buffer:
Schedule the finishing work a week later than the finish of the interior wall installation
Capacity buffer:
Have a stand-by crew for fabrication rework and to speed up installation
Inventory:
Have other prefabricated elements ready

Production metrics

- Number, types, reasons, and impacts of design changes during construction
  - Timing, quality, information basis, participants of design decisions
- Completeness, timeliness, format of quantity takeoff
  - Agreement on BIM format, MMI, process to create and check BIM and QTO information
- Duration of installation tasks (not average, but for each part), reasons for variations
  - Production data to be collected, data-driven pull and takt planning

➢ Agree on production metrics we want to collect and compare across this VDC program

To recap: Questions to understand and manage variability

- What varies? Who suffers the variation?
- Why does the variation happen? Who/what causes it?
- What is the impact of the variation? Who suffers the consequences of the variation?
- Can the cause of the variability be reduced or eliminated? How?
- Can the variability itself be reduced? How?
- Can the impact of the variability be buffered? How?
  - Inventory buffer
  - Capacity buffer
  - Time buffer

  Consider whether schedule or cost objectives matter more in selecting the type(s) of buffer

Main VDC practices for reducing and managing variability

- ICE
  - Makes latency more predictable (and shorter)
  - Makes it more likely that decisions will stick because the relevant decision makers are together and are considering all the necessary viewpoints on the basis of timely, visual, and complete information

Main VDC practices for reducing and managing variability

- PPM
  - Process models (maps) clarify the workflow for a team, expose tasks that are particularly variable, and allow a project team to develop the best (most reliable) production process and control mechanisms
  - Collaborative pull planning creates a value-driven, purposeful plan of work aligning everyone's understanding of the plan and priorities
  - Takt planning creates well-defined work assignments, aligns production rates as best as possible, and establishes rapid feedback loops, reducing some of the main variabilities in a production process
  - PPC exposes variability in sticking with commitments and getting planned work done, including the reasons for not getting work done as planned (i.e., the reasons for variability)

Main VDC practices for reducing and managing variability

- BIM
  - BIM establishes a shared, and most importantly, certain information basis
  - BIM eliminates spatial conflicts
  - BIM makes it more likely that the design is understood by all project participants and stakeholders in a timely manner, leading to a buildable, usable, operable, and sustainable design

Main VDC practices for reducing and managing variability

- Consider the interactions between the VDC elements
  - BIM provides the information basis for ICE sessions
  - ICE sessions prioritize the most important information to included in the next version of the BIM
  - PPM establishes the processes for creating and using BIM and the timing of ICE sessions
  - Etc.

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