Lean Construction Institute

Provider Number H561

Lean Design Forum P2SL/AIA/LCI 2016-Day Two

P2SLDF20162

January 29, 2016

4 LU/HSW Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES

for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

Kanban method (the pull production system invented by Toyota) will be analyzed and shown useful to coordinate and improve design and knowledge-based work in the construction industry. Use of kanban method in a variety of design applications will be explained. Discussion will include how kanban method practitioners may benefit from reliable promising (linguistic action) and system design concepts drawn from Last Planner®.

Learning Objectives

1. At the end of this presentation, participants will be able to recognize the difference between push and pull planning.
2. At the end of this presentation, participants will be able to define kanban method, its core practices, and terminology.
3. At the end of this presentation, participants will recognize how kanban method can be a powerful commitment-based approach to design and knowledge-based work in the construction industry.
4. At the end of this presentation, participants will understand how system design concepts from Last Planner® may be used in production system design of knowledge-based work.

This concludes The American Institute of Architects
Continuing Education Systems Course

Lean Construction Institute

info@leanconstruction.org

Kanban method

Application in design

Jeff Loeb

Agenda

- What is the goal?
- What is kanban method?
- Core practices
- Examples
- Flow concepts
- Coordinating work with kanban method

"There are four purposes of improvement:

Easier,
Better,
Faster, and
Cheaper

These four goals appear in the order of priority."

—Shigeo Shingo

"We're most efficient when down time is minimized."

"The sooner we start the sooner we'll finish."

"I can get 10 a day done. Doing only 5 would make me 50% productive."

"It's better to be caught up (even if others aren't)."

"I have to hurry up and get done so I have time to make all the changes."

"Let me alone. I don't have time to plan."

What is the goal?

Optimizing the whole

- Customer value focused
- High awareness of inter-relatedness
- Holistic measures of success

Reliable workflow

- Coordinated delivery of highest value work
- Manage promises, not people

Everyone learning

- Continual, evolutionary improvement
- Customer and business outcomes

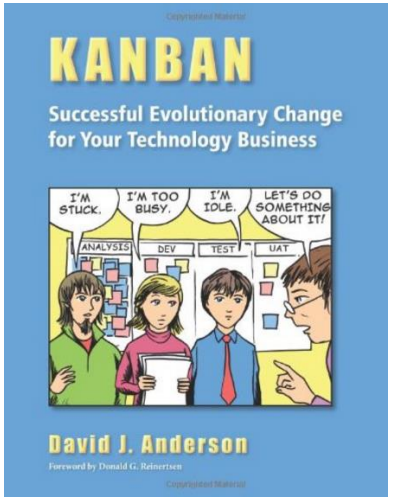
Remember the milkman?

What is kanban?

- Kanban means “visual board”
- A signal to another team member to “pull” (request) work from one step to another
- Kanban connects people and process steps, moving toward one piece flow
- David Anderson pioneered kanban method for product development in 2004
- Earliest Kanban invented by Toyota (Toyota Production System 1940s to 1970s)

Kanban method foundational principles

- Start with what you do now
- Agree to pursue incremental, evolutionary change
- Respect current roles, responsibilities & job titles
- Encourage acts of leadership at all levels



Kanban method core practices

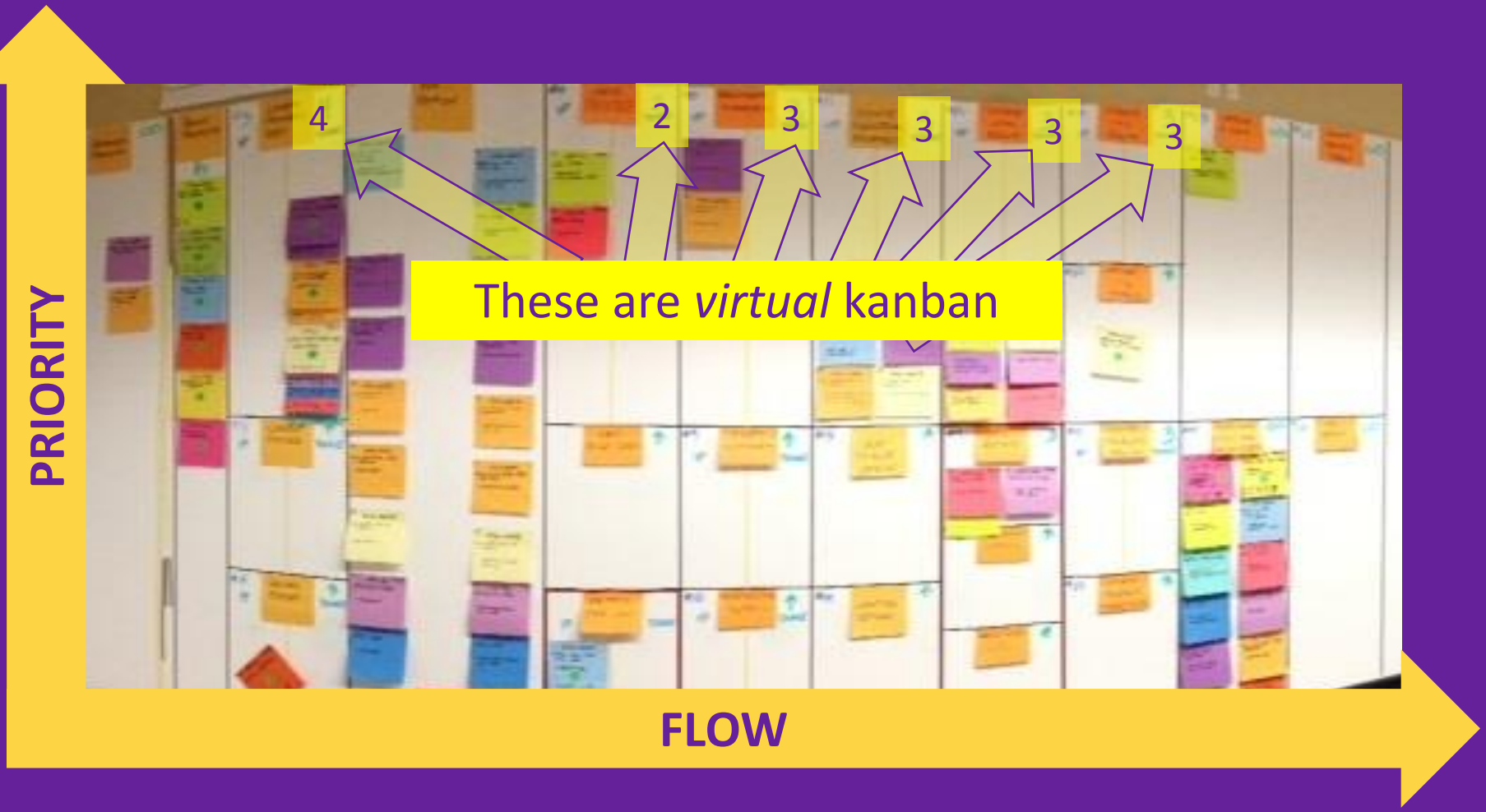
- Visualize the work
  - Create a visual model of your workflow
  - Use visual boards to observe the flow
- Limit work in progress (WIP)
  - When WIP is kept low learning and speed increase!
- Make explicit policies for managing your work
- Focus on flow
  - Remove causes of delay, interruption, rework
- Continuously, collaboratively improve
  - Build feedback into the work
  - Run experiments to 'change for the better'
  - Further lower WIP limits to reveal more opportunities

"If you're not limiting your WIP then there is no flow.

Your Kanban board is no more than a to-do list."

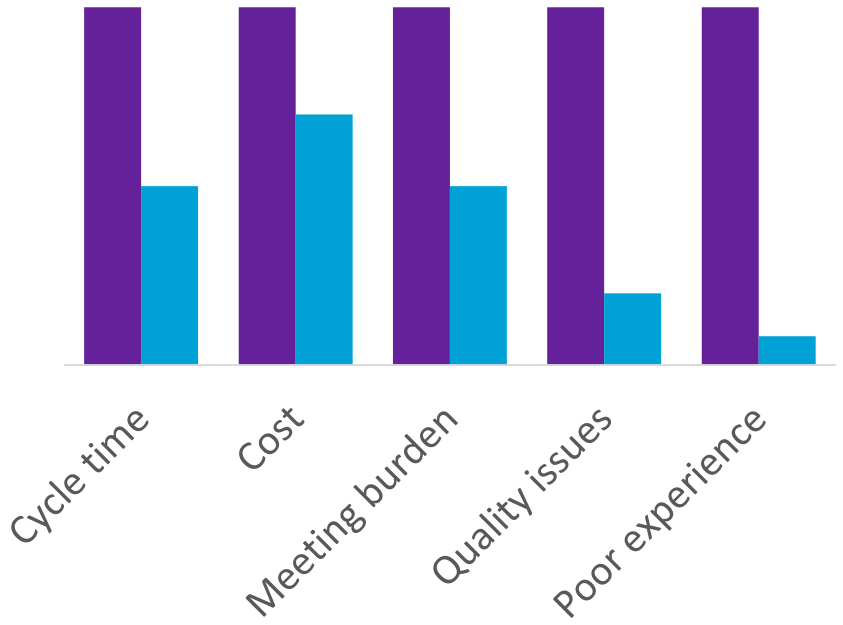
–Jim Benson, author of Personal Kanban

Visualize the workflow - kanban board

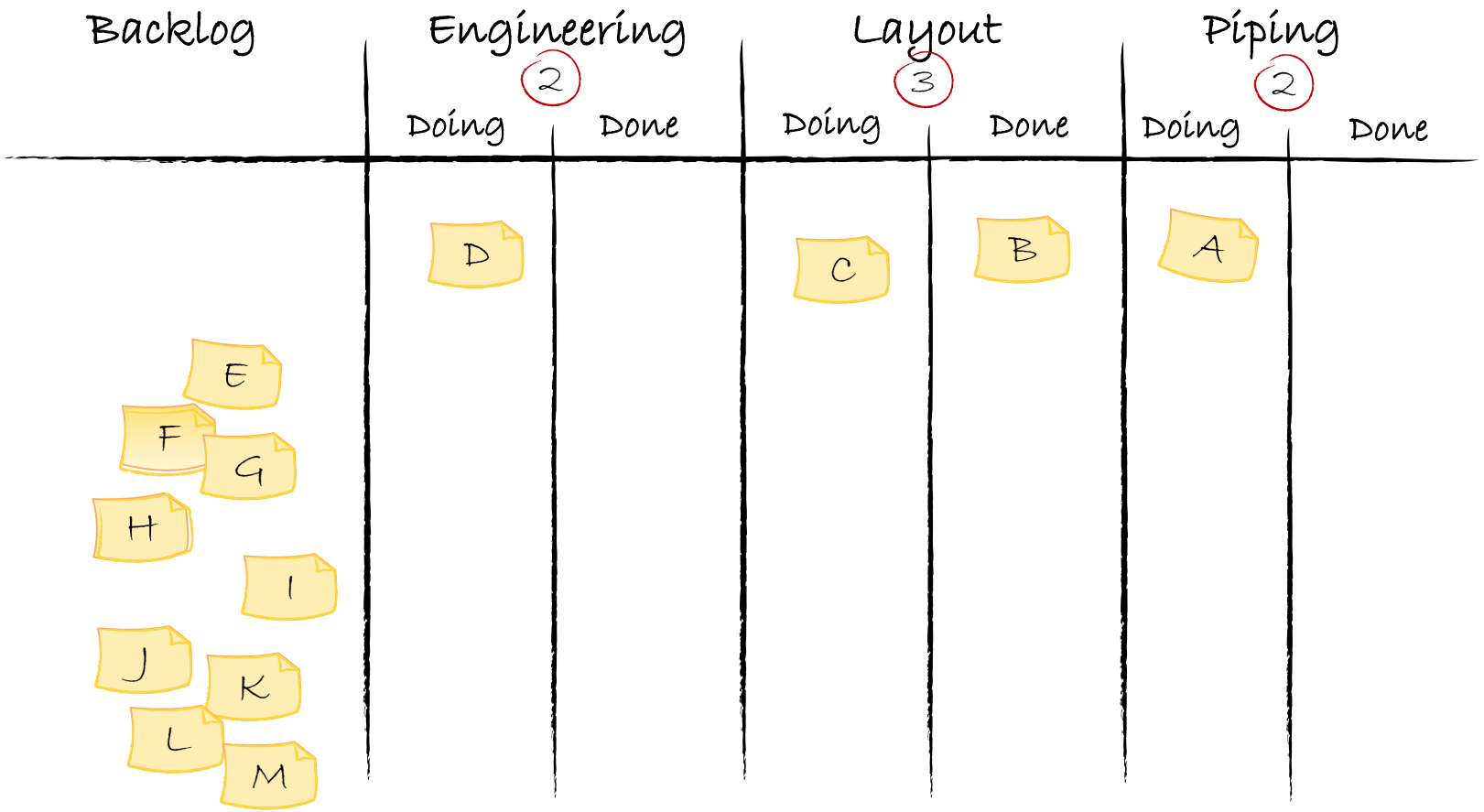


Expect results from disciplined implementation

- 50% quicker turnaround
- 30% higher productivity and lower cost
- 50% reduction in meeting burden
- 80% reduction in defects
- *Much* better experience for all involved



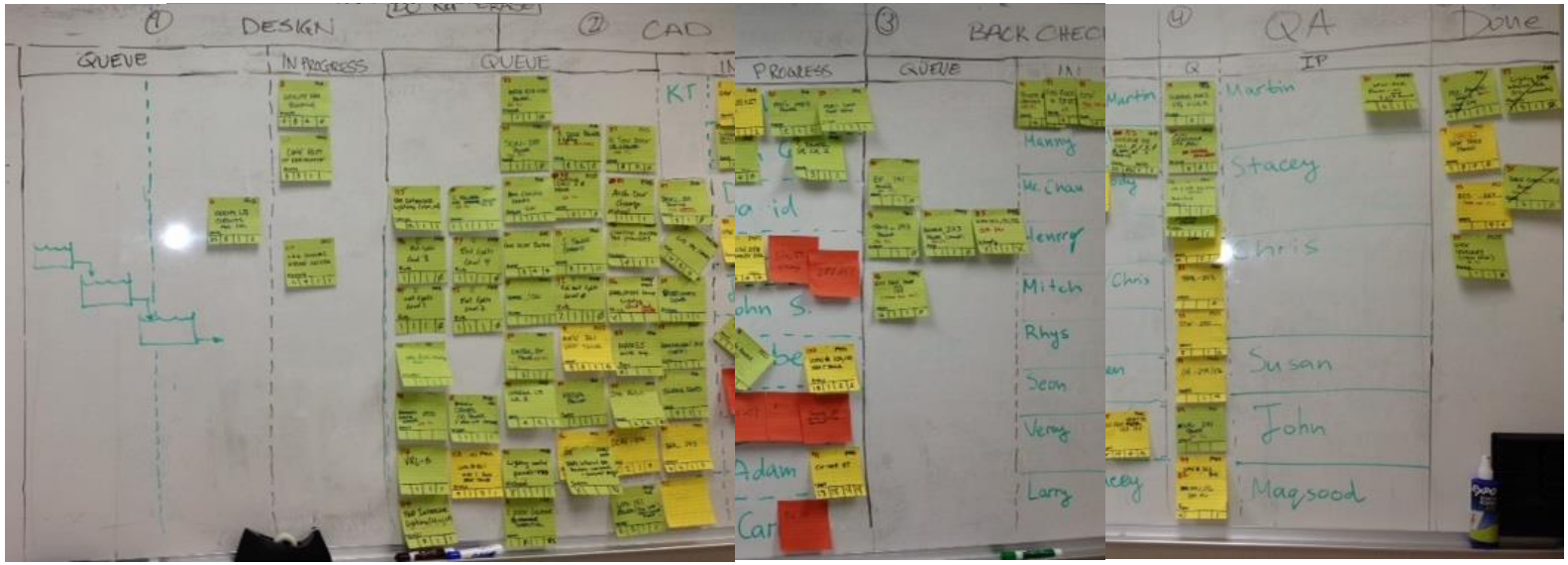
A simple kanban board



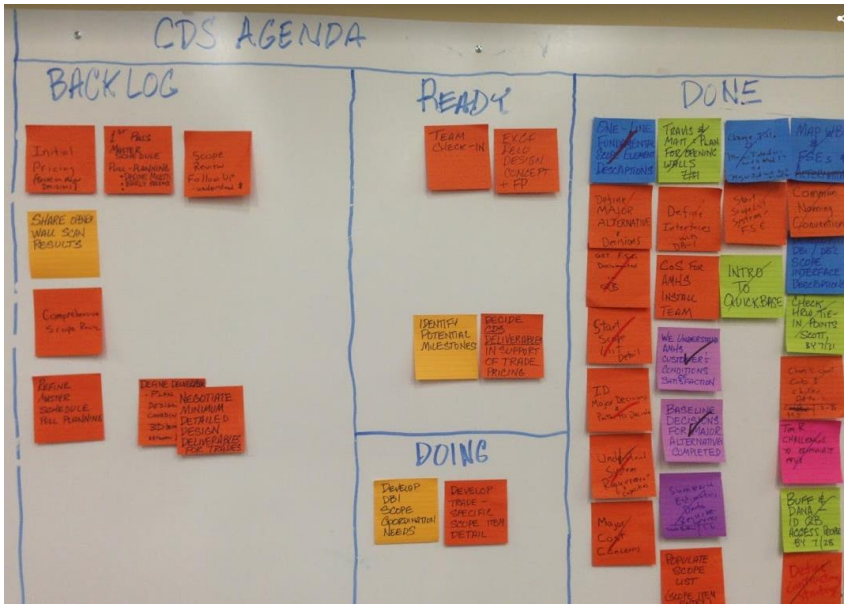
Example applications

Electrical engineering and design

- Problem: work stacking up. Performers being redirected frequently. Inability to see who has free capacity.
- Countermeasure: map the process. Make WIP visible. Create swimlanes by performer. Establish daily check-in and weekly cycle planning.
- Result: leveled load across designers. Improved focus on finishing. Highlighted need for additional senior staff.



Building an agenda & running a meeting

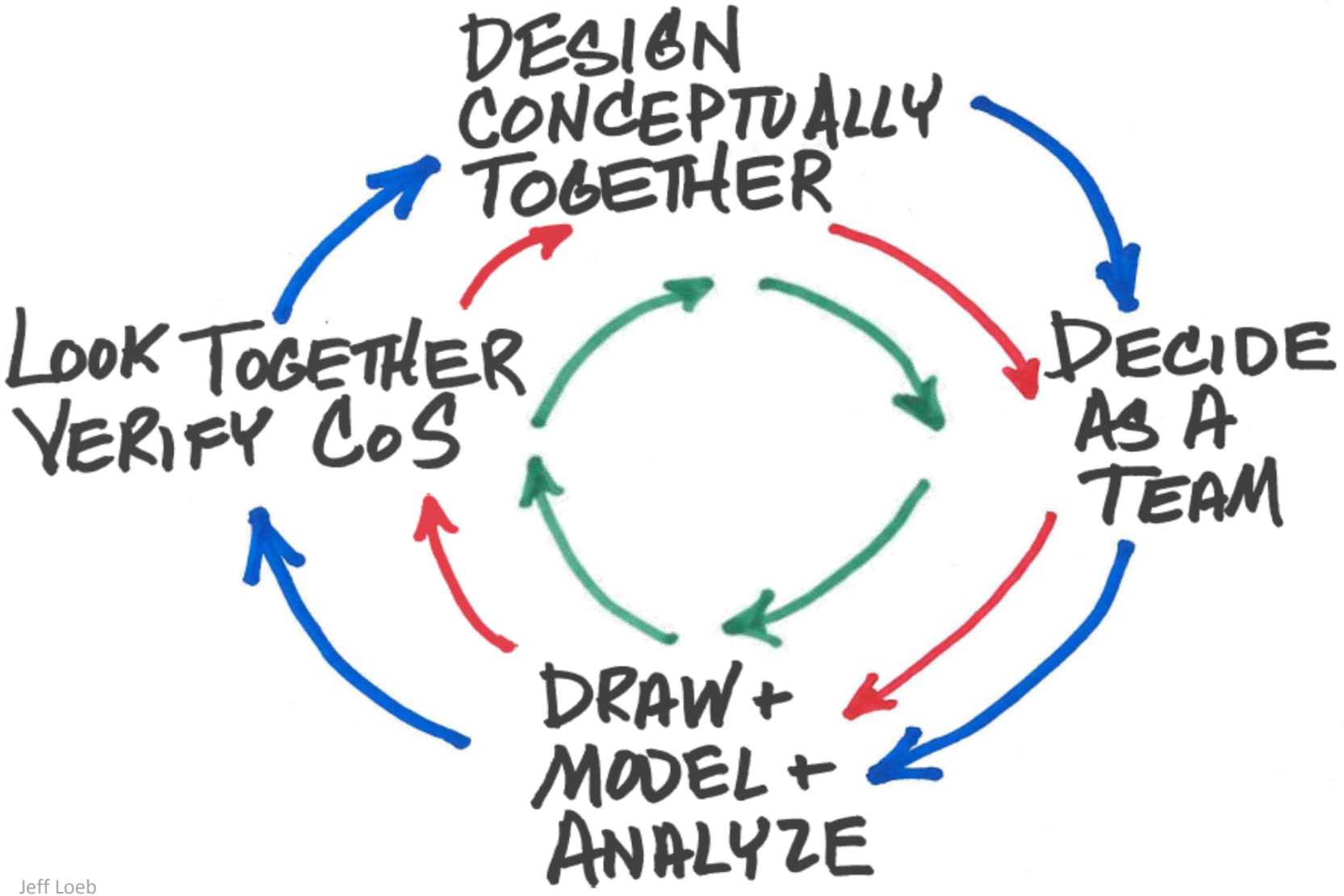


- Problem: boring meetings with inflexible agendas
- Countermeasure
  - Rapidly build agenda as a group based on what's most important to the team
  - Time-box topics
  - Adjust the agenda as you go, adding and reprioritizing topics
- Result
  - More engaging, focused conversation
  - Topics relevant to concerns
  - Adaptive

Managing improvement work

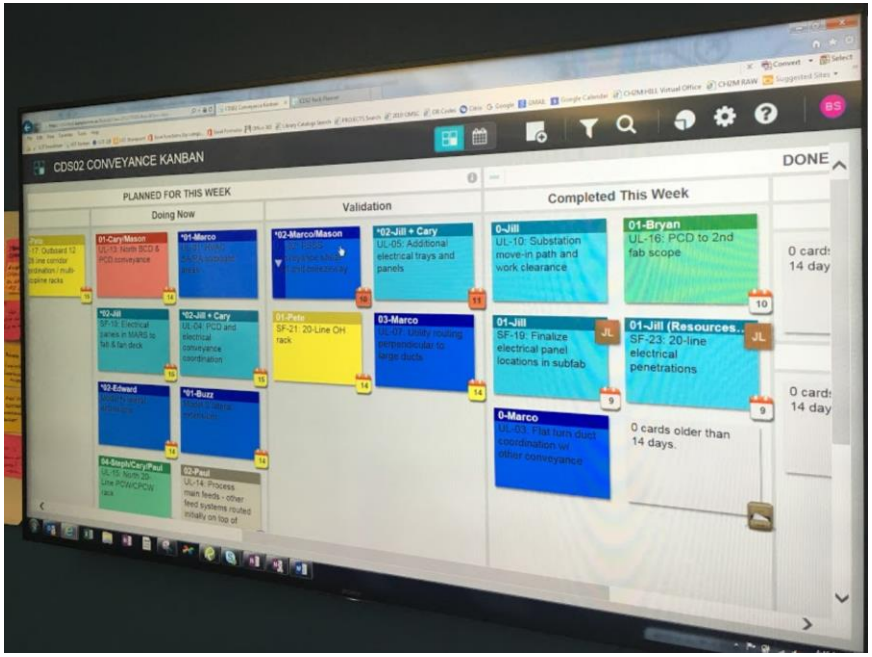
- Problem: we weren't making progress turning deltas into improvements
- Countermeasure
  - Turn deltas into actionable work
  - Create a prioritized backlog
  - Secure promises to complete. Have a recurring forum to manage commitments.
- Result
  - Steady, visible progress on improvements
  - More people engaged in improving

Design is conversation. Design is iterative.



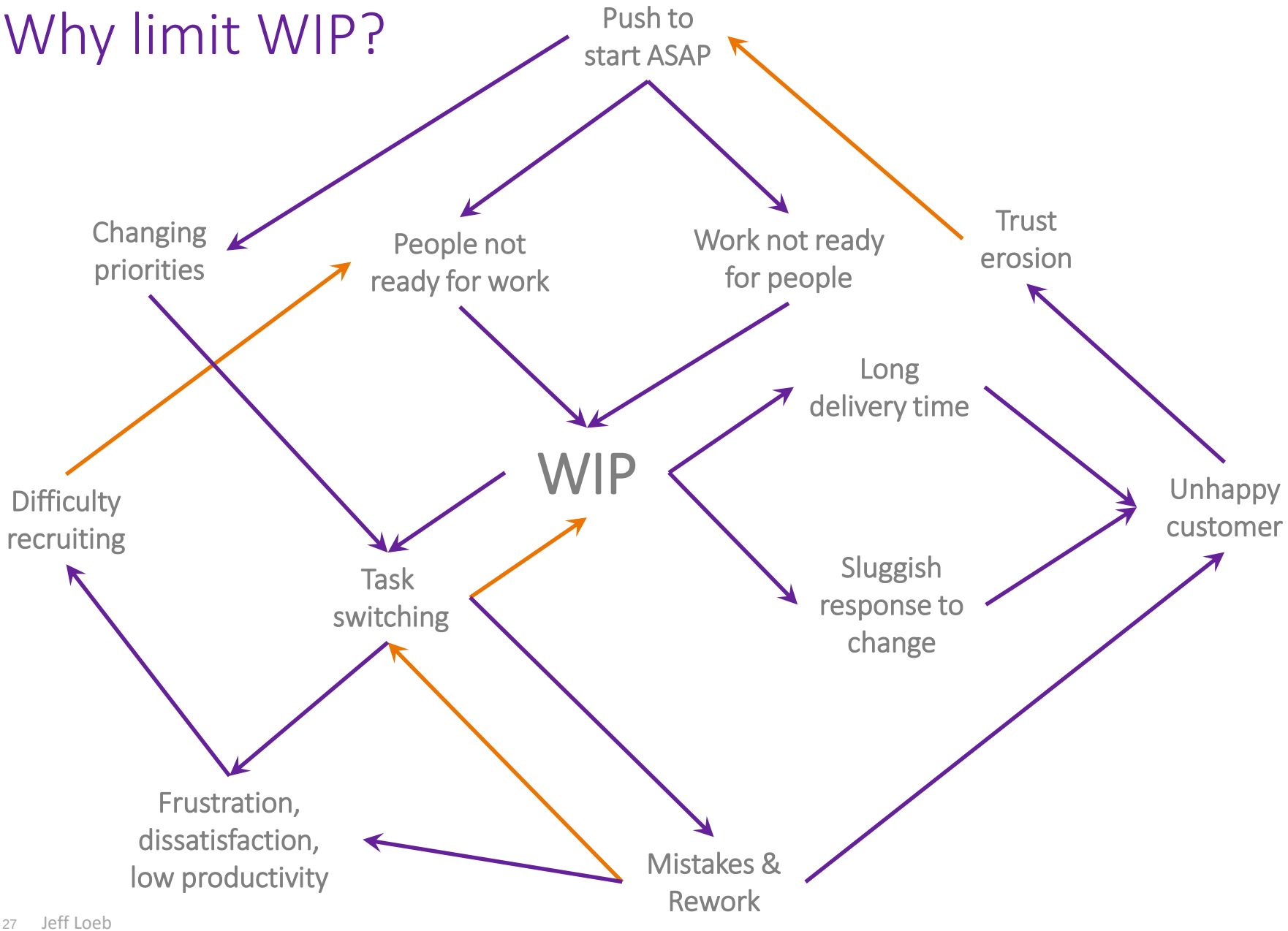
Managing iterative, emergent design during programming and layout

- Problem
  - Designers deciding alone, suboptimizing
  - Modelers in the habit of coordinating via clash detection
- Countermeasure
  - Make design decisionmaking explicit.
  - Distinguish design decisionmaking from modeling.
  - Make verification of results a discrete step.
- Result
  - Better decisions made cross-functionally, more conversationally
  - Validation provides feedback and often tees up the next iteration
  - Appreciation of the need to create different habits



Flow concepts
WIP, Little’s Law, and visualizing flow with Cumulative Flow Diagrams

Why limit WIP?



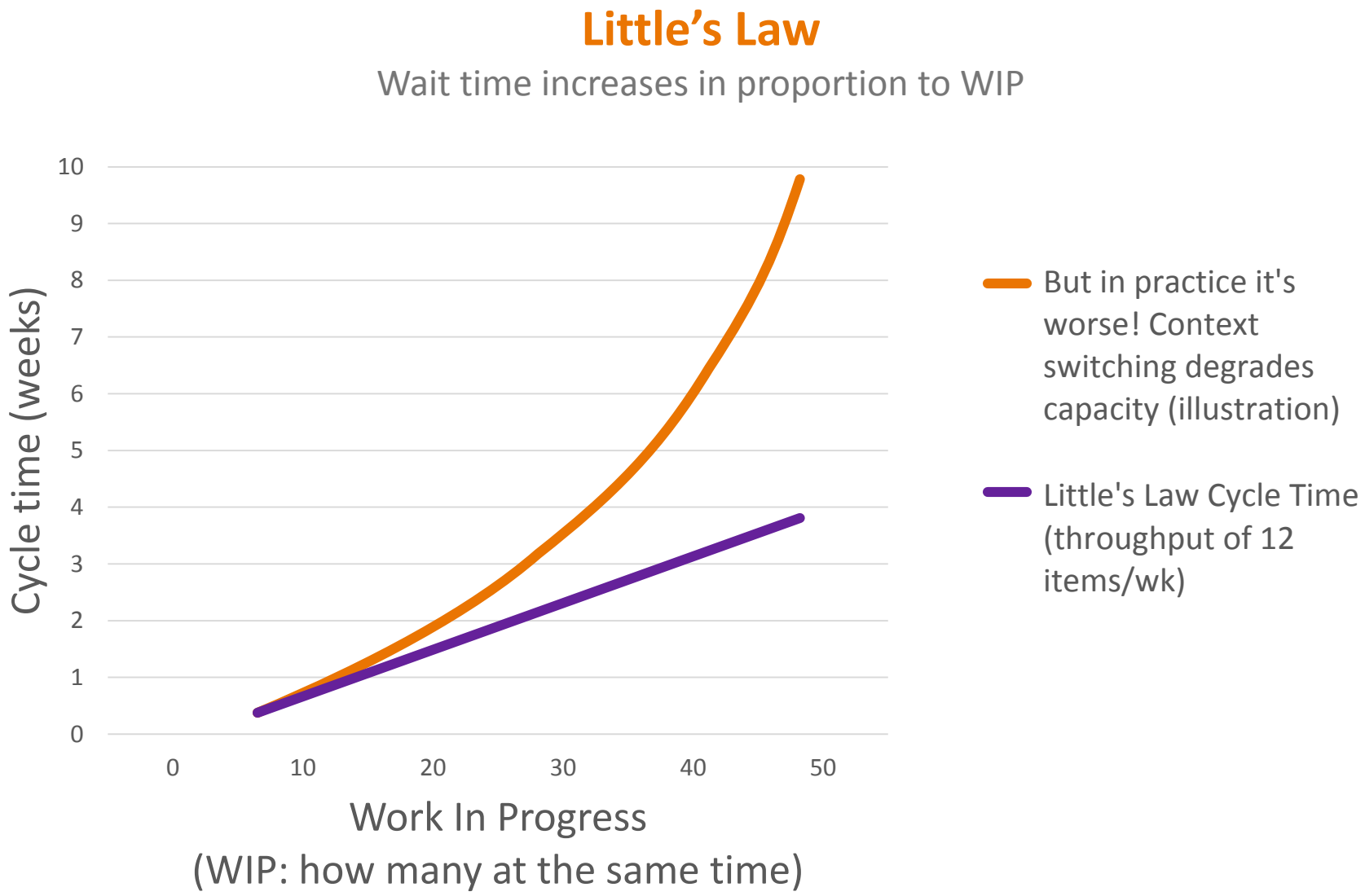
Little's Law

- An increase in WIP leads to a proportional increase in cycle time.
- If a team has 12 work items in progress and a throughput of 12 items/week, then the average cycle time is 1 week.
- If the team maintains throughput but increases its total WIP to 24 items, then average cycle time becomes 2 weeks.
- Little's Law shows how reducing WIP reduces cycle time

$$\text{Cycle Time} = \frac{\text{Work In Progress (WIP)}}{\text{Average Completion Rate}}$$

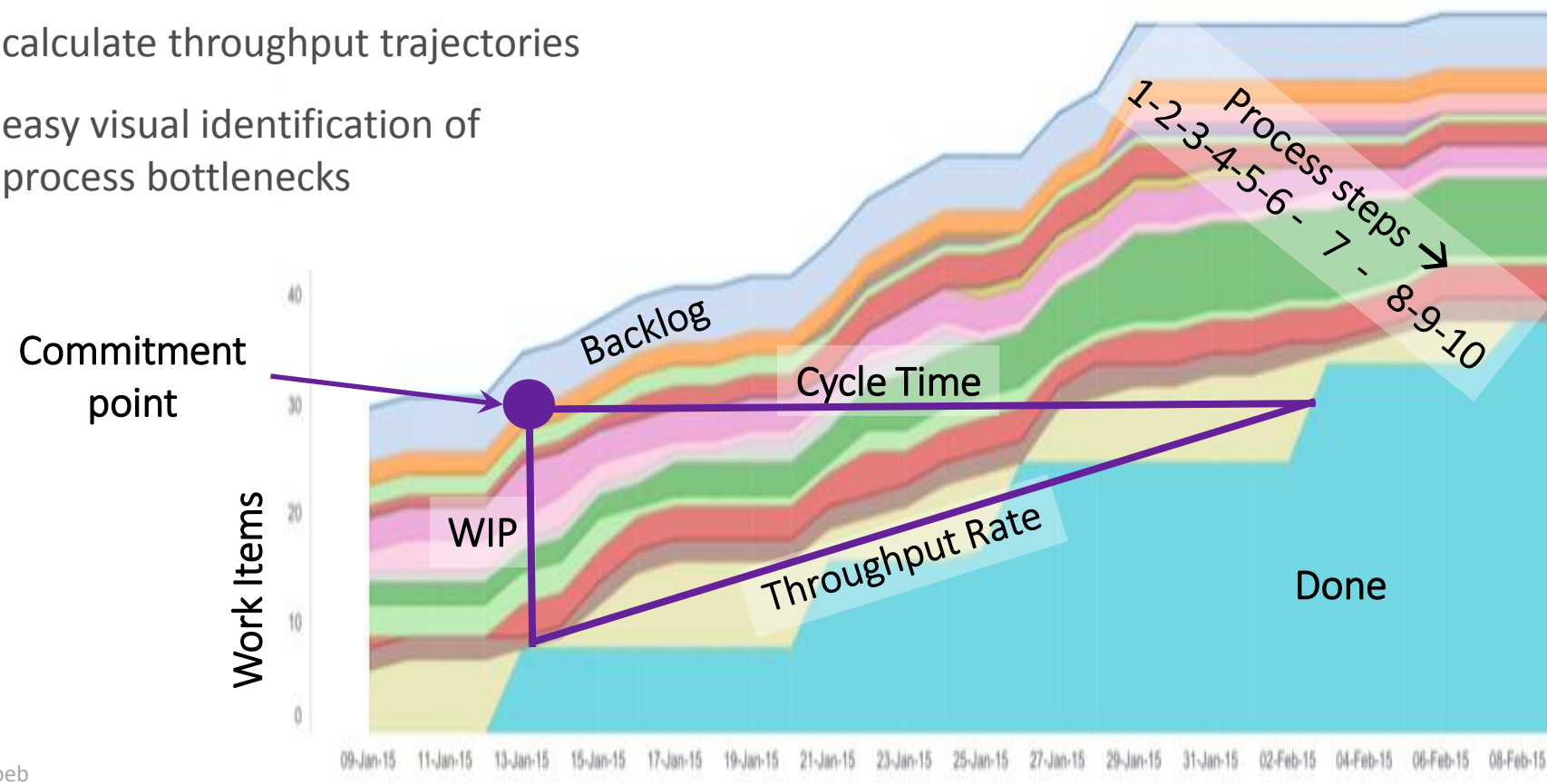
WIP	Throughput (items/week)	Cycle time (weeks)
6	12	0.5
12	12	1
24	12	2
48	12	4

Task switching is evil!



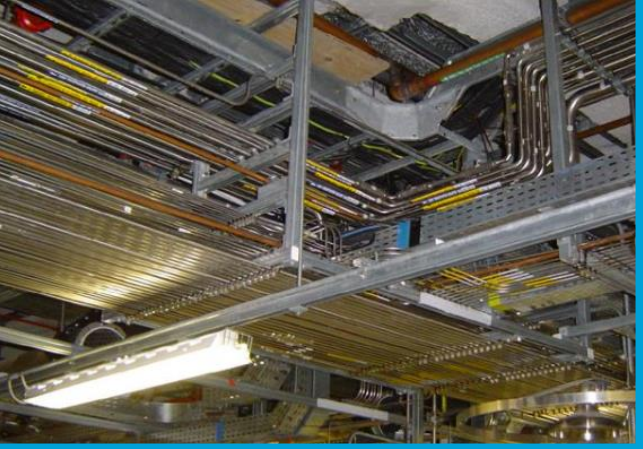
Cumulative flow diagram

- A cumulative flow diagram (CFD) quickly and visually represents WIP as it flows through the system
- Helps team understand current state of work and where to look to improve flow
  - calculate throughput trajectories
  - easy visual identification of process bottlenecks



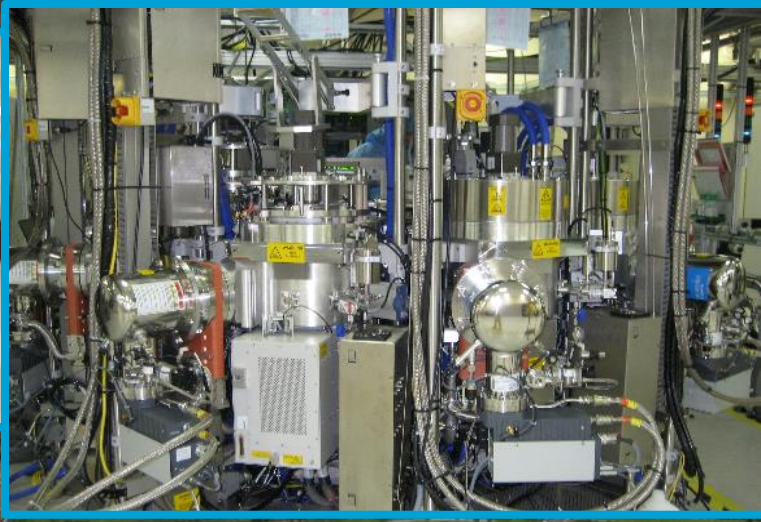
http://www.slideshare.net/yyeret/explaining-cumulative-flow-diagrams-cfd

Case study





L-2



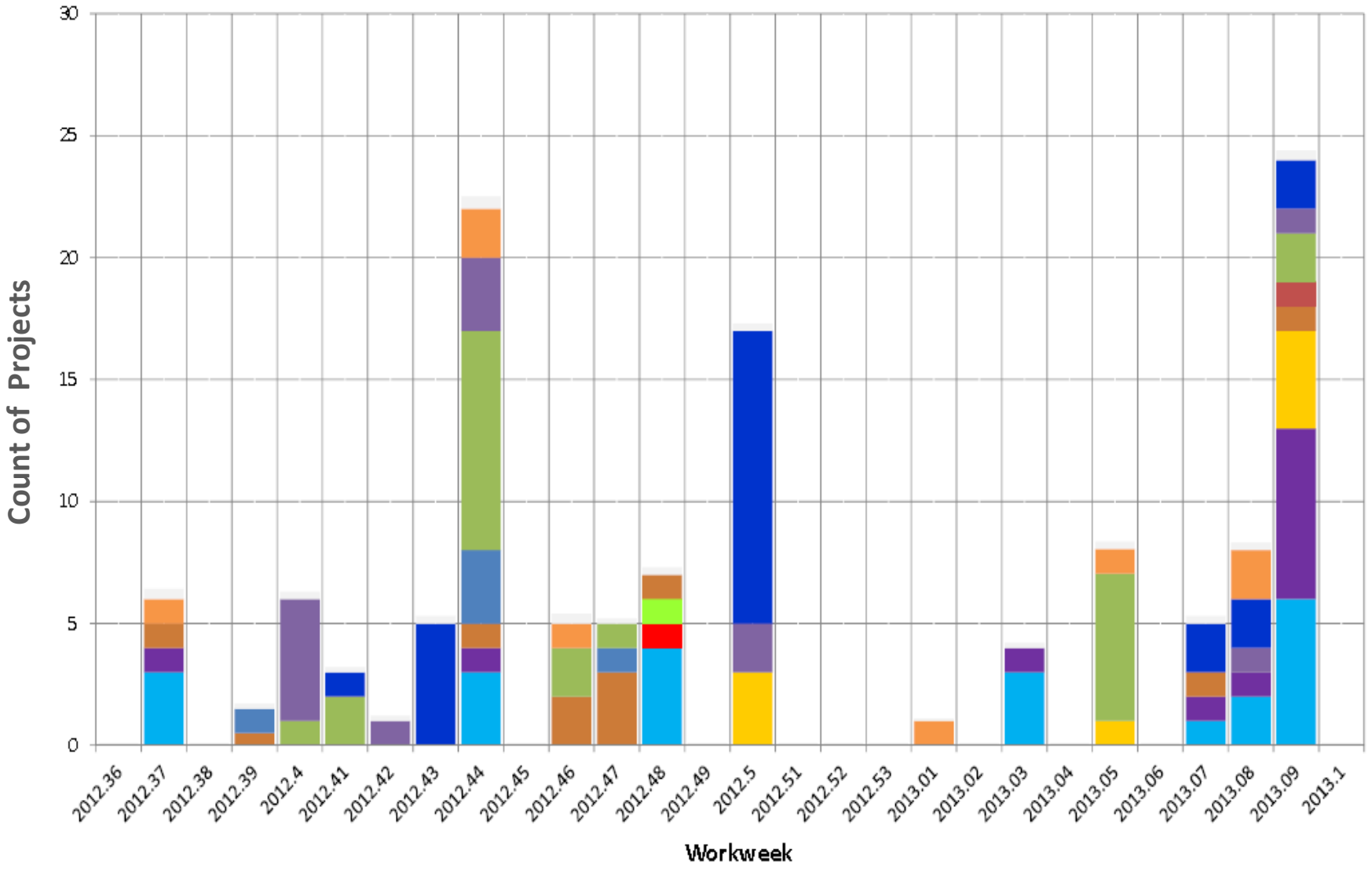
HITACHI


Owner’s request

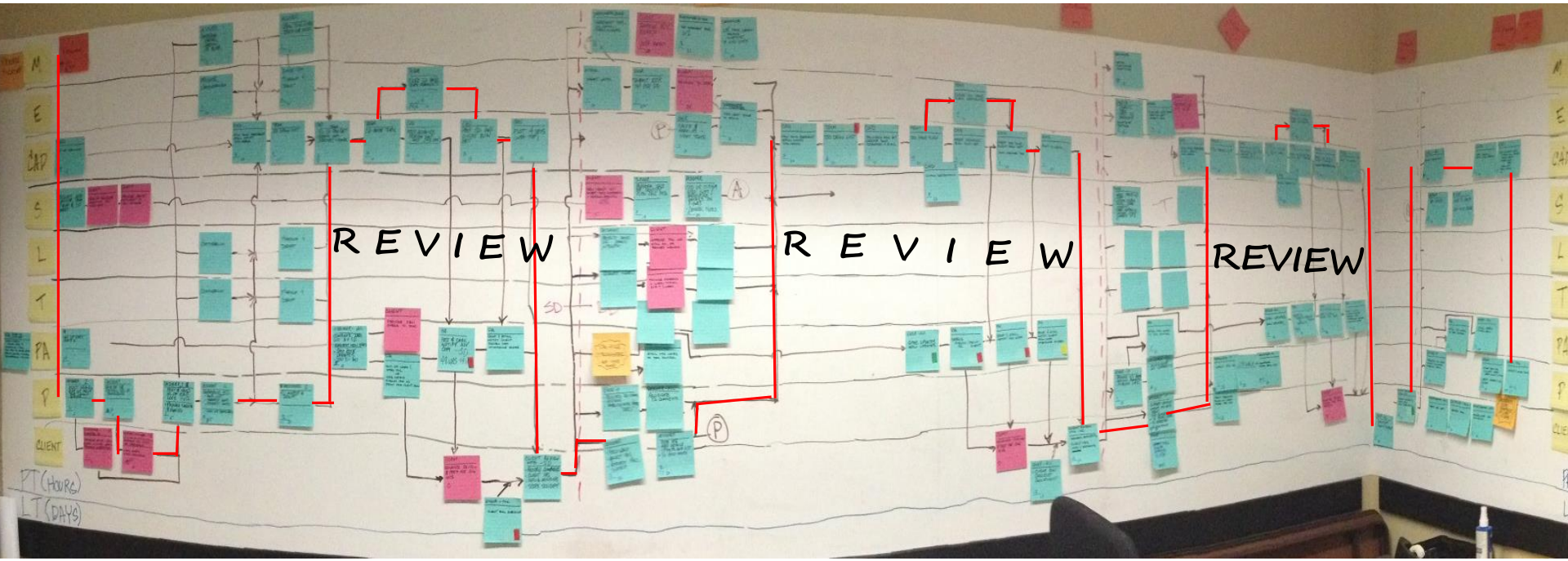
- Reduce design turnaround time by 88% from 8 weeks to 1 week
- Enable construction cost performance tracking by individual project
- Without sacrificing quality and coordination

Jeff Loeb

Customer demand profile



Current state assessment



Results after six weeks

Indicator	Baseline	Kanban method	Improvement
Lead time (weeks)	8	3	**67%**
WIP (projects)	16-60	15-25	**50%**
Flow efficiency	28%	66%	**135%**
Productivity			**Yes**
Scope churn	50%	<10%	**80%**
Number process steps	232	160	**30%**
Number design reviews	3-4	1	**67%**

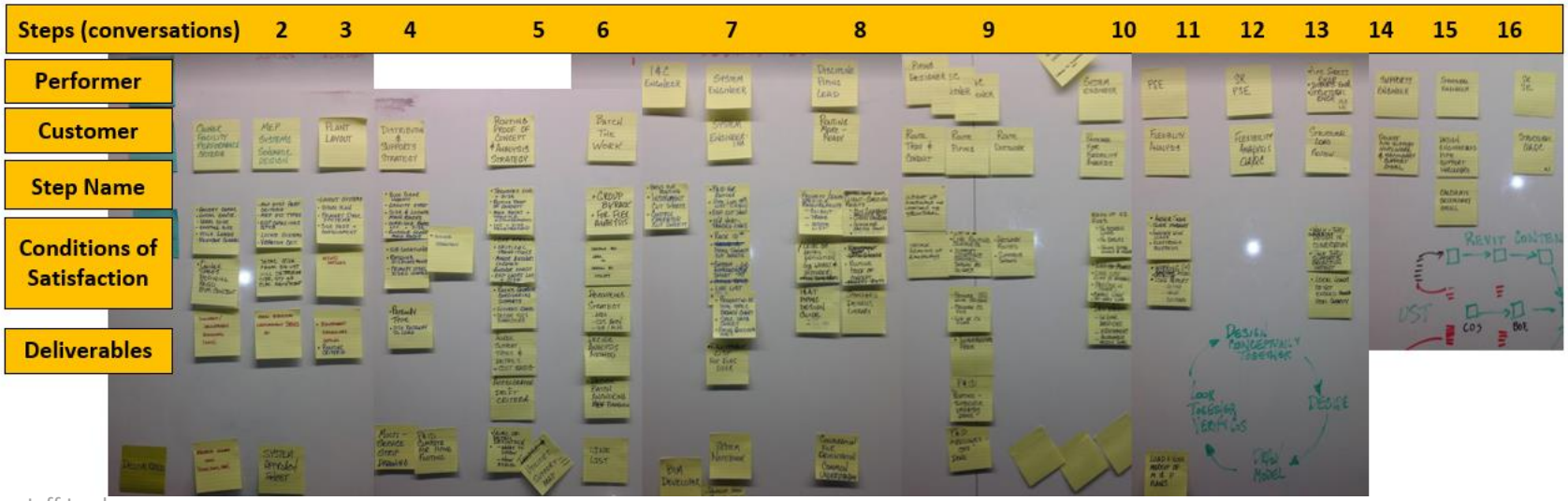
Production system design

Teams don’t survive when members behave like mercenaries (in this case, maintaining commitment only to the particular task and its completion date). In successful teams, participants fuse their personal identity with the team’s identity and develop a concern for the team’s future viability.

-Fernando Flores

Use pull-planning to design your work
Example: design of piping and supports systems

- Problem: we lack a shared understanding of our work across technical specialties. Success is understood narrowly within functional roles.
- Countermeasure: design the work as a team of performers, working from customer value backwards. Develop collaborative working relationships by visualizing how we are interdependent. Define success holistically based on end customer needs.
- Result: the work is mutually understood as a 'conversation system'. Many difficult problems exposed and impossible to ignore.



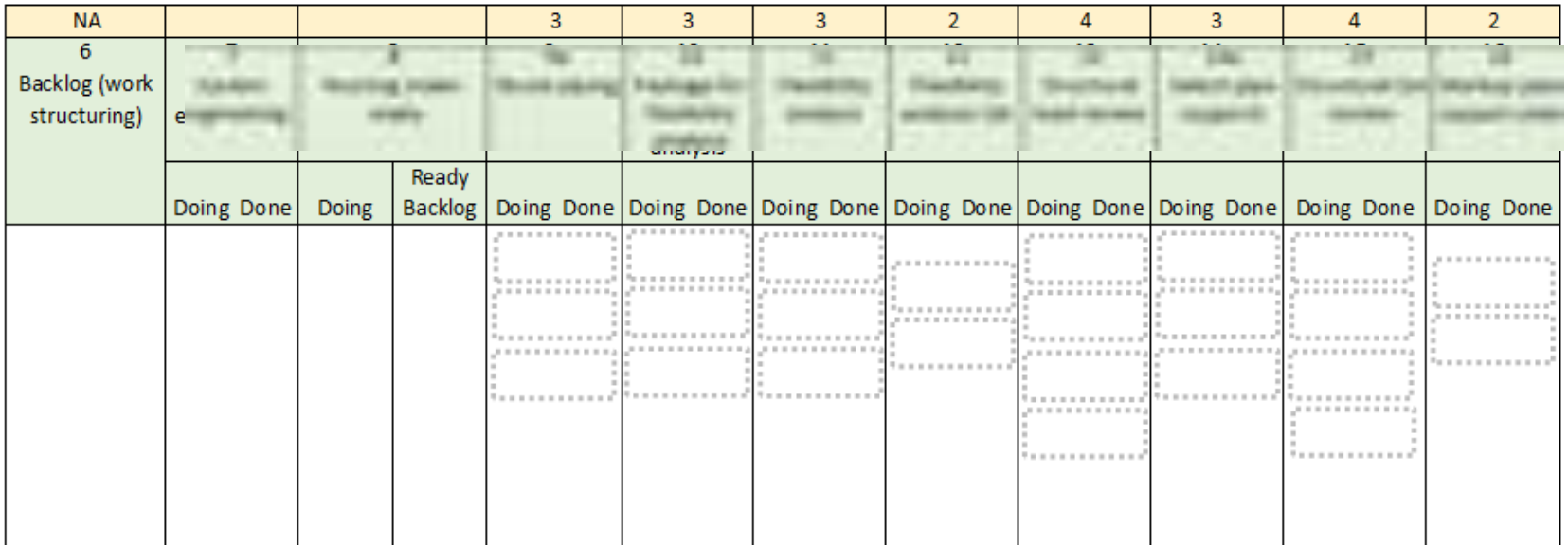
Write down your agreements, your ‘policies’ Basis for continuous improvement

Workflow Breakdown — **Revision date** 10/2/2015

CH2M Utility Supports Systems (USS) — **Revision number** D

Step	1	2	3	4	5	6	7	8
Step Name	Owner facility performance criteria	MEP systems schematic design	Plant layout	Distribution and support strategy	Routing proof of concept & portfolio strategy	Work structuring	System engineering	Routing make-ready
Performer Role	Owner in collaboration with delivery team	System engineer	PSE	Sr. PSE	SUE PSE SUE	SUE	SUE	Discipline piping lead
Customer Role	Delivery team	System engineer	Pipe Stress Engineer (PSE)	Structural Engineer (SUE) Supports Engineer (SUE)	PSE	SUE, DE SUE (auxiliary)	*Discipline piping lead *Designer	Designer
Summary Description	Owner's needs and concerns are understood in terms of facility throughput, performance, growth, and local/jurisdictional constraints. Developed in collaboration with the owner's organization.	Systems criteria, capacities, quantities, technology, and general layout are decided.	Layout systems in coordination with overall facility function, floorplan, architectural and structural systems selection, and code constraints.	Develop multi-discipline utilities routing approach. Sizes, locations, and content of integrated racks is decided and coordinated spatially with building superstructure. Building superstructure reflects anticipated imposed loads.	Define project scope of utilities supports systems. Establish facility wide utilities distribution framework. Develop solid space plan with holistic layout of multi-service racks, trenches, and trenches is coordinated. Document intended flexibility analysis methods by area, rack, and service.	Break down piping and utilities work for progressing through subsequent detailed design steps. Strive for small batches (Work Items), moving toward single piece flow, while making chunks that make sense.	Complete systems engineering for final routing of piping and utilities. Gather and document special loads information related to equipment, inline devices, and control valves.	Conversation for orientation between discipline piping lead, piping designer, and system engineer. Two purposes: 1. Work batch is ready (sound) to start and to finish subsequent steps. 2. Performing designer understands the work and has the skills and resources needed to finish the batch once started.
Conditions of Satisfaction (definition of done)	Factory throughput & process fully support MEP area & loads Factory noise & vibration criteria Factory growth strategy Decide CR MEP Building structural criteria Existing field/site conditions Site ambient vibration study Subfab laterals criteria Facility systems MEP loads (JM) Infrastructure, quantities Code evaluation Envir. noise & vibe visual criteria	MEP systems part. Criteria MEP materials, equipment, sizes MEP systems types & capacities Locate/layout MEP systems CR HVAC types & capacities	Locate/layout MEP systems CR HVAC types & capacities Layout planning criteria Overall functional space plan MEP systems SQ FT needs Primary structural systems selection Size equipment pads Layout containment	Primary structural systems selection Size equipment pads Layout containment Buildings clear heights; primary steel size, locate Gravity systems strategy Multi-service strip drawing Main utilities racks loc, size HVAC mains loc & size Subfab laterals racks locate, size Building displacements, title locate Racks strategy subfabs vibration criteria	Anchor strategy, loads for main racks Piping routing proof of concept Trenches locate, size Trenches locate, size, configure Trench displacements Fan connections located Racks geometry considering supports Locate and size penetrations Utilities dead load by rack Acceleration and drift criteria		*P&ID complete for routing *Insulation thickness (line list) *Tech ID (line list) *Piping specialty cut sheets *Equipment cut sheets *Span chart (System Approach Sheet) *Branch chart (Piping project spec) *Piping line class data sheet *Piping specialties project spec *Equipment list (for electrical designer) *Instrument cut sheets (secure from I&C)	Pre-flight checklist' conversation: *Routing proof of concept *Piping design guidance documentation *Design level of detail *Project-specific routing & layout criteria (client, trade, suspects), clearances, valve orientation signals...) *Standard details library and applicability *New BIM spec content (secure from BIM developer)
Deliverables	*Project Conditions of Satisfaction *Owner specifications *Owner design criteria *Owner BIM/CAD standards *Electronic BIM/CAD files	*System approach sheets *Equipment list	*Plant layout *Layout criteria (including reserve bay/maintenance/removal, minimum equipment clearances *Piping and utilities routing criteria	*Multi-service strip drawing/transposition guide (job aid) *Layout deliverable? *Volumetric routing deliverable? *P&ID complete for routing	*Detailed design level of detail *Utilities support map *Line list	*Project backlog comprising all Work Items and representing all scope.	System Notebook hardcopy	*New BIM content (Discipline piping lead is customer of BIM development workflow)
WIP Limit								
Prereq Steps		1	2	3	4	5	6,7, BIM workflow	

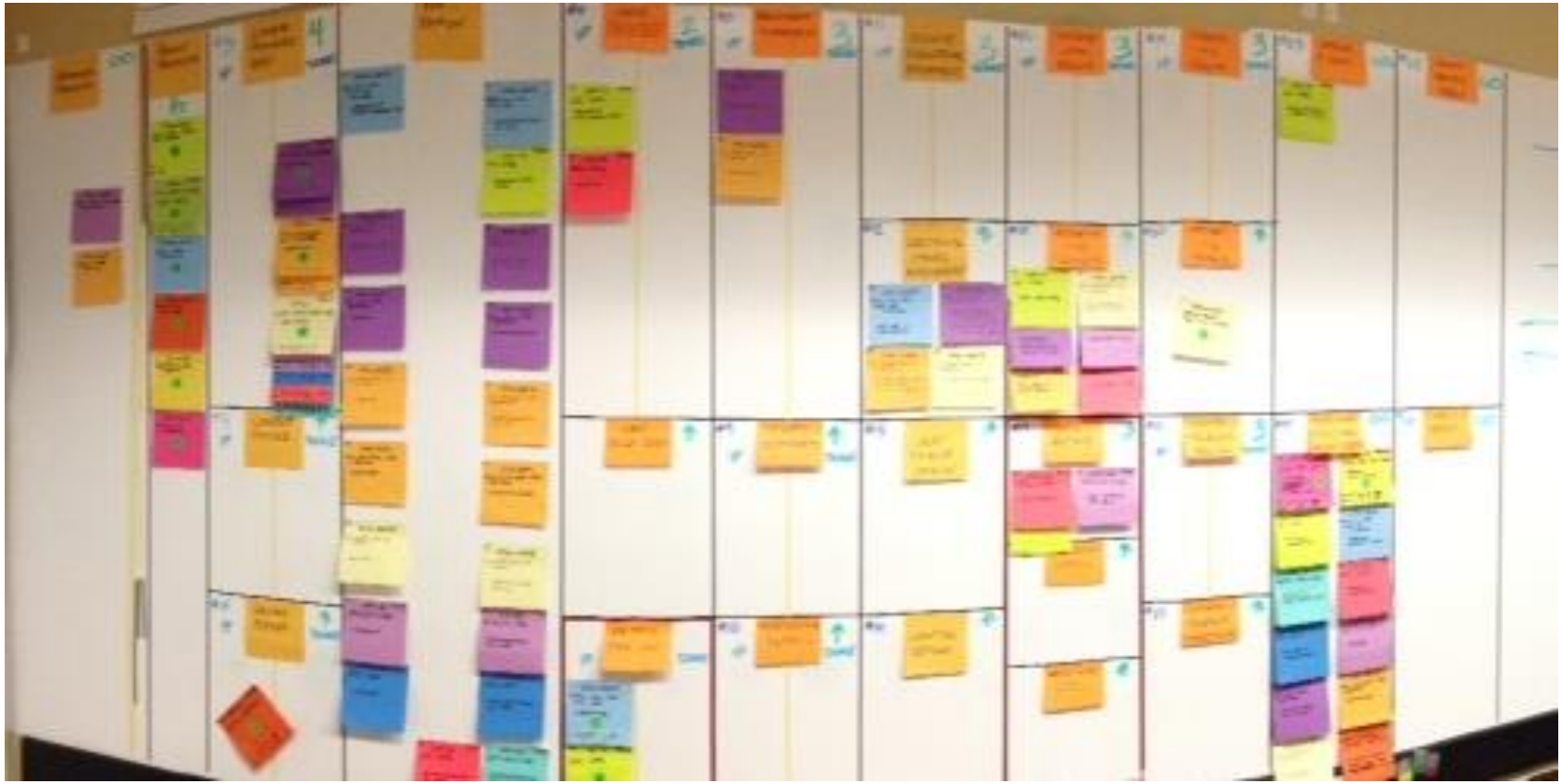
Design a kanban board to represent your process



NA				3	3	3	2	4	3	4	2
6 Backlog (work structuring)											
	Doing Done	Doing	Ready Backlog	Doing Done	Doing Done	Doing Done	Doing Done	Doing Done	Doing Done	Doing Done	Doing Done

All models are wrong; some models are useful.
George E.P. Box

Populate your board with in-progress and upcoming work

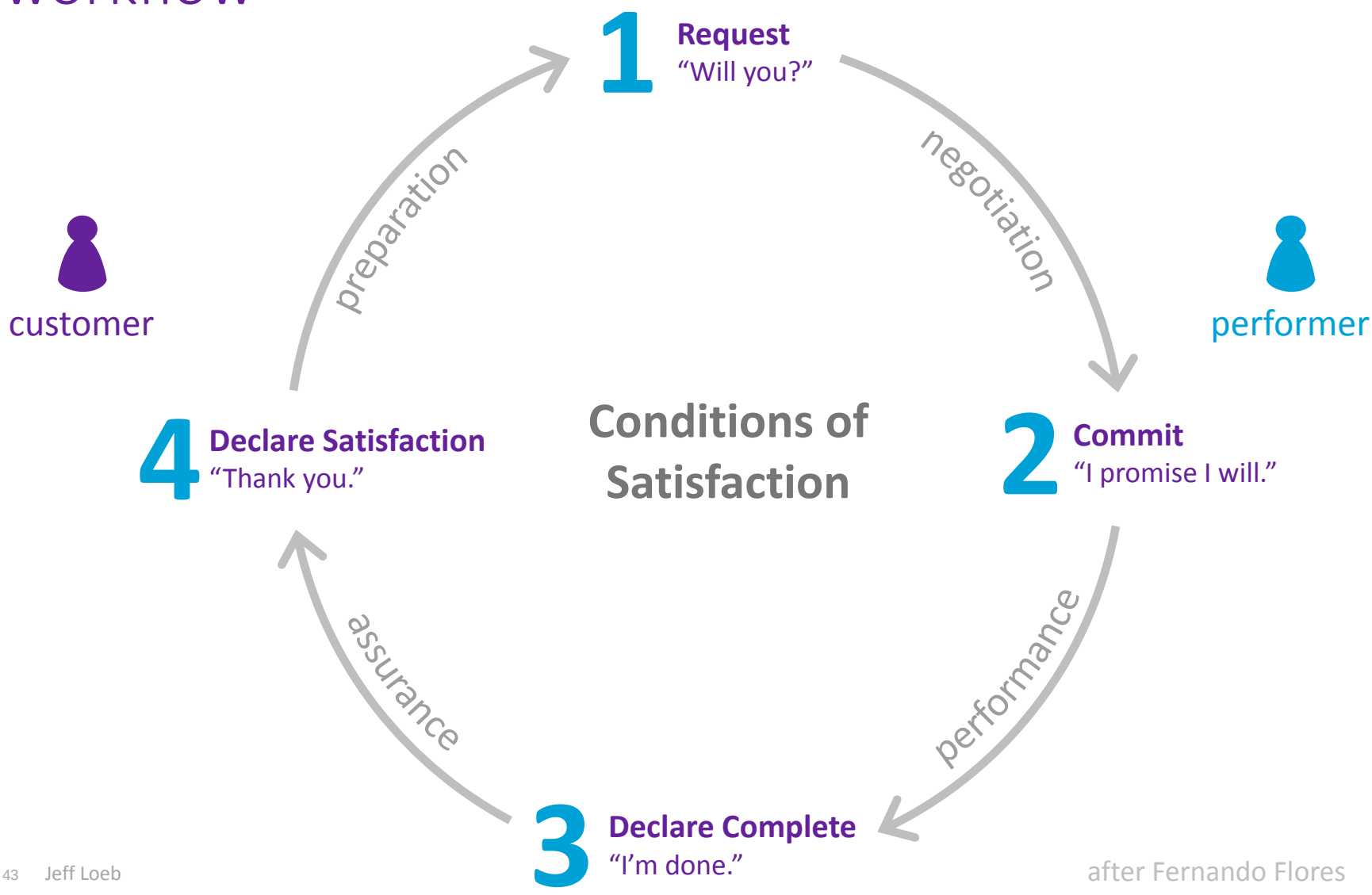


Coordinating work with kanban method

These issues are about coordinating people rather than things or information flows, and about building coherence between people's interpretations, intentions, commitments, and relationships.

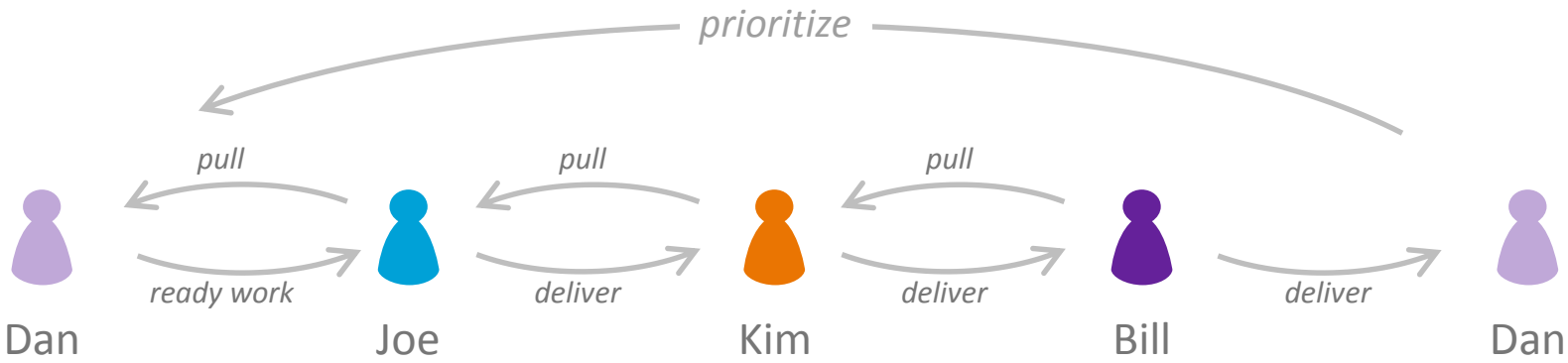
-Fernando Flores

The physics of coordination - commitment workflow

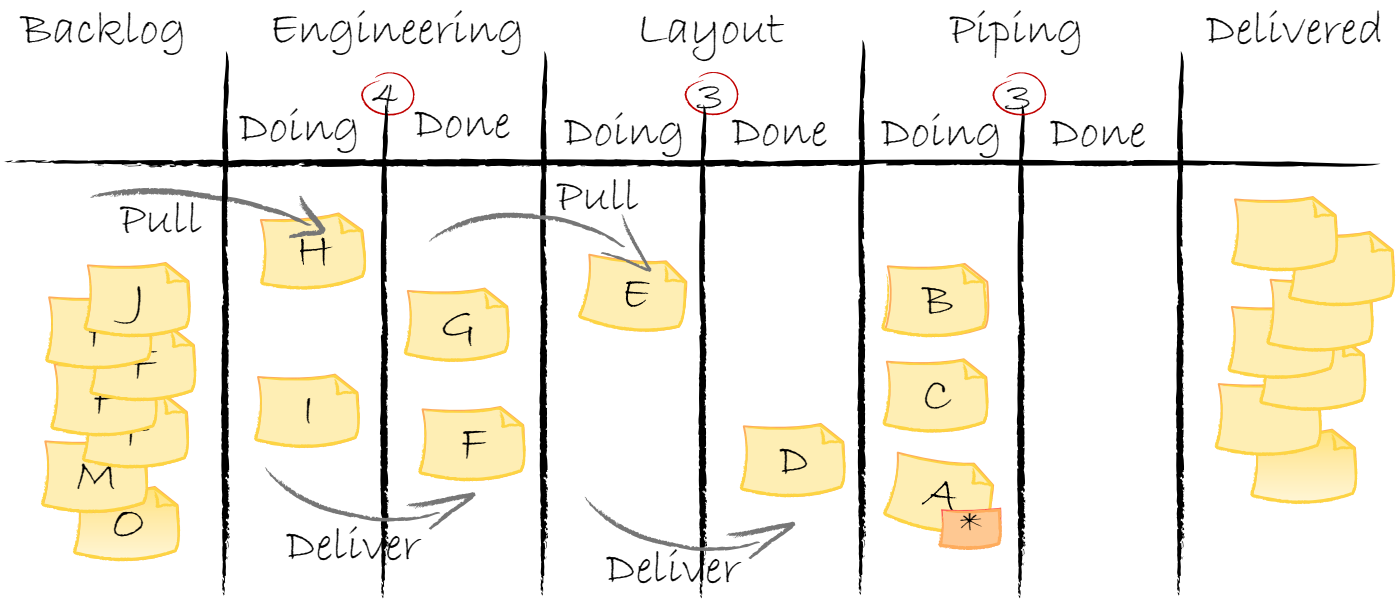


after Fernando Flores

Kanban method enables reliable workflow



Kim is a customer of Joe
and a performer for Bill



Establish a regular cadence

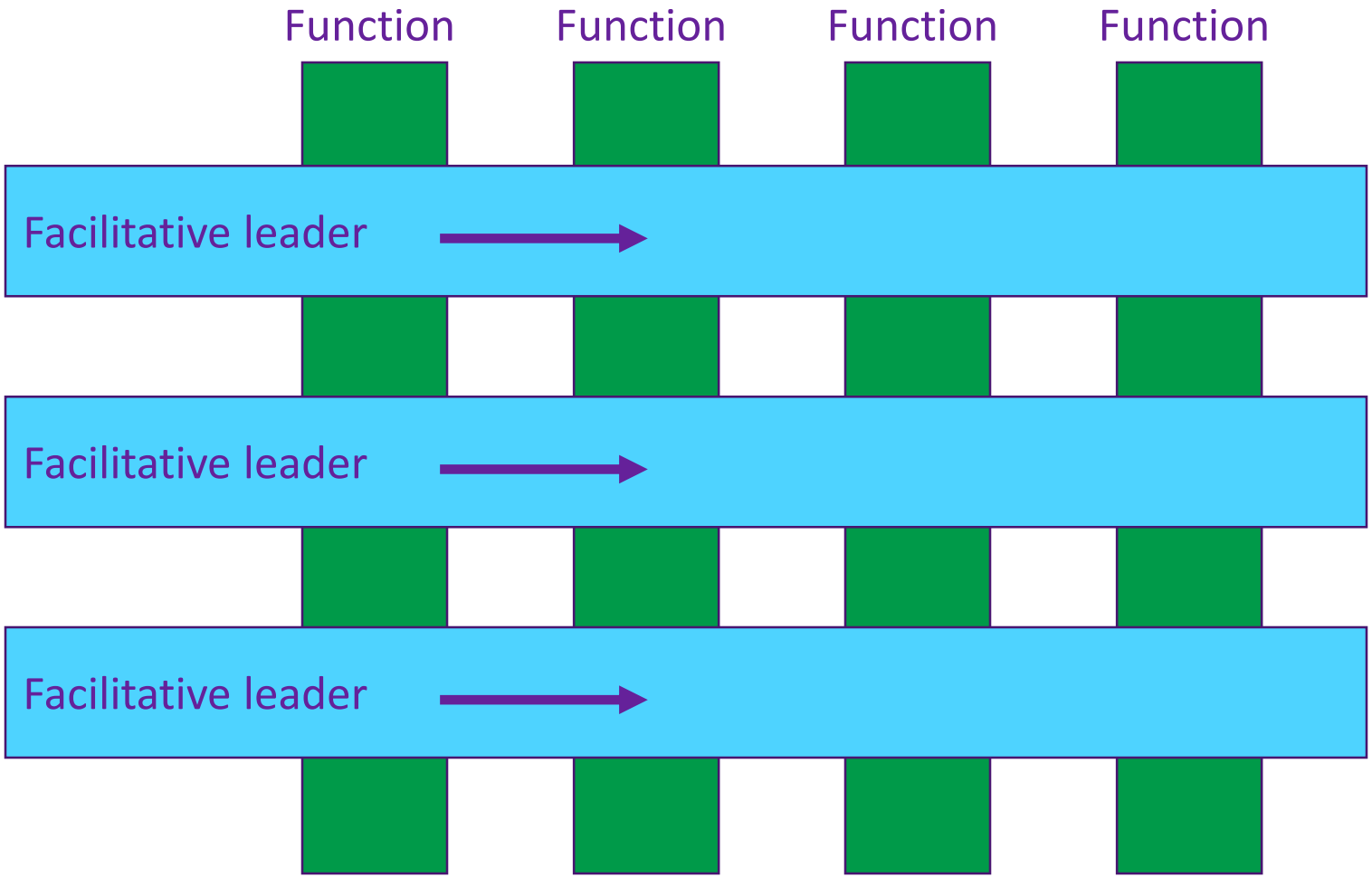
Event/Session	Purpose	Frequency
Daily Check-in	Coordinate action for the day	Daily
Cycle Planning	Make work ready. Prioritize backlog. Elevate constraints.	Weekly (Fri)
Design Review	Review completed work with customer	Weekly (Tue)
Issue for Construction	Release completed designs to trades	Bi-Weekly (Thurs)
Retrospective	Learning and improving	Bi-Weekly (Mon)
Operations Assessment	Review system performance and policies.	Bi-Weekly (Fri)

It’s a relay race…

- Begin work you can finish once you start
- Finish in-progress work before beginning new work
- Let your customer know you’re done as soon as you’re done. Better, signal when you *will be* done.
- ‘Done’ means accepted by your immediate customer.
  “Thanks, this meets my needs!”

Is the runner of the second leg wasting time while waiting for the baton?

Our organizations are networks disguised as and encumbered by hierarchies



Continuously incrementally improve

- Regular retrospectives
- Frequent Plus | Delta
- 5-Why when we “stop the line” or a defect reaches the customer
- Operations reviews using real data
- Improve Every Day – Small Wins
- Further reduce WIP to surface more issues!

“High performance is about getting better at getting better.”

—James Surowiecki, author of The Wisdom of Crowds

Resources

- Kanban: Successful Evolutionary Change for Your Technology Business, by David Anderson
- Conversations For Action and Collected Essays: Instilling a Culture of Commitment in Working Relationships, by Fernando Flores
- Personal Kanban: Mapping Work | Navigating Life, by Jim Benson
- Limited WIP Society
- Try out a local 'Lean Coffee'
- Get started! Pick a process and get some practice!

Questions?

Contact Jeff Loeb
jeff.loeb@ch2m.com

Be prepared to hear, ‘since we implemented kanban method we have a lot of issues!’

Not so…

Because in-process work is kept low, kanban method shows problems that were hidden by piles of WIP.