اجرا و مدیریت پروژه به روش اصول ناب
(Lean Project Management)

فصل اول: مفاهیم، اصول و ابزارهای روش ناب (Lean)

بخش دوم: مفاهیم فرآیند جریان (Flow)، کشش (Pull)، کانبان (Kanban)، زمان تکت (Takt Time) و بهنگام (JIT)

ارائه دهندگان:

سید محمدرضا علوی‌پور

(PhD, PMP, CMIT)

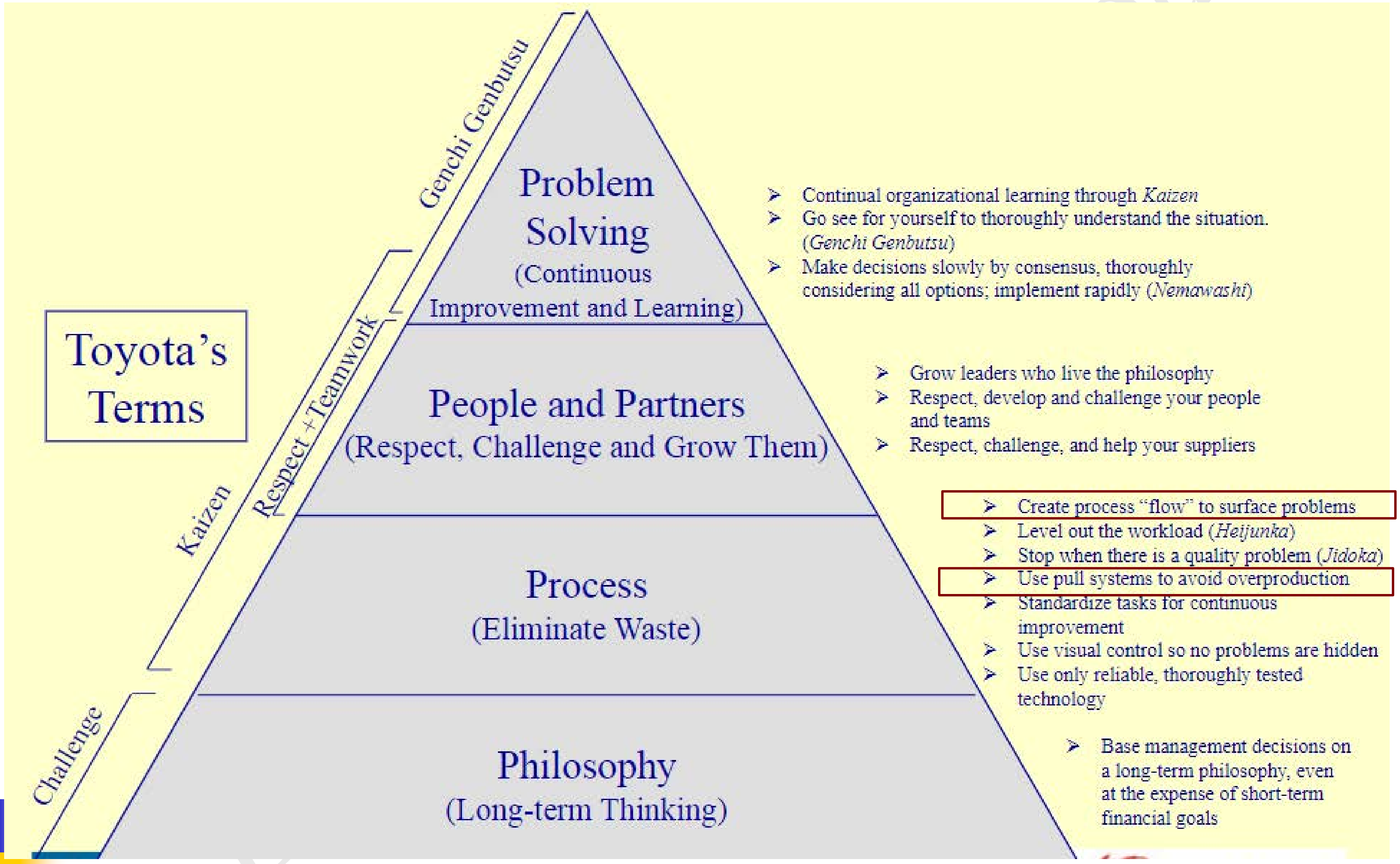
کامبیز کردانی

(M.Sc., PMP)

What we will learn?

- ❑ Construction as an activity
- ❑ Construction as a flow
- ❑ Continuous process flow and pull concepts
  1. Concepts, tools, and techniques
     - ✓ Mass production
     - ✓ Flow
     - ✓ Work in process (WIP)
     - ✓ Buffers
     - ✓ Continuous flow
     - ✓ Takt time
     - ✓ Pull system
     - ✓ Push system
     - ✓ Just in time (JIT)
     - ✓ Kanban
     - ✓ Implementing continuous flow
  2. Case study

Lean – Principles (4P Model of the Toyota way)



Continuous flow – Just-in-time (JIT)

See Video 2

Continuous flow – Just-in-time (JIT)

Toyota's production process was not necessarily a new technology,

but rather

the result of involving all participants in a new philosophy of avoiding waste of any type.

Toyota also developed a number of tools for operating his production format in a systematic framework.

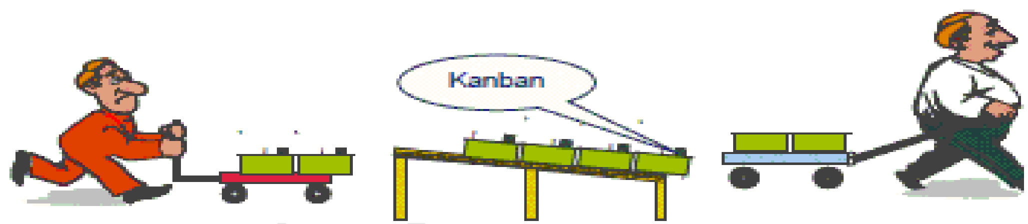
The best known of those tools is the Kanban system,

which provides for conveying information in and between processes on instruction cards.

Continuous flow – Kanban

Pure definitions:

- A **just-in-time process** in which the **movements** of **materials** and **information through a process** are **recorded** on specially **designed cards**
- Also refers to **any of the cards** used for **ordering materials** in such a system



Practical definition:

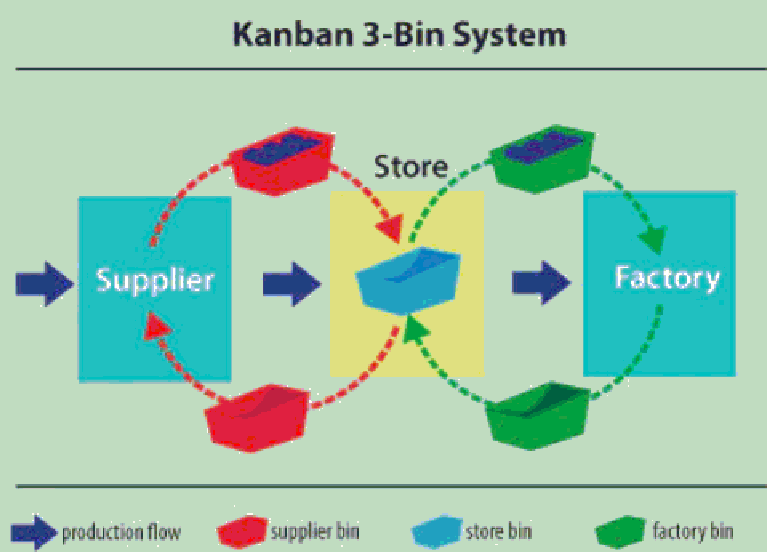
- **Any system** used to **trigger** the **release** of **upstream work** to the **downstream "customer"**
- **In construction**, this might be a **look-ahead schedule** that **alerts** the **trades to upcoming work** (i.e., what needs to be completed so that other work can be started)
- **Supply systems** may also use a **Kanban system**

Continuous flow – Kanban

- ***Kanban*** is based on a **series of rules** that include:
  1. The **successor <u>collects</u>** product from the **predecessor**
  2. The **later process <u>informs</u>** the **earlier process** what to produce
  3. The **earlier process** only **<u>produces</u>** what the **later process needs**
  4. **<u>No products</u>** are moved or produced **without *Kaban* authority**
  5. **<u>No defects</u>** are **passed** to the later process

Continuous flow – Kanban

- **Kanban cards follow** a **product through various stages** of production and provide **visual control**.
  - **"Kanban"** means sign, signboard, poster, card, billboard but *it is taken **more broadly** as a **signal of some kind**.*
- They **contain information** such as the part name, description, process instructions, and quantity required.

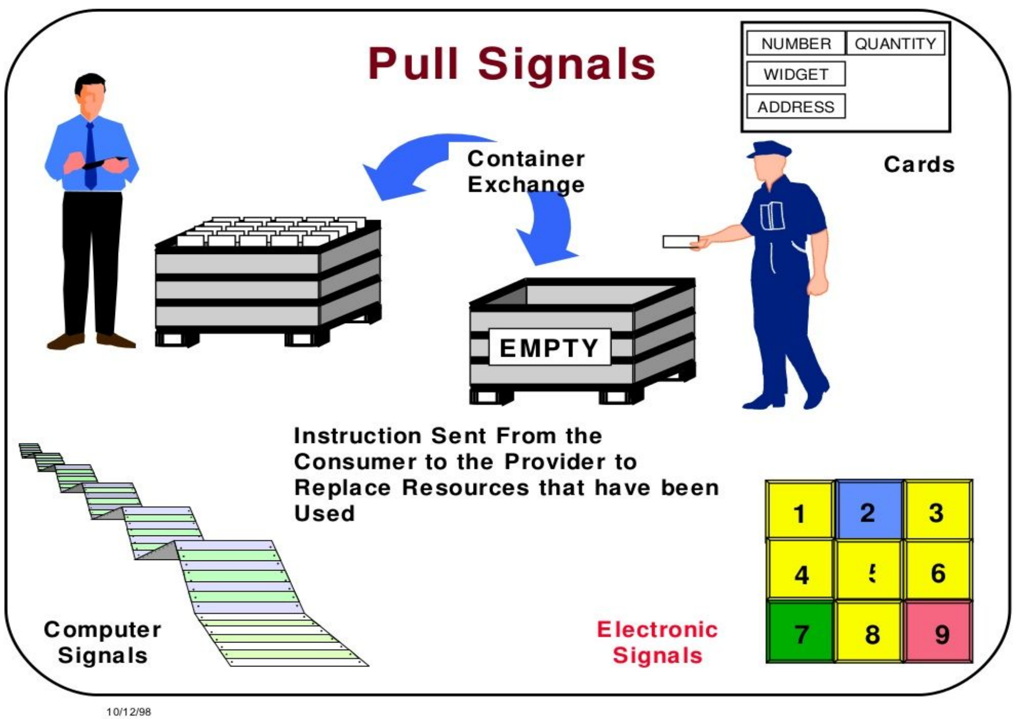


Continuous flow – Kanban

- In keeping with the **pull system**,

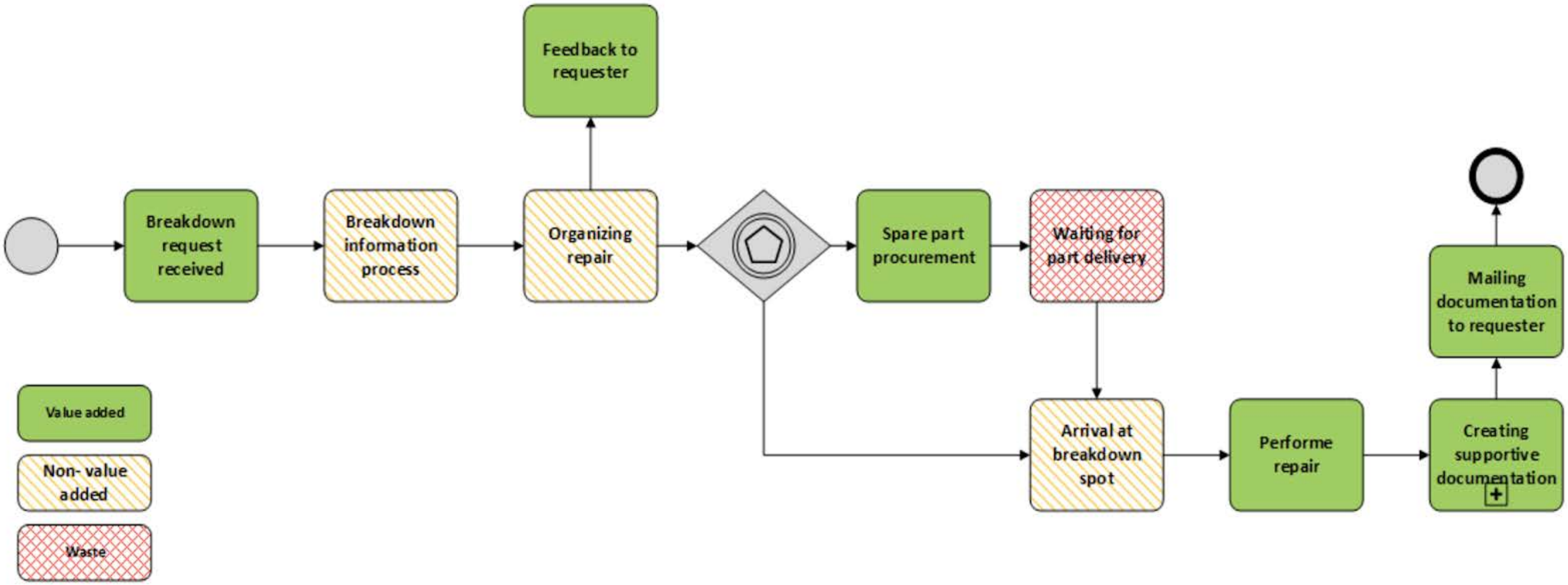
Kanban cards **signal "upstream"** **when** production or the **release of inventory is required.**

In effect, inventory is not created until it is needed.



Continuous flow – Kanban: Examples

- **Every operation** is **colored** depending on its value contribution.
- It is important to notice is that it has **multiple pathways** as well as unpredictable durations of some operations.



Simple corrective maintenance process

Continuous flow – Kanban

Kanban board: Kanban board should be positioned in the **central room**, allowing workers to use it at this **single place**.

		WR1				WR2			WR1 / WR2
B0 = NEW	Worker	B1	IN PROCESS	SOLVED	Worker	B2	IN PROCESS	SOLVED	INVOICED
1113	W1				W1	1112	1103	1102	
1114	W2	1110	1104		W2			1097	
! 1115	W3		1106	1100	W3	1111			
	W4	1108	1105		W4				
	W5		1107	1101	W5	1109			
	N/A				N/A				1099
	N/A				N/A				1098

$\sum WR1 + \sum WR2 < CONWIPul$

- **CONWIP (constant work in progress)** introduces **several modifications** to the Kanban system so that **high variability** of the process is **buffered**.
  - In CONWIP, the inventory is pulled depending on the demand.
  - That way, the **amount of WIP** required to be **maintained is controlled**, ***instead of limiting*** *inventory of* ***every stage*** *in the process, suggested by Kanban.*

Continuous flow – Kanban

Kanban board

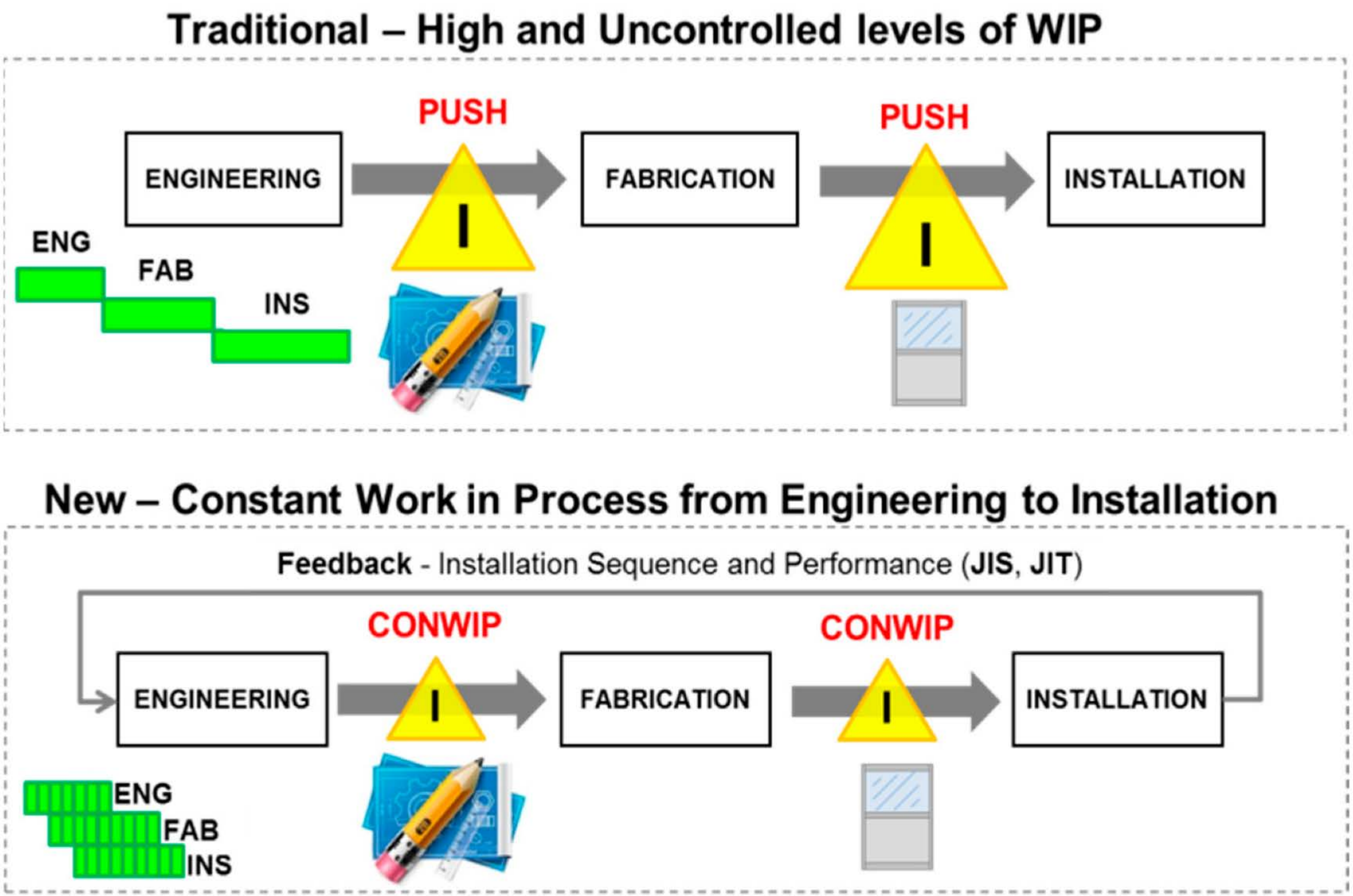
		WR1				WR2			WR1 / WR2
B0 = NEW	Worker	B1	IN PROCESS	SOLVED	Worker	B2	IN PROCESS	SOLVED	INVOICED
1113	W1				W1	1112	1103	1102	
1114	W2	1110	1104		W2			1097	
! 1115	W3		1106	1100	W3	1111			
	W4	1108	1105		W4				
	W5		1107	1101	W5	1109			
	N/A				N/A				1099
	N/A				N/A				1098

∑WR1 + ∑WR2 < CONWIPul

To make the **pull system effective**, the following **Kanban board rules** are introduced:

1. Work order from B0 is distributed based on type to WRn (work requested)
2. Work orders are distributed to workers in the **order of urgency and time of arrival**
3. Workers may **not have more than one work** order in B1
4. Workers may **not have more than one work** order “in process”
5. Sum of WR1 and WR2 has to be **less than CONWIP upper limit**

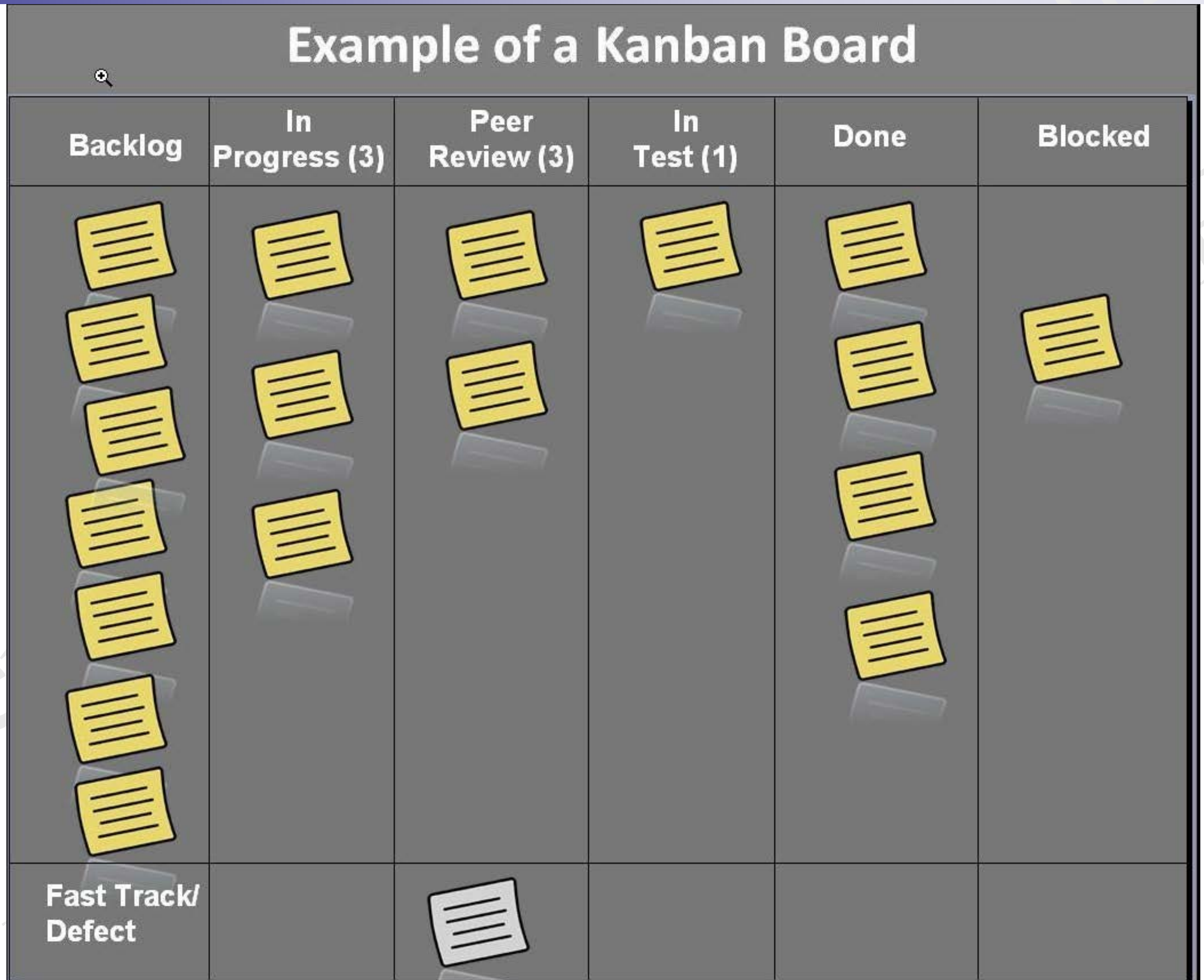
Continuous flow – Kanban



Continuous flow – Kanban: Examples

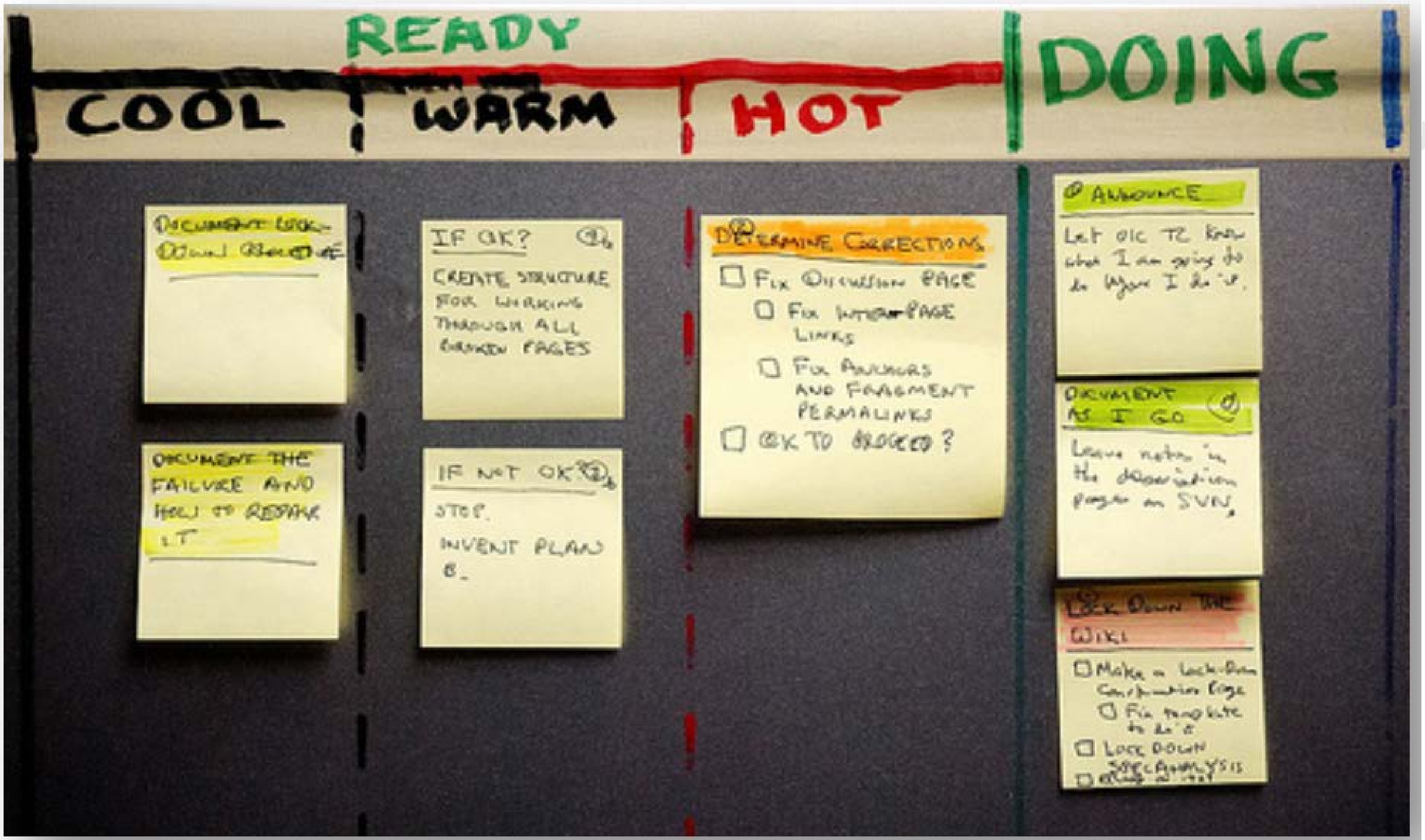
See Videos 3, 4 and 5

Continuous flow – Kanban: Examples



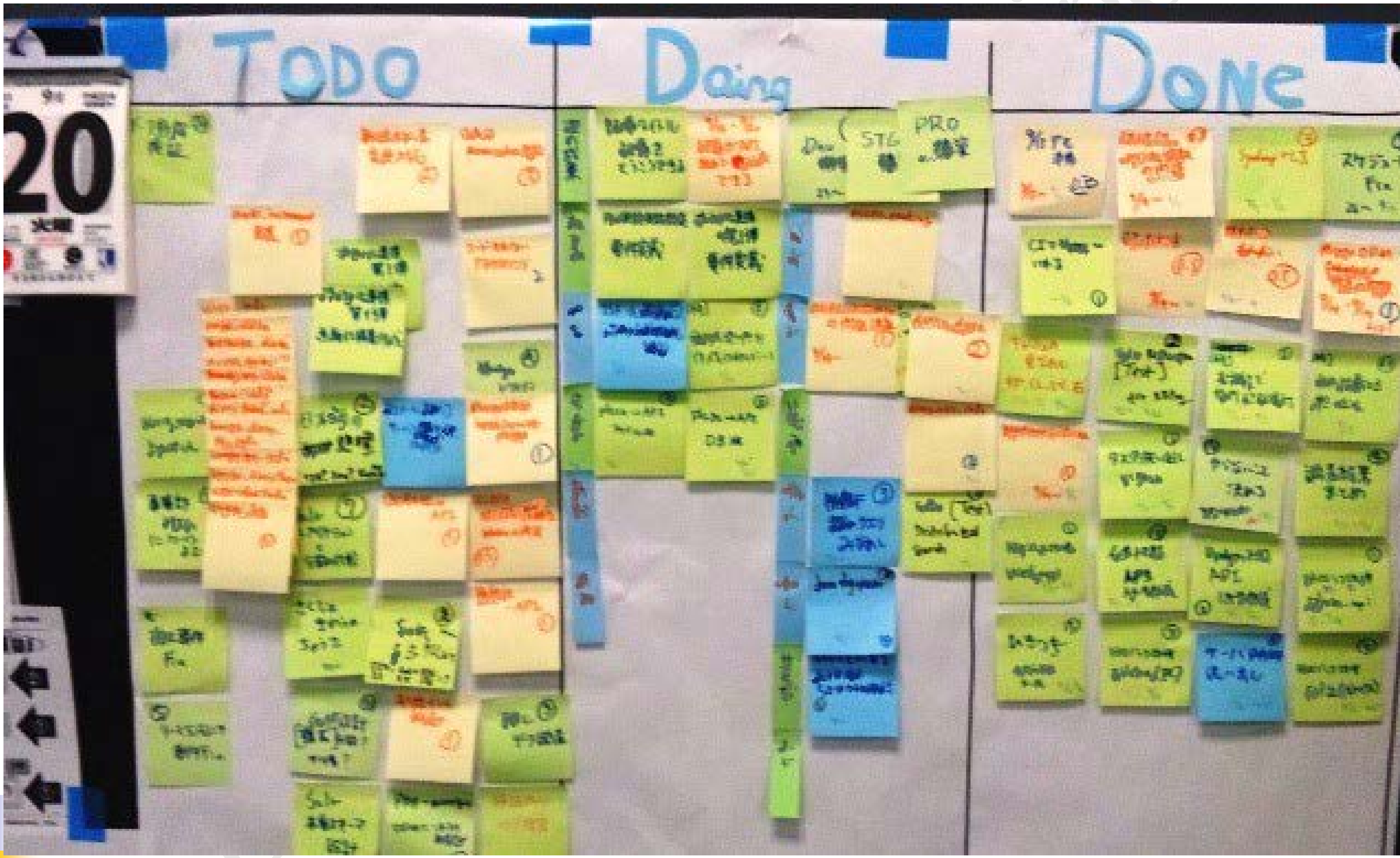
Continuous flow – Kanban: Examples

Post-It notes to show work coming up



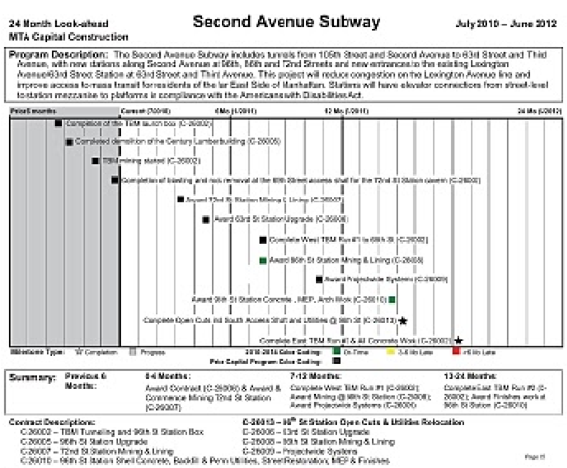
ACEMI

Continuous flow – Kanban: Examples



Continuous flow – Kanban: Examples

Look-ahead schedules



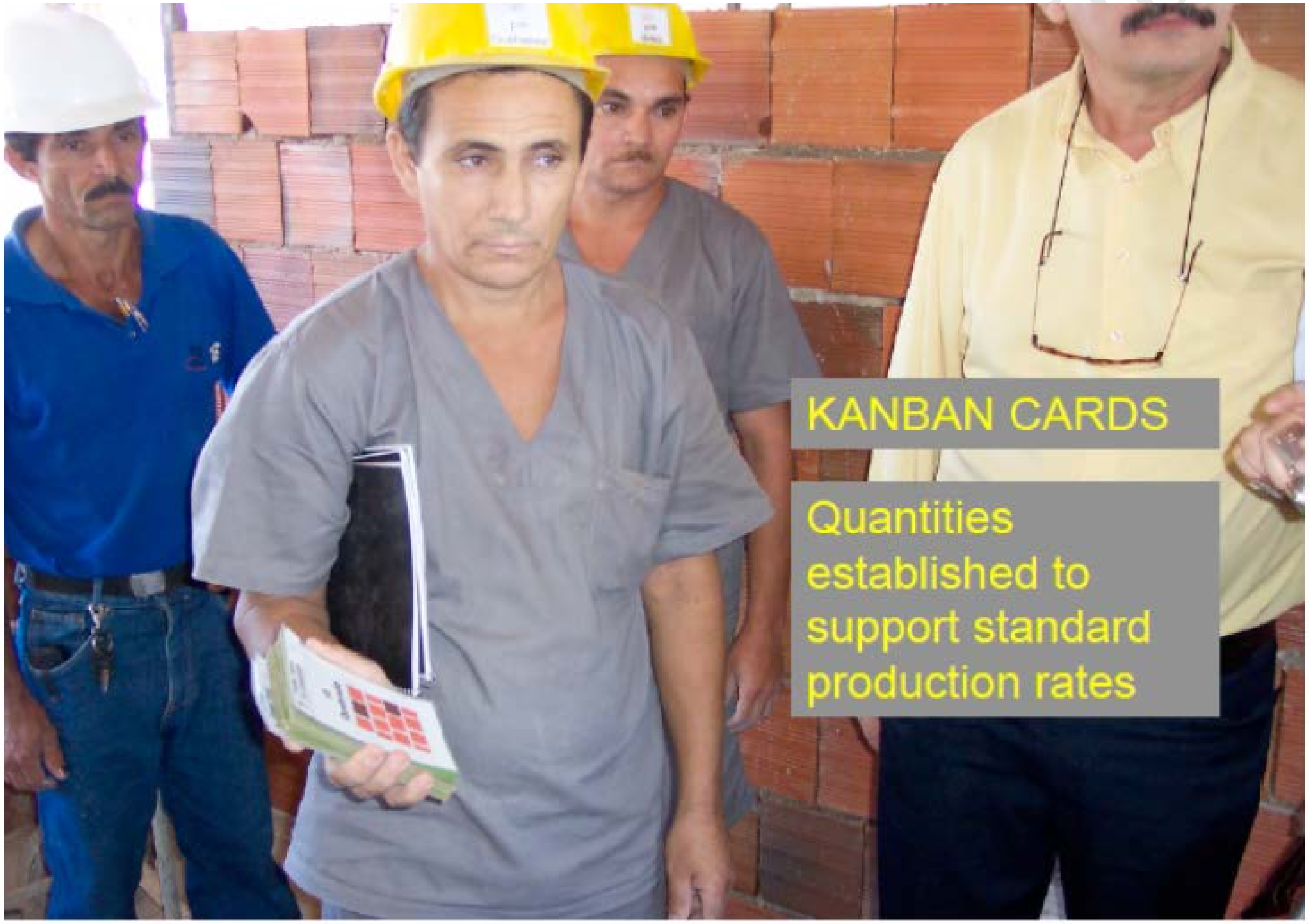
1-WEEK LOOK-AHEAD

Foreman:	Date:	Areas/sections
Paul	17/6/10	LEVEL 3 EAST WING
AD2101 PROJECT		SMLT room

Activity	Make ready	P-%	A-%	Mon	Tues	Wed	Thur	Fri	Sat	Sun	T-C	Reasons for
prep work for SMLT A	DBs	70%	100%	xxx	xxx						1+2	Builder
LT installation	Lable machine		100%			xxx					" "	
Main LT cables term			100%				xxx				"	
DB Wiring			80%				xxx	xxxx	xxxx	xxx	"	
LT room earth		50%	100%							xxx		
Testing			0%									
Finishing - labling												

Continuous flow – Kanban: Examples

Look-ahead schedules

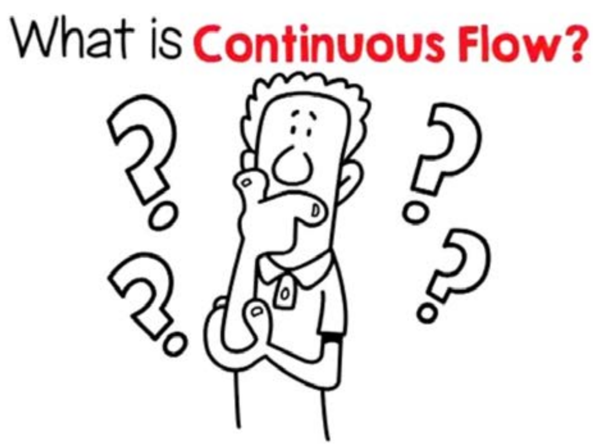


Continuous flow – Implementing continuous flow

1. **Start** with what you do **now**
2. **Modify** accordingly to **implement one piece flow**
   - ❖ **Convert** batching to continuous flow using one piece flow
   - ❖ **Kanban** is a common method for achieving Pull (**will be talked later**)
3. **Use a transparent method** for viewing work, and organizing the team
   - ❖ **Cellular arrangements** are often implemented in production environments to achieve pull and flow
4. **Limit** **work in progress (WIP)** and pull work when the **team has capacity**
5. **Evolve** from there by **recognizing** **bottlenecks**, **waste**, and **variability** that impact performance

Continuous flow – Checklist

1. What would continuous flow of activities look like?
2. What would need to happen? And in what order?
3. What resources are needed to make that possible?
4. How would roles and responsibilities need to be defined?
5. What is the ideal work flow?
6. How can we improve to meet the ideal?



Continuous Process Flow and Pull Concepts

(Case Study)

Continuous flow – Takt time

- Steps to Takt time planning

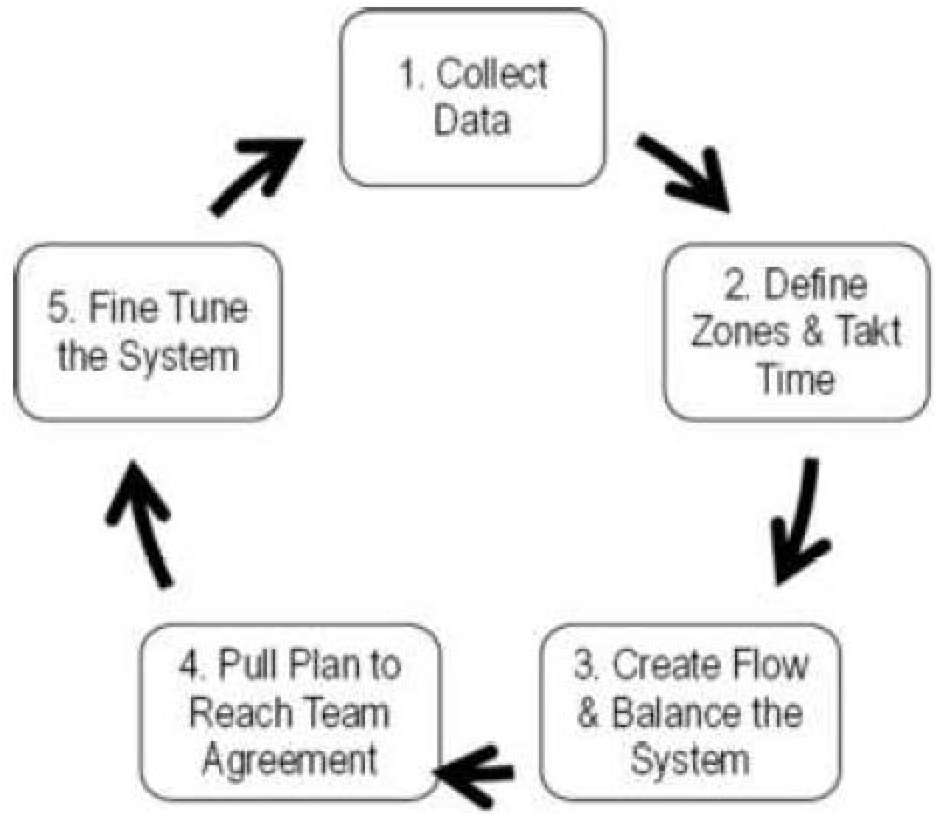


Figure 1: Process Steps for TTP (after Ballard and Tommelein 1999)

Continuous flow – Takt time

- **Step 1 – Collect Data**
  1. Data collected from each **trade foreman** directly responsible for managing work.
  2. They have been asked to **bring hard copy of the plan** showing their scope
  3. They **verbally describe** the way in which they wanted to approach their work while **coloring-up** the plan for **2-day time interval**
     - ✓ Don't forget to consider **alternative approaches** and **color-ups** if time allows.

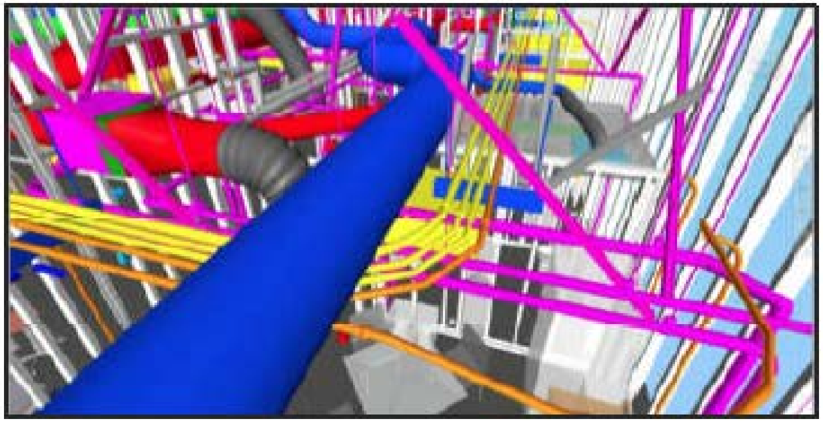


Figure 2: Building Information Model of Interior Overhead Space on Pilot Project

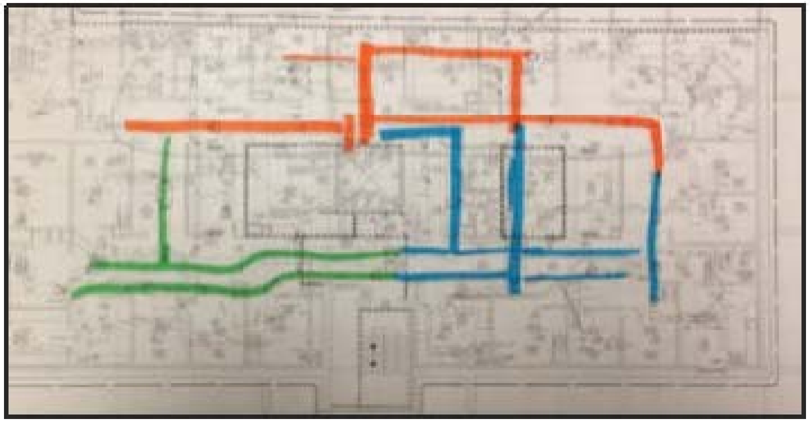
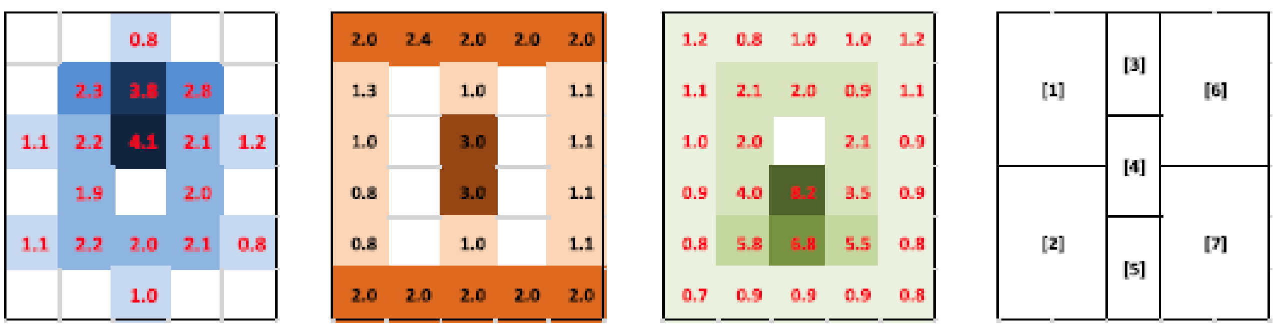


Figure 3: Input from Mechanical Trade using Work Chunks of 2-Day Takt, Sequenced Orange, Blue, then Green

Continuous flow – Takt time

- **Step 2 – Zones and Takt Time**
  1. Created a **grid pattern** to compute density (**greater work density in darker colors**)
  2. The number inside **each grid cell** is the **time** the trade needs to complete their work in each area (given their **assumed** means, methods, and crew sizing)
  3. Subsequently a zoning defined (4.d) to make sure
     All space is covered and **no zones** overlap

How to calculate time in each zone?



4.a Mechanical Trade | 4.b Framing Trade | 4.c Electrical Trade | 4.d Tentative Zoning

Figure 4: Work Density for Different Trades and Zoning

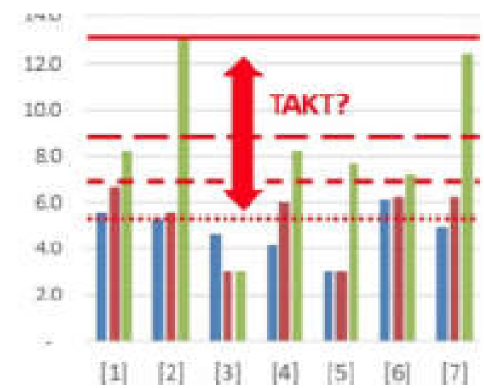
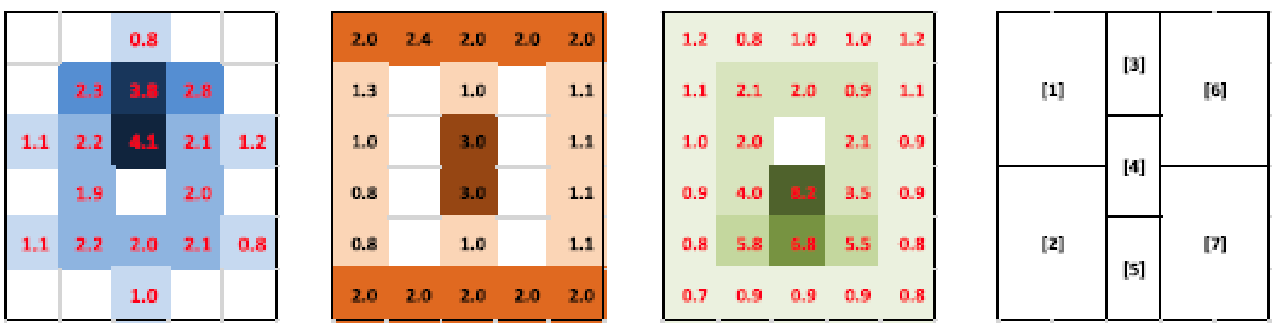


Figure 5: Time needed per Zone per Trade

Continuous flow – Takt time

❑ Step 2 – Zones and Takt Time

4. Time each trade needs to complete their work is computed by adding the numbers in the cells included in each zone
   - ✓ Look at zone 5
     - o *Mechanical* = 2+1, *Framing* = 1 + 2, *Electrical* = 6.8+0.9
5. Setting an upper limit on the time for trades to complete their work in each zone



4.a Mechanical Trade 4.b Framing Trade 4.c Electrical Trade 4.d Tentative Zoning

Figure 4: Work Density for Different Trades and Zoning

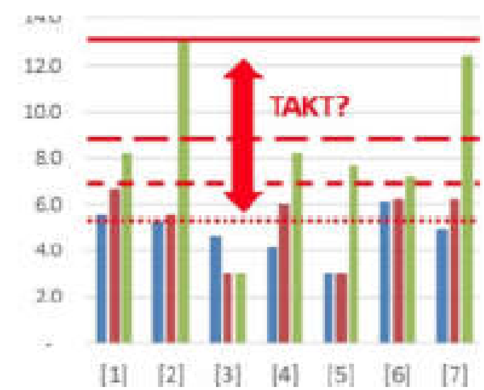
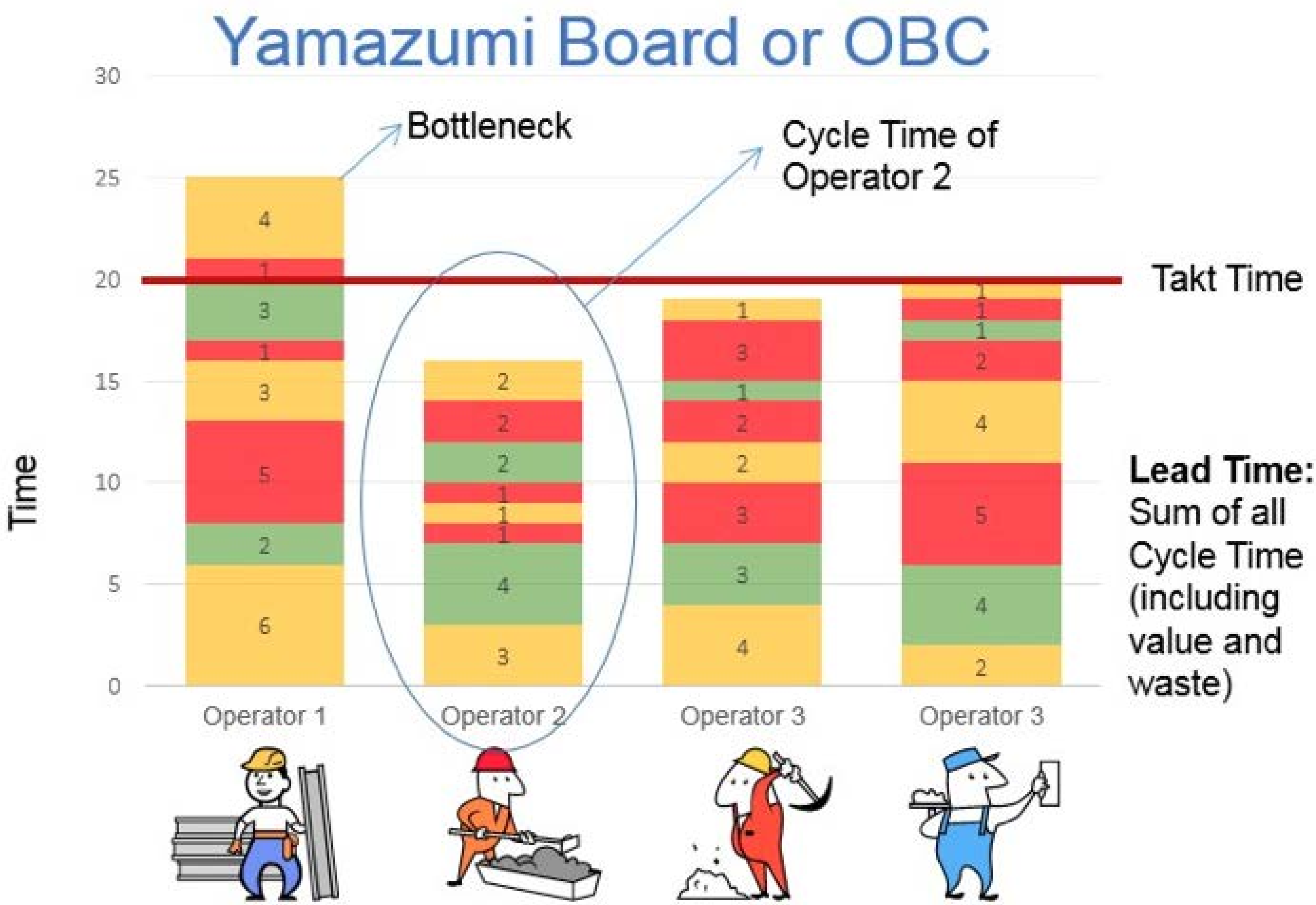


Figure 5: Time needed per Zone per Trade

Continuous flow – Takt time



Continuous flow – Takt time

$$\text{TAKT TIME} = \frac{\text{Available Working Time Per Day}}{\text{Customer Demand Rate Per Day}}$$

$$\text{TAKT TIME} = \frac{\text{600 seconds}}{\text{10 buildings}} = \text{60 seconds/building}$$

Continuous flow – Takt time

- **Step 3 – Create flow and balance the system**
  - Used the **work flows in color-ups** to illustrate how **each trade's would progress** over time using a **2-day takt** and **Figure 4.d's zoning**.
    - Steps 1, 2, and 3 prepared each trade to come to the **phase planning meeting** with their **preferred plan and alternatives**.

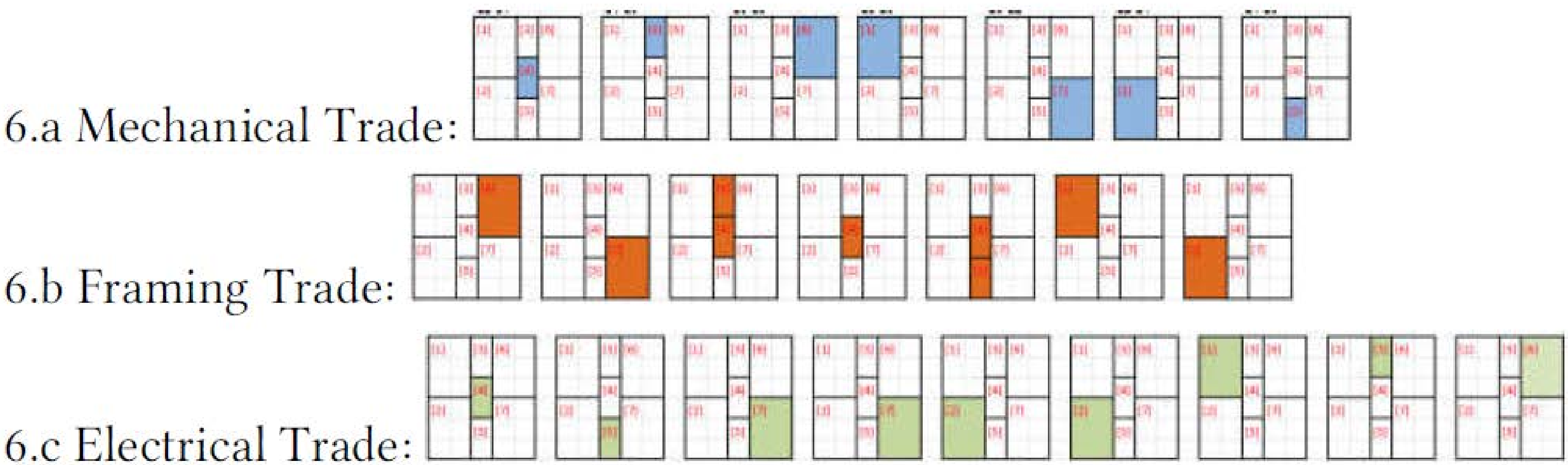


Figure 6: Patterns of Work Flow per Trade in 2-day Takt with Zoning

Continuous flow – Takt time

- **Step 4 – Pull plan to reach team agreement**
  - The team got together to **discuss the process** as a flow
    - The result was a **takt plan**, albeit **not an optimal one** since zones left white are **waiting on workers**

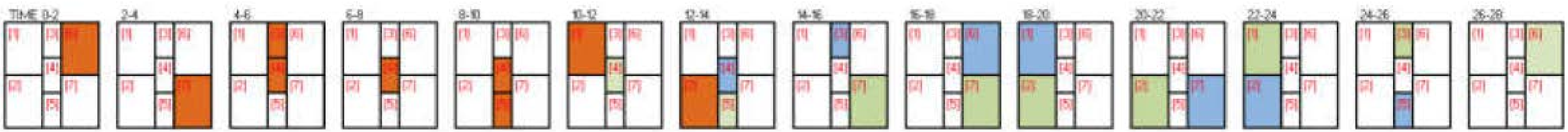


Figure 7: Meshed Patterns of Work Flow by 2-day Takt with Zoning

Continuous flow – Takt time

- Step 5 – Fine tune the system
  - Trades added **phase plan work** to be done in **areas other than those zoned** as **backlog**

    to fill "time left"

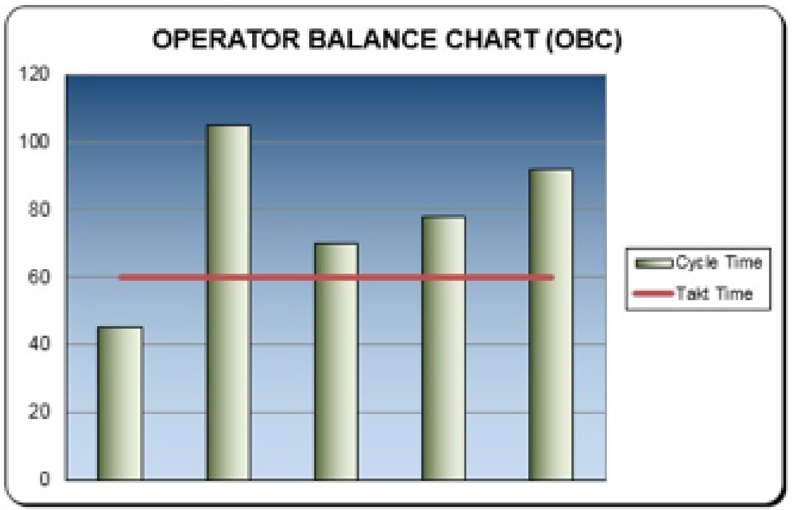
This is a concept that we expand in **Last Planner System (LPS)**!

Continuous flow – Example

ROUND 1

	Cycle Time	Takt Time
Operator 1	45	60
Operator 2	105	60
Operator 3	70	60
Operator 4	78	60
Operator 5	92	60
	390	78

Minutes		Sec.		Total
10	x	60	=	600
Total Shift Time			=	600
Orders per Shift			=	10
Takt Time			=	60

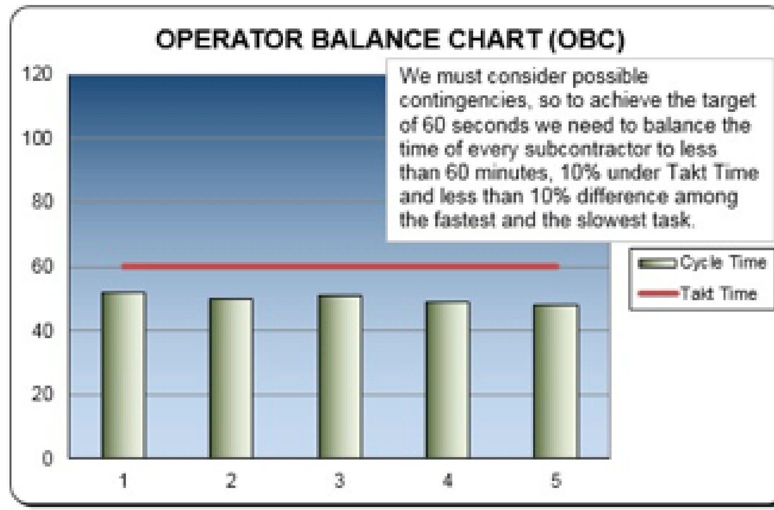


1 2 3 4 5 SUB-CONTRACTORS

ROUND 2

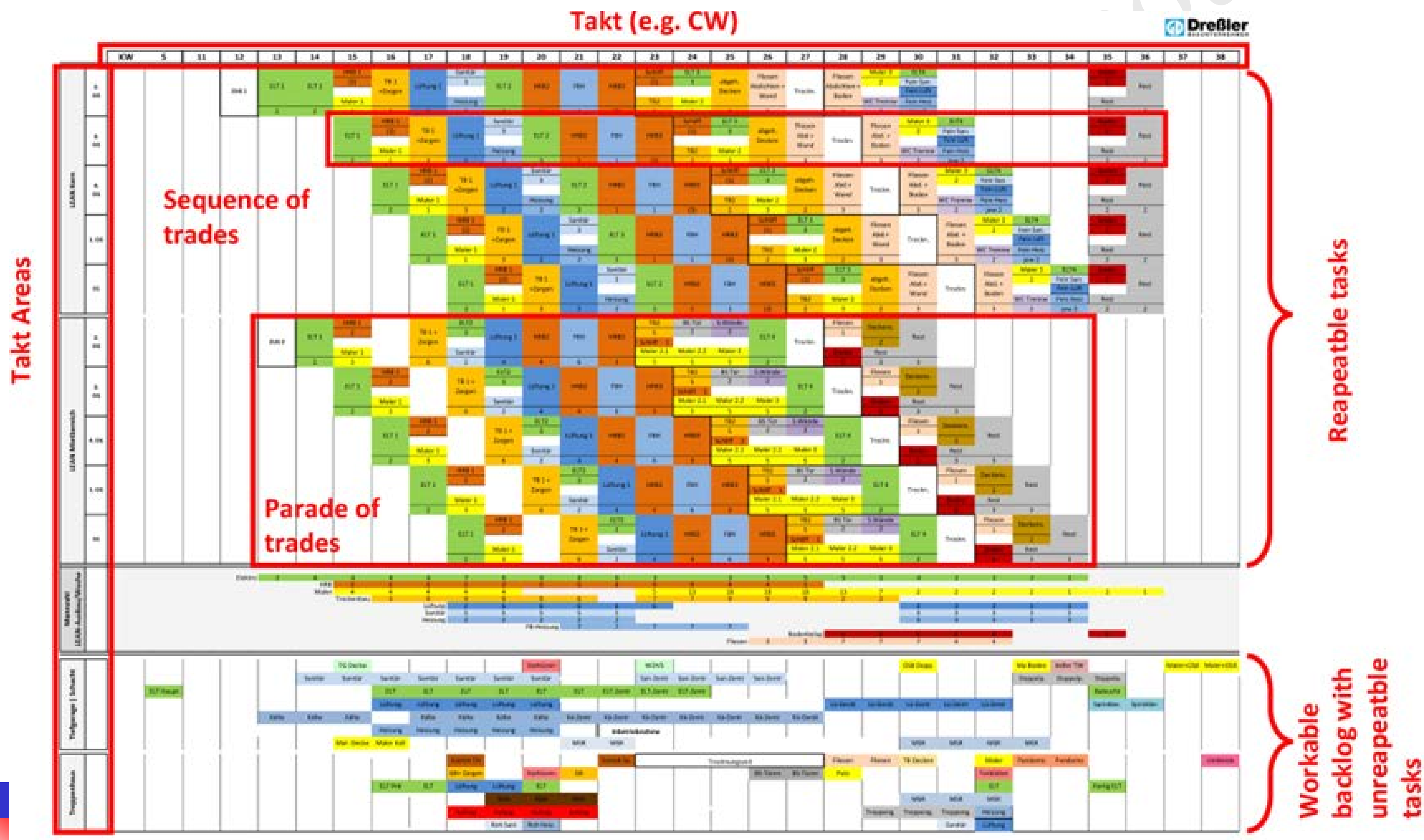
	Cycle Time	Takt Time
Operator 1	52	60
Operator 2	50	60
Operator 3	51	60
Operator 4	49	60
Operator 5	48	60
	250	50

Minutes		Sec.		Total
10	x	60	=	600
Total Shift Time			=	600
Orders per Shift			=	10
Takt Time			=	60



1 2 3 4 5 SUB-CONTRACTORS

Continuous flow – Takt time

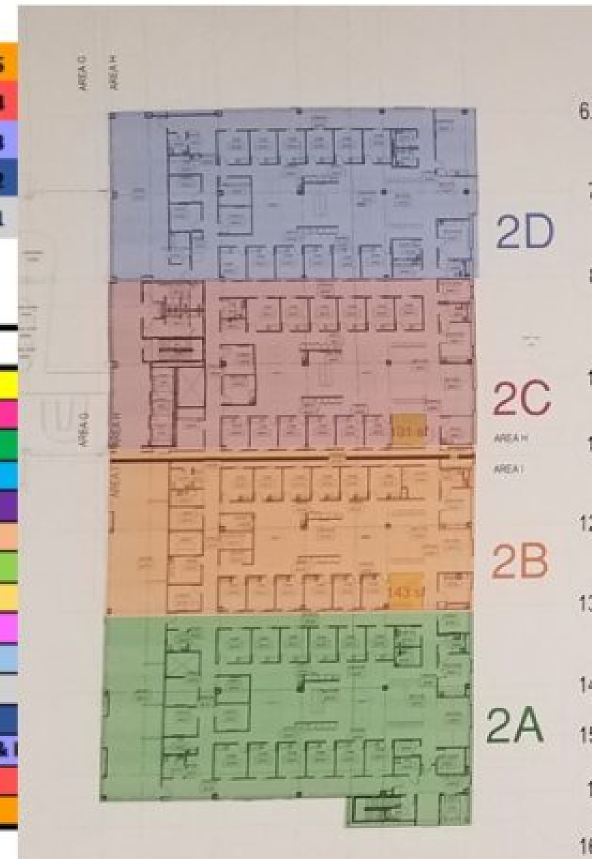


ACEMI

Continuous flow – Takt time

	1/21	1/28	2/4	2/11	2/18	2/25	3/4	3/11	3/18	3/25	4/1	4/8	4/15	4/22	4/29	5/6	5/13	5/20	5/27	6/3	6/10	6/17
2A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15							
2B		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15						
2C			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
2D				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
3A					1	2	3	4	5	6	7	8	9	10	11	12	13	14				
3B						1	2	3	4	5	6	7	8	9	10	11	12	13				
3C							1	2	3	4	5	6	7	8	9	10	11	12				
3D								1	2	3	4	5	6	7	8	9	10	11				

Task	Activity Description	Contractor
1	Layout - walls/duct/plumbing	Von Alst/C&R/Franklin
2	Install Priority Wall Framing/Associated Door Frames	Von Alst /Waterhout
3	Install Priority Wall Topout	Von Alst
4	Install Priority Wall Fire Tape & Head of Wall Detail	Von Alst
5	Electric/LV OH Rough-In	Kaiser
6	Install Main Duct & VAVs	C & R
7	Install Exhaust & Lowside Duct	C & R
8	Install DMV Hangers/Main Duct (Hallway)/Duct Testing	Franklin/C & R
9	Install DMV Pipe/Duct Insulation	Franklin/C & R
10	Install Water Hangers	Franklin
11	Install Water Piping & Plumbing In-Wall Rough-In	Franklin
12	Plumbing Inspection/Install In-Wall Mechanical	Franklin/C & R
13	Install Remaining Studs/Door Frames/Sound Boots	Von Alst/Waterhout/C &
14	Install Electrical In-Wall Rough-In/Plumbing Insulation	Kaiser/ Franklin
15	Install Blocking & Multivista As-Built Scan	Waterhout/Alberici

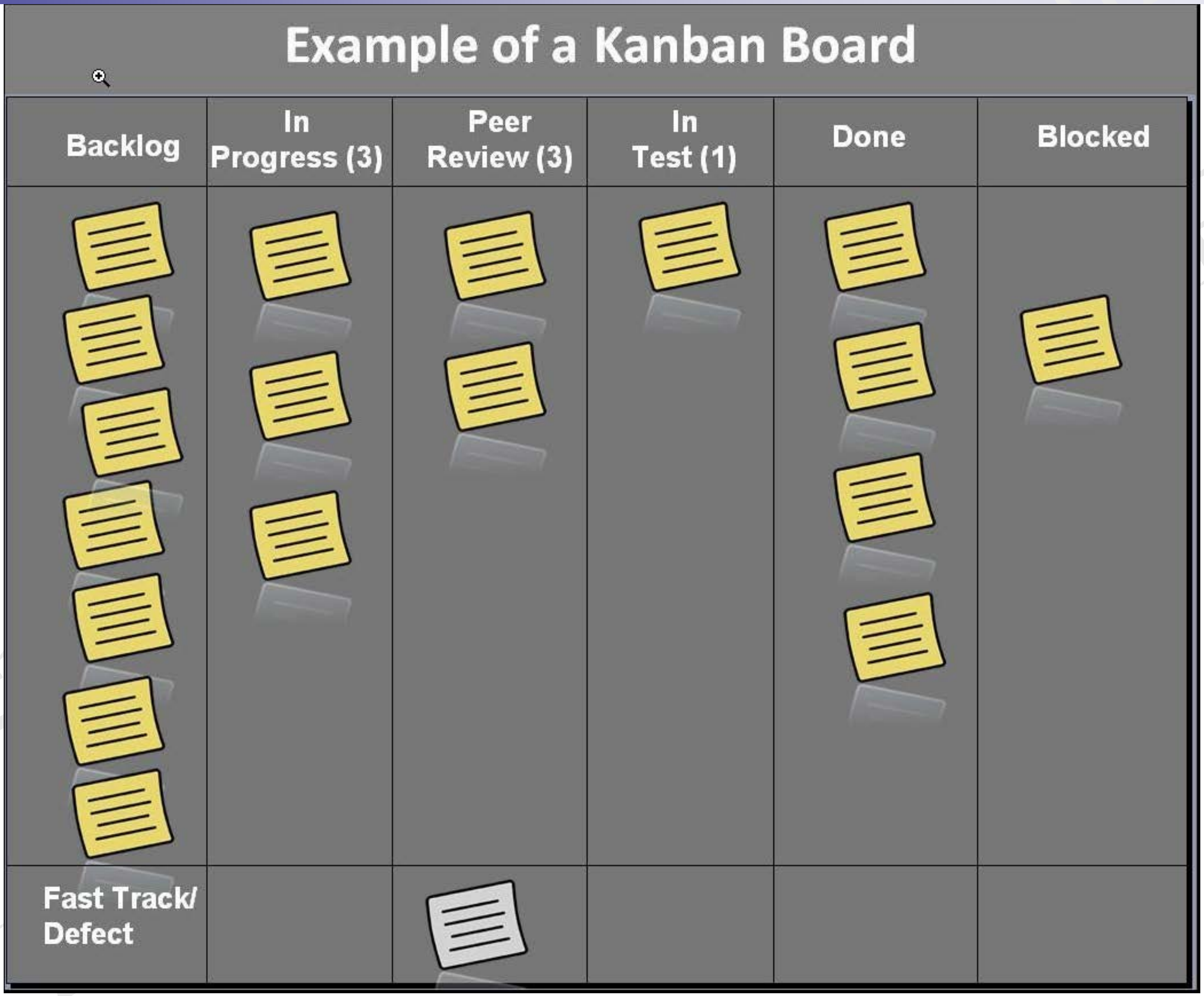


Continuous flow – Takt time

- Increased concurrency of trades to eliminate WIP and reduce duration

	Week Number	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26	Week 27	Week 28	Week 29	Week 30	Week 31	Week 32	Week 33	Week 34	AREA STRUCTURE
Production Floor 2	Area 1	Framing	Plumbing	Electrical	F/F/B	CLOSE UP	Drywall	Firetape	Electrician	Tape and Mud	Prime and Paint							
	Area 2		Framing	Plumbing	Electrical	F/F/B	CLOSE UP	Drywall	Firetape	Electrician	Tape and Mud	Prime and Paint						
	Area 3			Framing	Plumbing	Electrical	F/F/B	CLOSE UP	Drywall	Firetape	Electrician	Tape and Mud	Prime and Paint					
	Area 4				Framing	Plumbing	Electrical	F/F/B	CLOSE UP	Drywall	Firetape	Electrician	Tape and Mud	Prime and Paint				
	Area 5					Framing	Plumbing	Electrical	F/F/B	CLOSE UP	Drywall	Firetape	Electrician	Tape and Mud	Prime and Paint			
	Area 6						Framing	Plumbing	Electrical	F/F/B	CLOSE UP	Drywall	Firetape	Electrician	Tape and Mud	Prime and Paint		

Continuous flow – Kanban: Examples

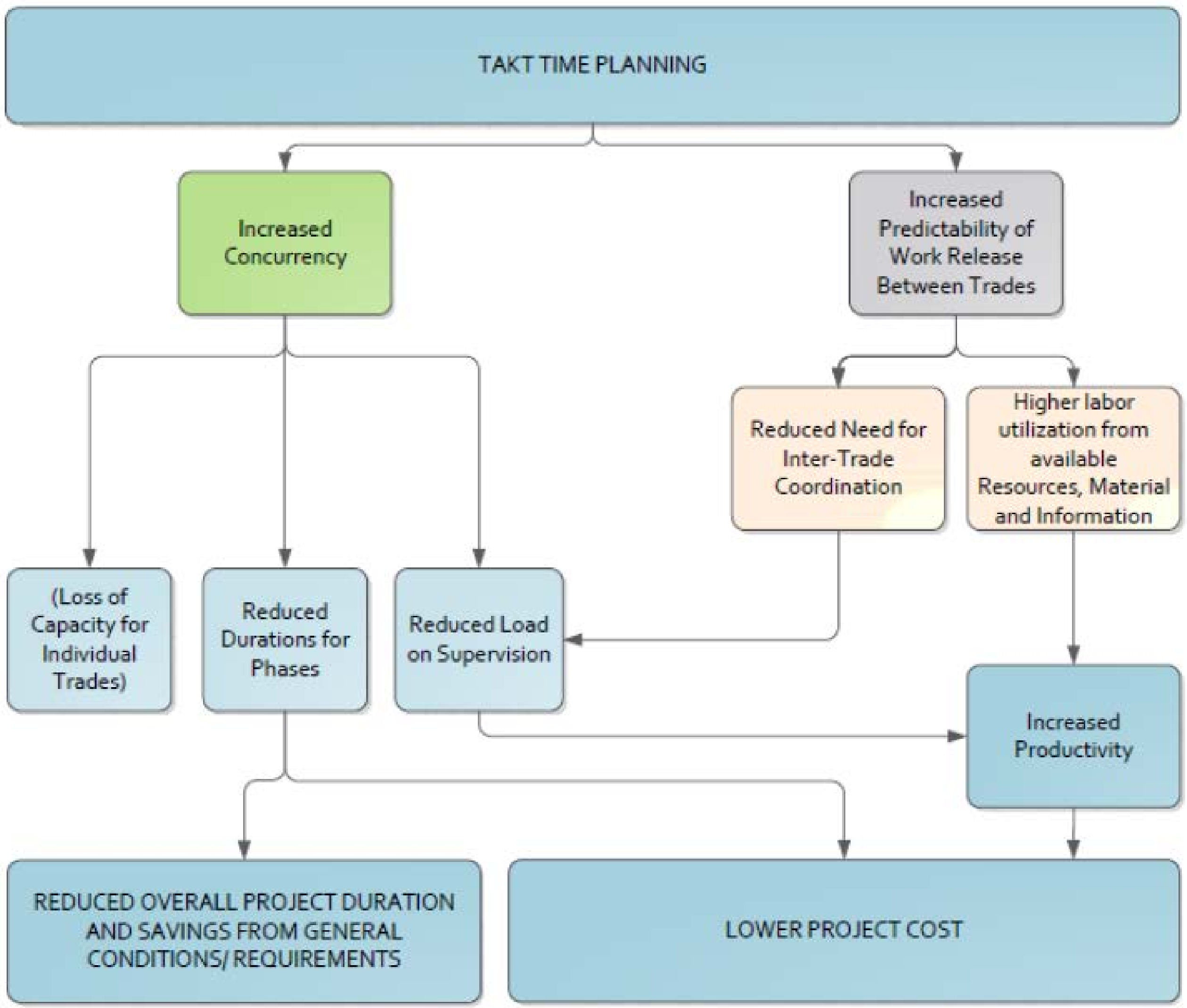


Continuous flow – Example

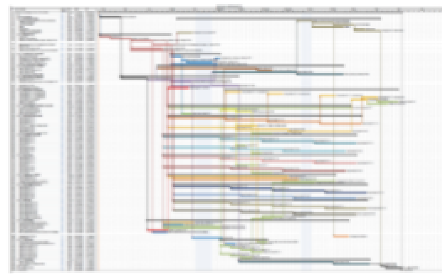
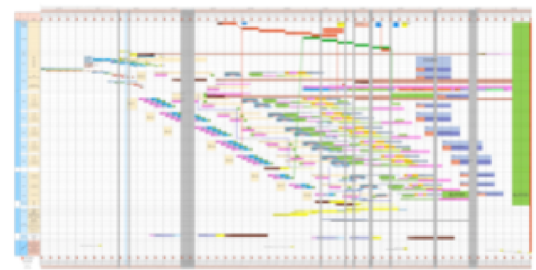
Indicators (KPI's)	Round 1	Round 2
Safety (from 0 to 10)	4	9
Quality Defects	6	1
Productivity	40%	100%
Time per shift	10	10
Delivered apartments	4	10
WIP	7	0
Lead Time (seconds)	623	300
Employees engagement (from 0 to 10)	3	9

Continuous flow – Example

Continuous flow – Takt time: Benefits



Continuous flow – Takt time

	Gantt Chart	Time-Location Diagram
Planning Type		
Axes	Tasks / Time (Each line represents a task)	Areas / Time (Each line represents tasks sequence in an area – colours define teams or companies)
Information size	As many lines as defined tasks	As many lines as defined areas
Improvement priority	Focus on resource efficiency	Focus on flow efficiency
Associated postulate	Resource occupancy is critical. Reducing a task duration reduces the schedule duration.	Areas occupancy is critical. Reducing a task duration can lengthen the schedule.
Natural optimization	Local - The project duration depends on all the tasks duration	Overall – The project duration depends on pace differences between tasks.
Benefits	Each company can have its own schedule	Links & dependencies between company's activities are obvious even to a new person on the project

Continuous flow – Takt time

Read "Takt Planning Workshop" Document

Continuous flow – Assignment

ASSIGNMENT 1-2-1:

1. **Meet your team members online and think of a schedule (min of 10 and max of 20 activities for the duration of two weeks) that should be done to complete your project (It could be even your project in your life).**
2. **Try to create Takt time planning based on 5 steps you learned.**
3. **Put your schedule at least in Excel**
4. **Design a Kanban board and assume you are at the end of 1st week!**
5. **Send your work (in PDF format) to ralavipour@gmail.com**

Due on the next week (next week with similar day)

اجرا و مدیریت پروژه به روش اصول ناب
(Lean Project Management)

فصل اول: مفاهیم، اصول و ابزارهای روش ناب (Lean)

بخش سوم: شناسایی و تشخیص اتلاف به کمک Gemba Walk

ارائه دهندگان:

سید محمدرضا علوی‌پور

(PhD, PMP, CMIT)

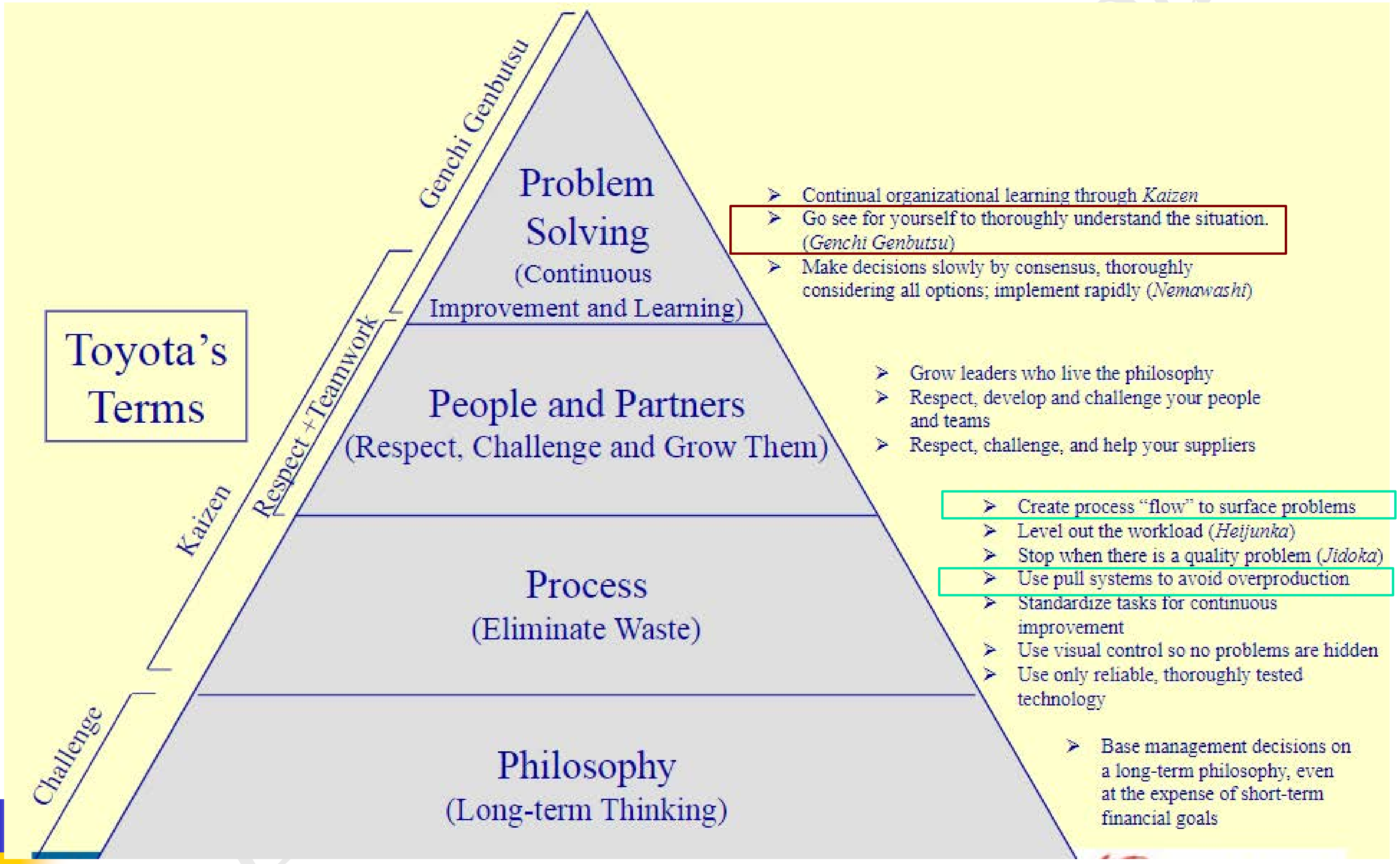
کامبیز کردانی

(M.Sc., PMP)

What we will learn?

- Waste identification in process
  - What is waste?
  - Value adding and non-value adding activities
  - How to find wastes?
  - How to remove wastes?

Lean – Principles (4P Model of the Toyota way)



Heart of lean systems

- **Eliminating:**
  1. **Waste (This section)**
  2. **Unevenness (Next section)**
  3. **Overburdening (Next section)**

Heart of lean systems

Lean methods include three mainstream items and we have to solve all these three items to reach lean:

1. **Waste (Muda):** Non-value-added
2. **Burden (Muri):** Overburdening people or equipment. It is on the opposite of Muda which means pushing a machine or person beyond natural limits.
3. **Uneven (Mura):** Unevenness results from an irregular production schedule or fluctuating production volumes due to internal problems, like downtime or missing parts or defects.

Unevenness** in production level means it will be necessary to **have on hand** the equipment, materials and people for the **highest level of production

***even if** the **average** requirements are **much lower** than that.*

Non value added will be result of **Unevenness**

Overburdening will also be the result of **Unevenness**

Heart of lean systems

- Interestingly, focusing on **Muda** is the most **<u>common approach</u>** to "implementing lean tools,

  because it is **easy to identify** and **eliminate waste**.

- But what **many companies fail** to do is the more difficult process of s**tabilizing the system** and creating **"evenness."**

Principle 12

- **Term: Go to Gemba: See for yourself to understand the problem**
  - Solve problems and improve processes
  - Has an understanding of situations

- **Tool: The Gemba Walk and *Genchi Genbutsu***

Waste Identification in Process

(What is Waste?)

Introduction

- An **activity** that adds **cost or time**,

  but does **not add value**

- **Consuming more resources** (time, money, space, etc.)

  than are **necessary to produce** goods or services that **customer wants**

What is difference between wastes and values?

Introduction

What is difference between wastes and values?

Pure waste – **non-value-adding and unnecessary**.

Incidental waste – **non-value-adding but necessary**.

For example, auditing and saving records for a specific period of time due to legislative requirements.

Some experts estimate that 90% of our work activities are some type of

Let's see the types of waste!

8 types of waste

1. Defects / poor quality
2. Over-production
3. Waiting & delays
4. Non-utilized resources (usually human resources)
5. Transportation & handling
6. Inventory (excess inventory)
7. Motion (unnecessary movement)
8. Excess processing

THIS IS CALLED

DOWNTIME

8 types of waste

8 types of waste in <u>production industry</u>

<u>See Video #6</u>

8 types of waste

8 types of waste in construction industry

See Video #7

ACEMI

8 types of waste

Let’s look at each type in detail!

Defects / Poor quality

- **Defective** information, materials, and products
- **Poor** workmanship
- **Cost** of inspecting for defects
- **Responding** to customer complaints
- **Rework** or **re-inspection** of defective materials

- **Common causes:**
  - Emphasis on inspection
  - Too rushed to correct a defect
  - Lack of standard work
  - Material handling (transportation)
  - Poor design

EXAMPLE: Re-work caused by last-minute changes to design; ceramic tile that develops cracks after installation

Over-production

- Producing items for which there are **no orders or requests**
  - No need or demand
- Producing **more than is needed or sooner than is needed**, which generates **excess inventory**
- Overproduction **causes almost all** other types of waste

- **Common causes:**
  - Scheduling according to forecasts rather than demand
  - Avoiding switches to different tasks or production, which leads to large-quantity production

EXAMPLE: Completing work in one area long before the next trade needs to work in that area

Waiting & delays

- **Workers waiting** for other workers or machines to complete their cycle
- **Equipment waiting** for an operator
- **Waiting** for parts, instructions, approval, information, maintenance, decisions

- **Common causes:**
  - Mismatched production rates
  - Poor layout or poor planning
  - Machine breakdowns
  - Insufficiently staffed
  - Indecision

Non-utilized resources

- **Employees** are seen as a **source of labor only**, **not** seen as true process **experts**
- **People** are told what to do, and **asked not to think**
- **Employees** are **not involved** in finding solutions and opportunities to improve a process are missed

- **Common causes:**
  - Narrowly defined jobs and expectations
  - Management does not involve employees in problem solving

EXAMPLE: Failure to let each trade contribute to the schedule; telling a worker what to do rather than asking their opinion

Transportation and handling

- **Double or triple** handling, moving in and out of storage areas, warehouses, and processes
  - Material can get damages
  - No value is added
  - Often used to get the extra inventory out of the way
- **Staging or ordering** materials from far distances

- **Common causes**:
  - Too much debris on site
  - Extra Inventory sitting on site
  - No JIT delivery system
  - Excessive distance between operations (layout)

EXAMPLE: Moving materials multiple times because they were delivered too soon to the jobsite

Inventory

- **Excess** material, WIP, or finished goods on the jobsite
- **Requires** people, equipment and space to count, transport, store and maintain it
- Inventory is often **used** to help **hide other wastes**

- **Common causes:**
  - Overproduction
  - Mismatched production speeds
  - Poor layout
  - Long handoff times
  - Defective materials

EXAMPLE: Delivering materials in bulk to the site rather than just-in-time; creates the possibility of damaging materials

Motion

- Any **wasted motion** employees perform during work
- **Walking without working** (away from task location)
- **Searching** for tools, materials or information
- **Reaching, bending or unnecessary motion** due to poor housekeeping or workplace layout

- **Common causes:**
  - Poor task or site layout
  - Shared tools
  - Site congestion
  - Process not designed with employees in mind

EXAMPLE: Walking a long distance to use the toilets or to get materials; going up and down the ladder many times

Excess processing

- **Doing more steps** than is necessary to produce an effectively functioning product
- **Extra** setup steps, over-specification of the process, extra processing steps
- **Over-designing** or **over-planning**

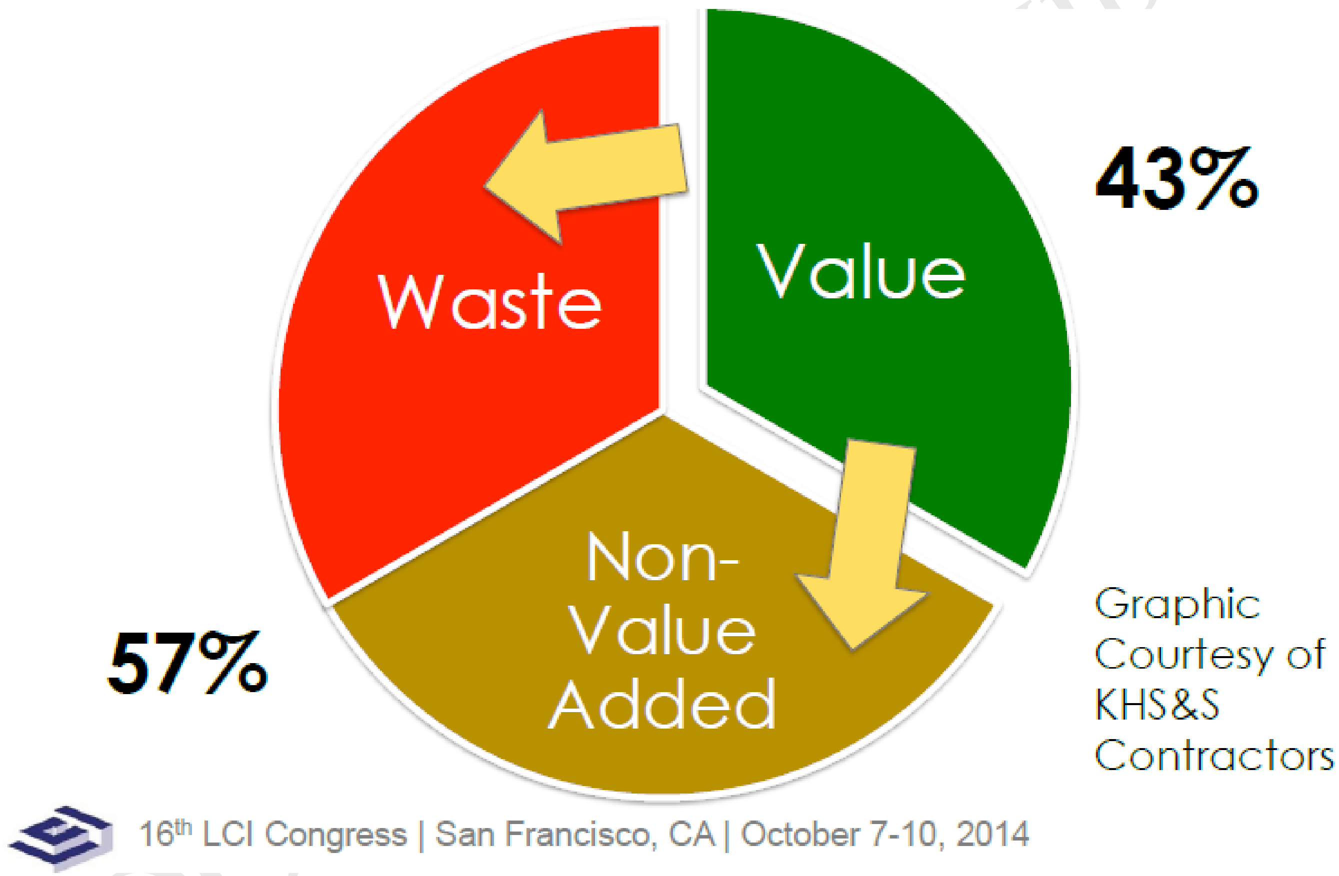
- **Common causes:**
  - Lack of standard work/processes
  - Failure to identify and eliminate waste from processes
  - Excessive caution
  - Lack of effective problem solving

EXAMPLE: Planning too far out (e.g., 5-year Plan); designing an elaborate structure when a simple one would work fine

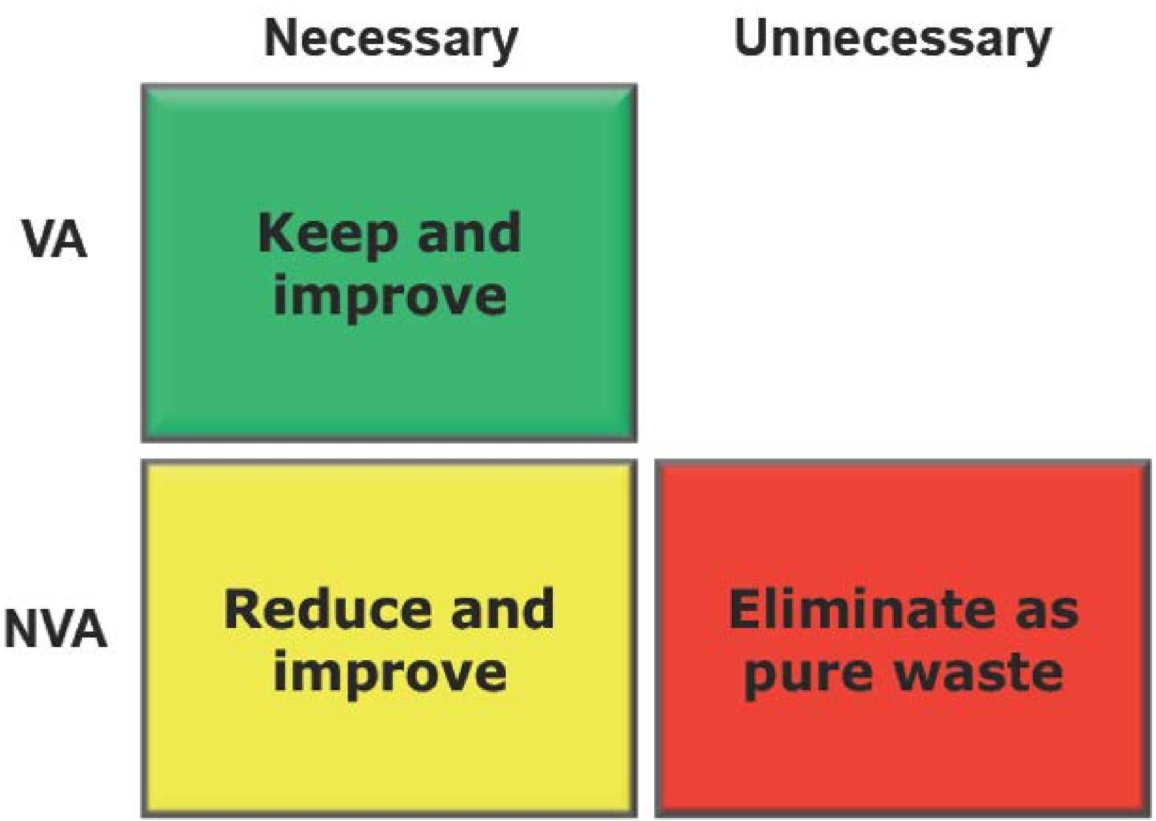
Waste Identification in Process

(Value Adding and Non-Value Adding Activities)

Waste and value identifications and orderings



Waste and value identifications and orderings



Waste and value reviewed

<u>Value-Adding and Necessary Activities</u>

- Transforms or shapes material or information
- Customer wants it
- Examples: Lights that turn on, systems that work, mechanical equipment that does not break down; others?

Waste and value reviewed

Non-Value-Adding but Necessary Activities (Incidental Waste)

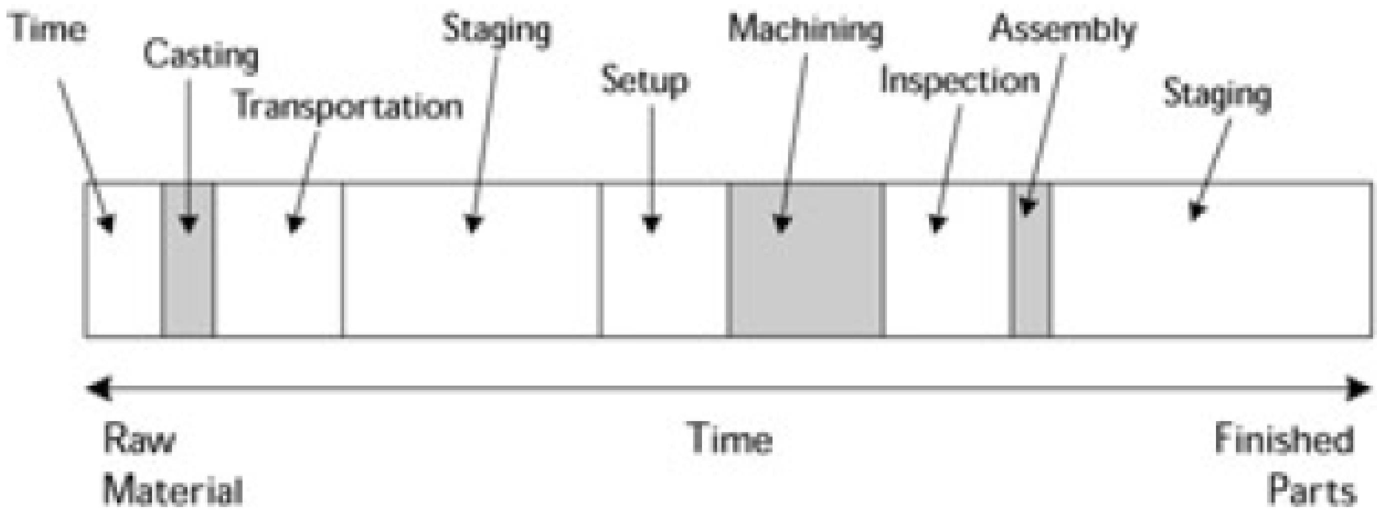
- No value created but activity is required
- Examples: Submittal processing; material delivery; interpreting blueprints; others?

Waste and value reviewed

Non-Value-Adding and Unnecessary Activities (Pure Waste)

- Consume resources but creates no value for the customer
- Could be stopped and it would be invisible to the customer
- Examples: Staging materials too far away; inefficient meetings; indecision; sitting in someone's inbox; others?

Waste in the value system



Value-Added Time

Non-Value-Added Time (Waste)

- Value-added time is only a small percentage of the total time.
- Traditional cost savings focuses only on value-adding items.
- Lean thinking focuses on the value stream to eliminate non-value-adding items.

Waste Identification in Process

(How To Find Wastes?)

What is Gemba Walk?

- **Gemba Walk** promotes **deep understanding:**
  1. Going out to the field
  2. Observing the problem
  3. Verifying the situation
  4. Thinking for yourself

What is Gemba Walk?

- **Gemba is where the work takes place**
- A **Gemba Walk** allows supervisors to
  1. Identify **waste**
  2. Encourage **continuous improvement**

Who/What/Where/When/Why

- **Who?**
  - Company leaders, manager, supervisors, etc.

- **What?**
  - Have a clear and obvious focus
  - Don't look for every type of waste
    - ✓ You will likely accomplish nothing and confuse everyone.
  - Select 1-2 issues to look at while walking

Who/What/Where/When/Why

- **Where?**
  - **Begin** at the **last step** of your value stream in your process then **walk upstream** through the process
- **When?**
  - As often as necessary or desired
- **Why?**
  - If **done regularly**, with clearly stated intentions it will **consistently demonstrate**
    1. Commitment
    2. Alignment
    3. Support

    of the **continuous improvement process**.

Hints by Mr. Yamashina, Toyota Technical Center

- Always keep the **final target** in mind
  - Carefully **plan** for your final target
  - Have a clear **purpose** for **meetings**
- Clearly **assign tasks** to yourself and to others
- **Think and speak** based on **verified**, proven information and data
  - Go and confirm the **facts** for **yourself** (genchi genbutsu)
  - **Your are responsible** for the information you are reporting to others
- Take **full advantage** of the **wisdom** and **experiences** of others to send, **gather or discuss** information (form of genchi genbutsu)
- **Share** your information with others in a **timely manner**
  - Always consider **who will benefit** from receiving the information

Hints by Mr. Yamashina, Toyota Technical Center

- **Always report**, inform and consult in a **timely manner**
- **Analyze and understand <u>shortcomings</u>** in your capabilities in a **measurable way**
  - Clarify the **skills and knowledge** that your need to further **develop yourself**
- Relentlessly strive to conduct **kaizen activities**
- **Think "outside the box,"** or beyond common sense and standard rules
- Always be mindful of protecting your **safety and health**

Videos on Gemba Walk

See Videos #8 to #10

ACEMI

Waste identification

Identify one example of each type of waste below	Possible cause	Proposed Action	Method of measurement
Overproduction			
Delays			
Transportation			
Process			
Inventories			
Motions			
Defective products			
Untapped resources			
Misused resources			

Waste identification – Assignment

ASSIGNMENT 1-3-1:

1. Watch Video #11 for 15 minutes
2. Meet your team members online and identify as many types of waste as you can identify.
   a) You may see waste or you may hear the Project Engineer and Videographer talk about waste
      - ❖ Instruction: Think in terms of trades, materials, inventories, etc.
3. Write down the waste you identify in one two pages (preparing a table highly recommended).
4. Send your work (in PDF format) to ralavipour@gmail.com

Due on the next week (next week with similar day)

Waste Identification in Process

(How To Remove Wastes?)

Tools to be used

- **All of the lean tools** are designed to help identify and eliminate waste
  1. **Kanban**
  2. **Continuous process flow**
  3. Standard work
  4. Mistake proofing
  5. Value stream mapping

اجرا و مدیریت پروژه به روش اصول ناب
(Lean Project Management)

فصل اول: مفاهیم، اصول و ابزارهای روش ناب (Lean)

بخش چهارم: مفهوم انحراف یا تغییرات به عنوان منبع اتلاف

ارائه دهندگان:

سید محمدرضا علوی‌پور

(PhD, PMP, CMIT)

کامبیز کردانی

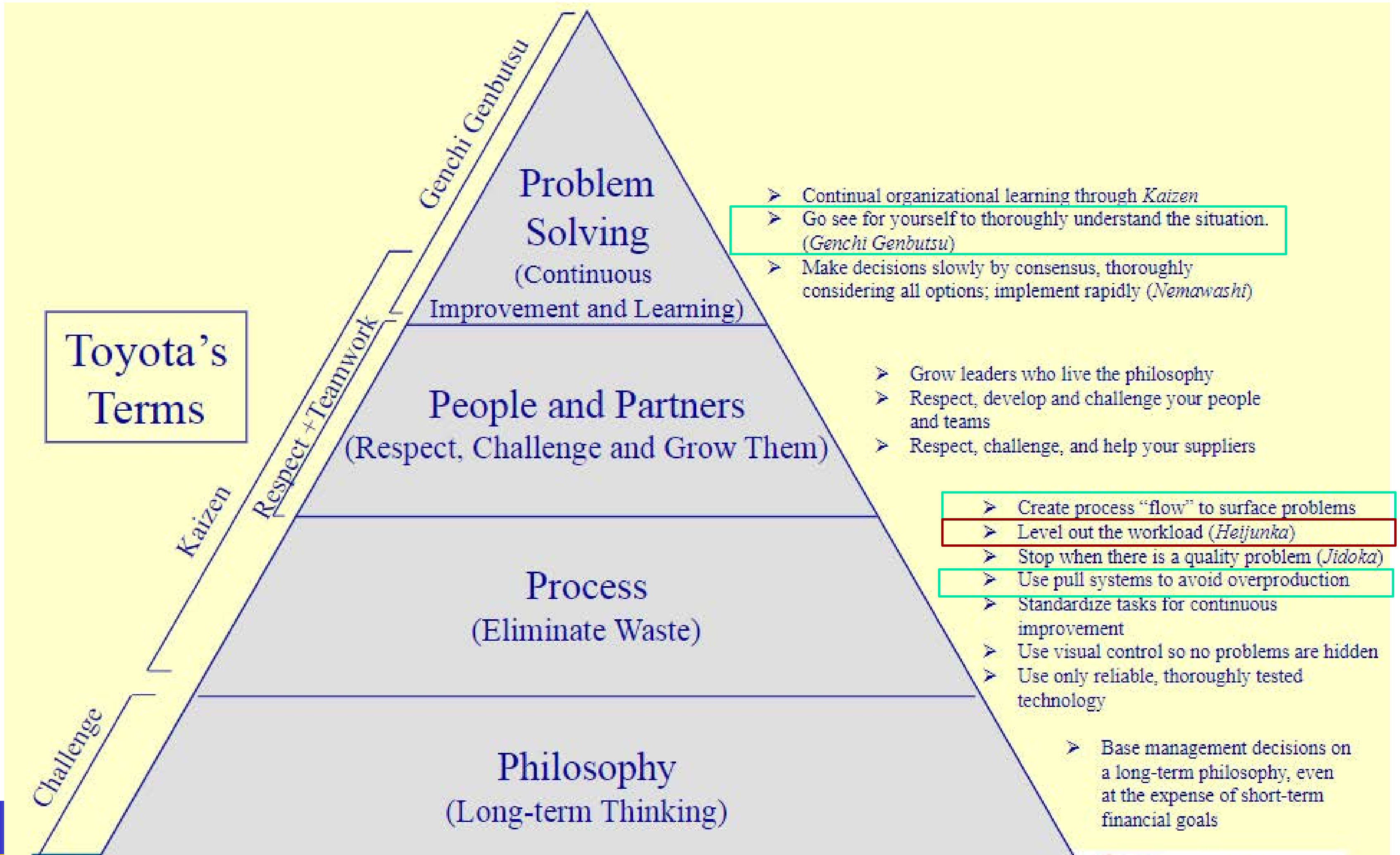
(M.Sc., PMP)

ACEMI

What we will learn?

- Variation as a source of waste
  - What is variation?
  - Types of variation
  - Lean strategy for reducing variation

Lean – Principles (4P Model of the Toyota way)



Heart of lean systems

- **<u>Eliminating:</u>**
  1. **Waste (This section)**
  2. **Unevenness (This section)**
  3. **Overburdening (This section)**

Heart of lean systems

<u>Lean methods include three mainstream items and we have to solve all these three items to reach lean:</u>

1. **<u>Waste (Muda):</u>** Non-value-added
2. **<u>Burden (Muri):</u>** Overburdening people or equipment. It is on the opposite of Muda which means pushing a machine or person beyond natural limits.
3. **<u>Uneven (Mura):</u>** Unevenness results from an irregular production schedule or fluctuating production volumes due to internal problems, like downtime or missing parts or defects.

Unevenness *in production level means it will be necessary to* ***have on hand*** *the equipment, materials and people for the* ***<u>highest level of production</u>***

even if *the* ***<u>average</u>*** *requirements are* ***much lower*** *than that.*

Non value added will be result of **Unevenness**

Overburdening will also be the result of **Unevenness**

Heart of lean systems

- Interestingly, focusing on **Muda** is the most **common approach** to "implementing lean tools,

  because it is **easy to identify** and **eliminate waste**.

- But what **many companies fail** to do is the more difficult process of s**tabilizing the system** and creating **"evenness."**

Principle 4

- **Term: Level the workload**
  - Eliminates overburden to **people** and **equipment**
  - Eliminates unevenness in the **schedule**
  - Looks for achieving **high reliability** rather than achieving **high speed**

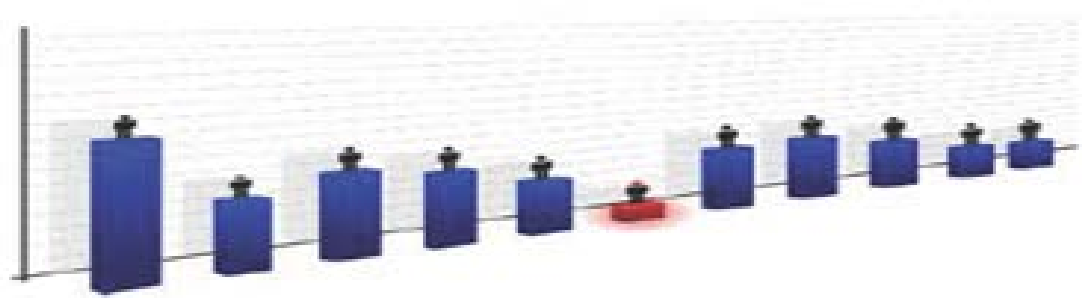
- **Tool: Parade of Trades Game and *heijunka***

Variation As a Source of Waste

(What is Variation?)

Variation in general term

- **<u>Unevenness</u>** is **variation**
  - Hurry up and wait
- A **<u>change</u>** or slight **<u>difference</u>** in
  - Condition
  - Amount
  - Level



- A **deviation**
- Something that **differs** from a **<u>standard</u>** or **<u>convention</u>**
- Variation creates <u>Unpredictability</u>

Overburdening in general term

1. **Overburdening people:**
   - ❖ Physical problem
   - ❖ Unnecessary movement
   - ❖ Extreme productivity losses due to extended overtime

2. **Overburdening equipment:**
   - ❖ Machinery

Variability in construction

- A **change** or slight **difference** in **stationary conditions**
- A **deviation** in the **production** from **standard** or **expected rate**
- **Something** that **differs** from **a repeating sequence** of planned processes/activities

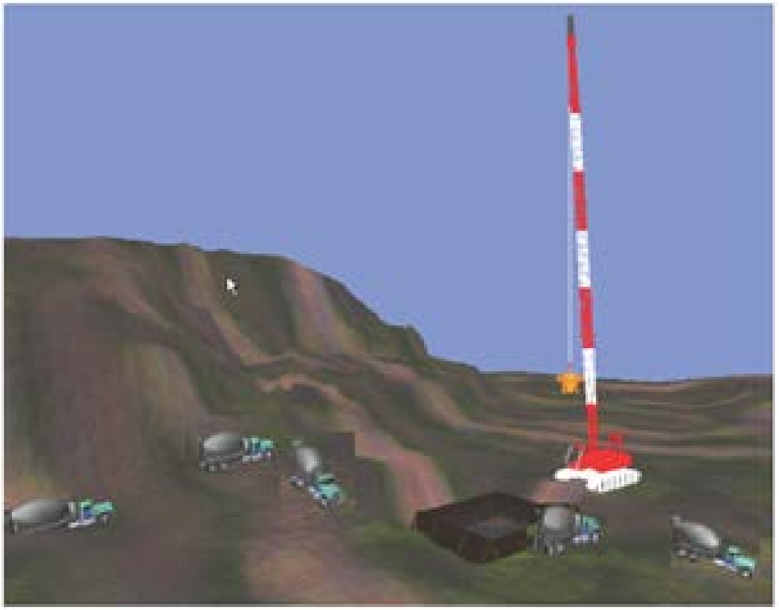
What is standard rate?

See company's historical records or databases like RsMeans

Variability in construction – Example

- Concrete is received from **ready-mix trucks**
- Trucks are coming **every minute**
- It takes **two minutes** to receive the concrete from the truck and **pour** the foundation

What happens?



Variation As a Source of Waste

(Types of Variation)

Types of variation in production

- Types of variation refers to **random** or **non-random** differences in a production process.
- **E. Deming** identified **two** types of variation:
  1. **Common cause variation (natural)**
     - **Random** causes that are **inherent** in the system/process over time
       1. **Affect everyone** working in the system
       2. **Affect all outcomes** of the system
  2. **Special cause variation (unusual)**
     - **Non-random** causes that are **not part of** the system/process all the time
       1. Do **not affect everyone**
       2. Arise because of **specific circumstances**

Source: Associated General Contractors of America

Types of variation in production

Variation of either kind in production systems is negative!

Special cause variation must be addressed before common cause variation

Variations in workflow

Variation is often a result of deviations from planned start and/or completion dates for tasks

Variations in workflow

- **Variation** is **caused** by **fluctuations** in the construction or production process.
  - It arises when people do **whatever they can** to get the results
  - It results in:
    1. Interrupted workflow
    2. Workers waiting for work
    3. Work waiting for workers
       - ✓ When work is **unreliable**, it often causes **one group** on the project to be going at **full speed** while **one waits for work**
  - Variation occurs in the **field** and in the **office**

Variations in workflow

- **Examples:**
  - Change orders
  - Late replies to requests such as **request for information (RFI)**
  - Lack of **materials**
  - Physical interference between **materials/workspace congestion**

Variations in workflow

Definition of workflow!

- **Workflow** is the **progression of work**
  1. Within a trade or
  2. From one trade to another

Let's see types of workflow!

Variations in workflow

Let’s see types of workflow!

- Predictable workflow vs. reliable workflow
  1. **Predictable:** The ability to **consistently foretell** something in **advance**
  2. **Reliable:** The **long-term consistency** of a system

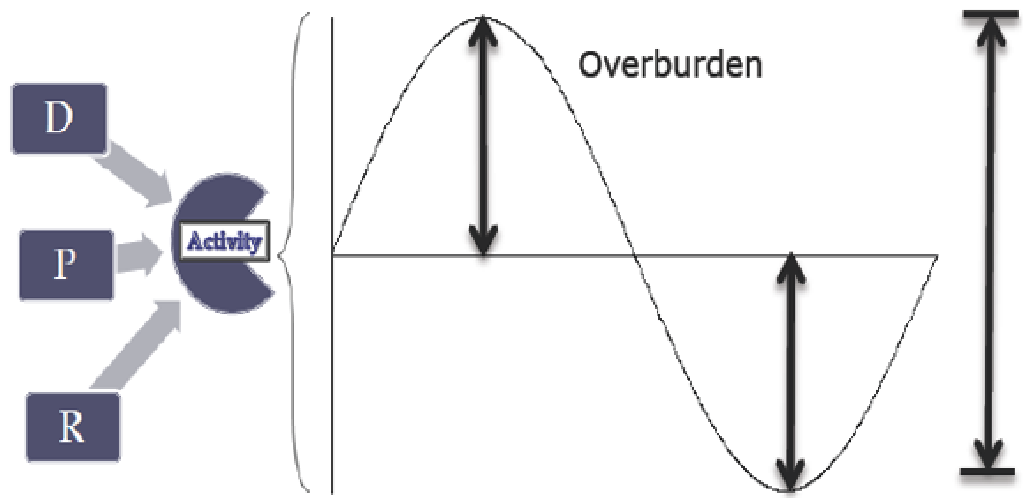
Ideally, we would like to minimize the impact of variation on the workflow

What are three primary items that affect the workflow?

Variations in workflow

What are three primary items that affect the workflow?

1. **Directives**
2. **Prerequisite work**
3. **Resources**



Source: Associated General Contractors of America

What if we fail in each of the items mentioned?

ACEMI

Variations in workflow

What if we fail in each of the items mentioned?

1. **Planning failure**
   - If any of "D," "P," and "R" are **not available**

2. **Execution failure**
   - If the activity **cannot be finished** in the planned time, even "D," "P," and "R" are available once activity started

Who play a key role in variations?

Variations in workflow

Who play a key role in variations?

1. **Owners**
2. **Architects/engineers**
3. **Project managers**
4. **Key stakeholders**

Play a key role in preventing disruptions to construction work

Which in turn will generate variations in the workflow

What is a primary solution?

Variations in workflow

What is a primary solution?

- It is a matter of **managing**
  1. Interdependences
  2. Uncertainties

to reduce the effect of variability

Coordination among trades is a key tool

IPD will play a key role to reduce variations!

Variation As a Source of Waste

(Lean Strategy For Reducing Variation)

Lean tools to reduce variations

1. **Pull planning**
2. **Resource allocation (resource-constrained problems)**
3. **Resource leveling**
4. **Contingency (Buffer)**

- **Impose** **reasonable demands** when selecting **subcontractors** and **trades**
- **Recognize** **when problems occur** using one piece flow
- **Impose** **realistic expectations** on the production process

To see the effects the Parade of Trades would be helpful

What is this?

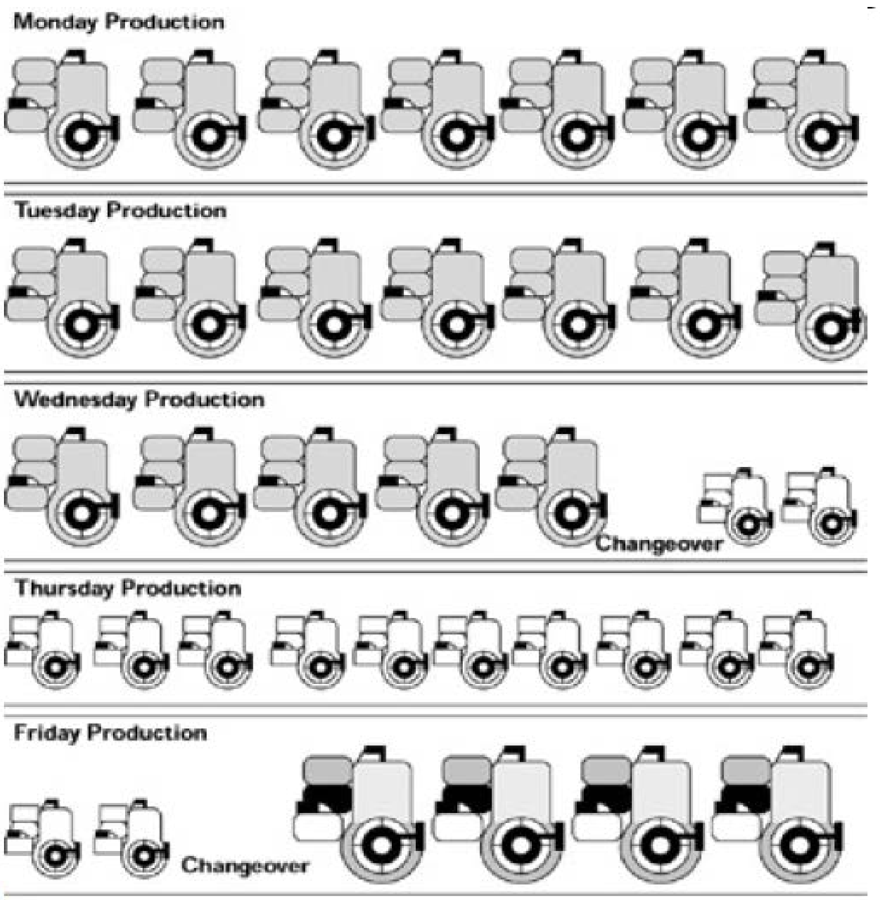
Parade of trades

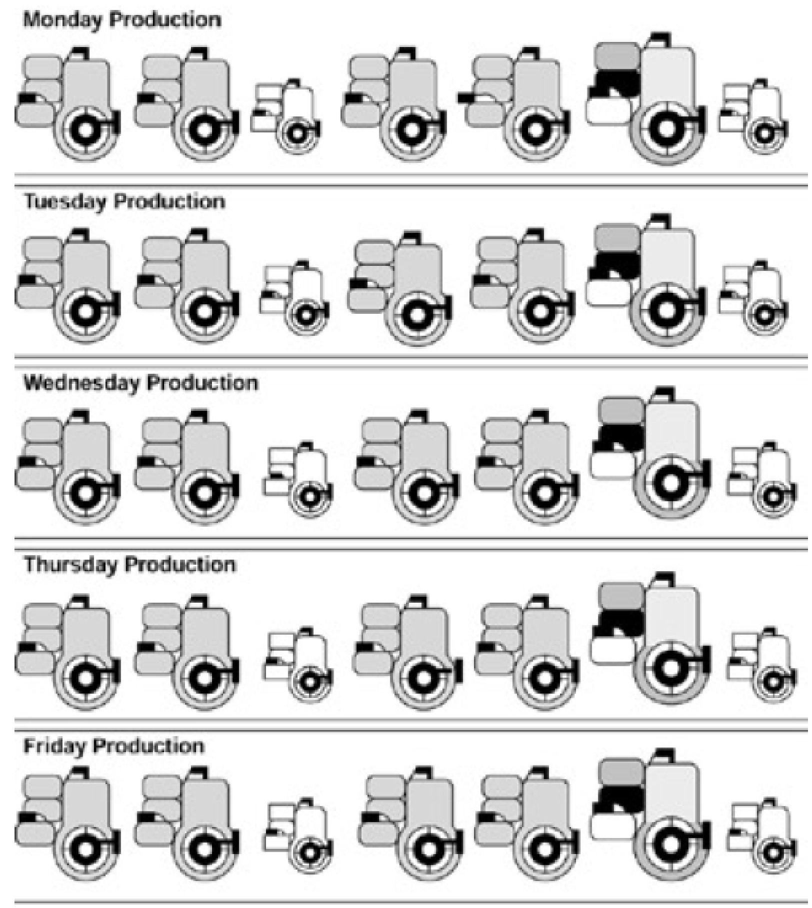
- The **Parade of Trades®** **simulates** the way work moves in a **"Parade"** through a project.

- It **explores** the **impact** of **unpredictable workflow** on project performance
  - Things go wrong in **simulations just as in real life.**

Let's see an example!

Parade of trades: Example





What are the problems and benefits here?

Parade of trades: Example

Problem:

- Unfortunately, **customers are not predictable** and actual orders **vary significantly** from week to week and month to month.
- If you build product as it is ordered at **maximum rate of production**, you may be **building huge quantities** one week, **paying overtime**, and **stressing your people** and equipment.
- But then, if **orders are light the next week**, your people will have **little to do** and your equipment will be **underutilized**.
- You will also **not know** **how much to order** from your **suppliers**, so you need to **stock** the **maximum** possible amount of each item the **customer might possibly order**.

What are the benefits of leveling here?

Parade of trades: Example

- There are **four benefits** of **leveling the schedule**:

1. **Flexibility** to make what the **customer wants when** they want it
2. **Reduced risk** of **unsold goods**
3. **Balanced use** of **labor** and **machines**
4. **Smoothed demand** on upstream processes and the **plant`s suppliers**

Some people may say it is even more time-consuming to change the trade in line!

What is the problem and solution to this?

Parade of trades: Example

Problem:

- **Changing over tools** to alternate between making product A and product B **seems wasteful** because parts are **not being produced during changeover time**.
- You are **also paying the equipment operator** while the **machine is being changed** over.

*but this approach has most **four problems which have been discussed**.*

But does it have a solution?

Parade of trades: Example

Analysis:

- In the case of the **motors**, the plant did a **careful analysis** and discovered the **long time to changeover** the line was due to
    1. **Moving in and out parts and tools**
    2. There were also **different sized pallets** for the **different engines**.

Solution?

Parade of trades: Example

The solution of wasting time by changeover line:

1. The solution was to **bring a small amount of all the parts** on flow racks to the operator on the line.

2. It was also necessary to **create a flexible pallet** that could **hold any size engine**.

*Shingo wondered **how much of changeover** he could perform **while the machine was still running**,*

*so he **organized an operator`s workplace** for that purpose.*

Variations in construction workflow

- **CM** takes **proactive actions** to establish **buffers**
  - Remember **contingency** at the end of the path?
- **Project Engineers** pay attention to workflow variation by means of **careful planning** and **detailed observations**
- **Superintendents**
  1. Set **flow rates**
  2. Require contractors to **meet these rates**

     while ensuring work space is still available when needed.
- **Superintendents** actively set up **space managing techniques** such as
  1. Coordination of traffic paths
  2. Storage spaces

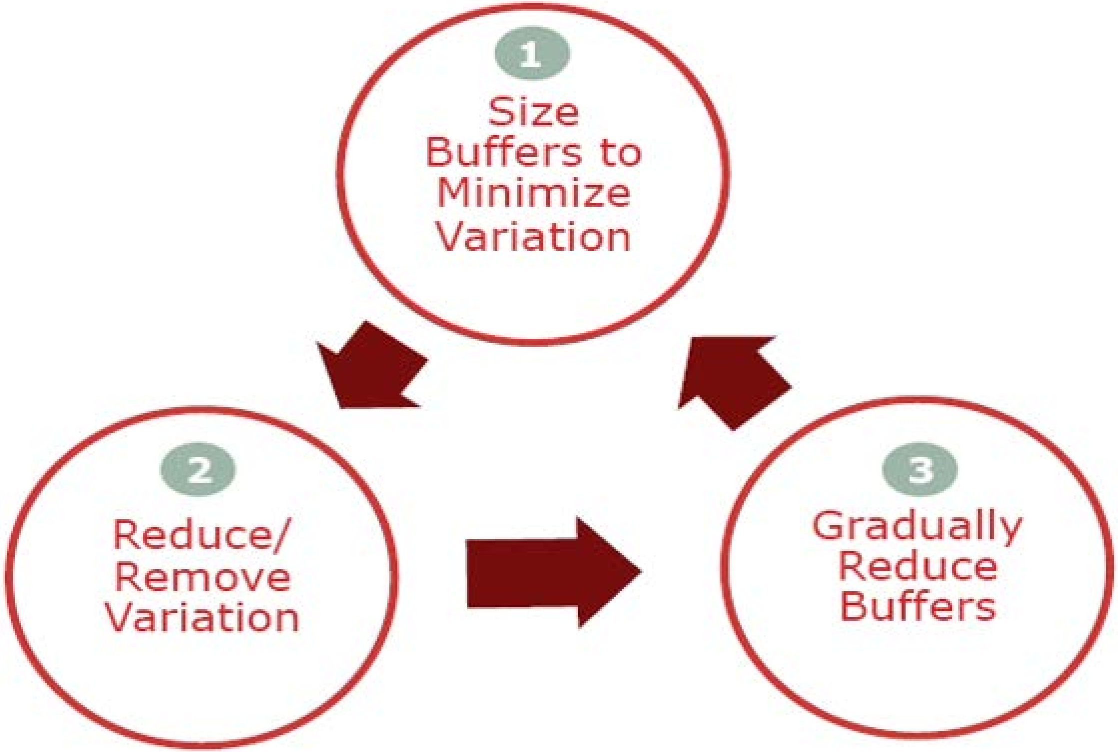
     to define patterns and sequences.

Variations in workflow

How to use buffer for reducing variation?

Use buffer to reduce variation

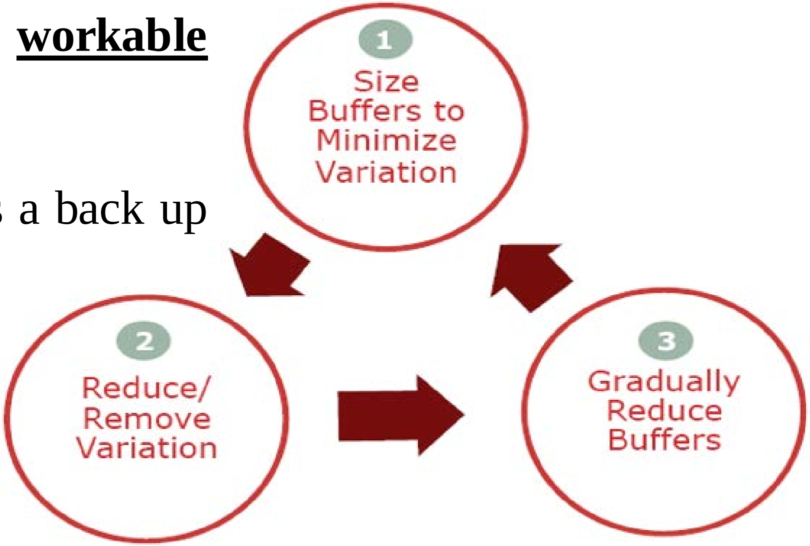
- Three steps:
  1. Size buffers to minimize variation
  2. Reduce/remove variation
  3. Gradually reduce buffers



Let's see what they mean?

Use buffer to reduce variation

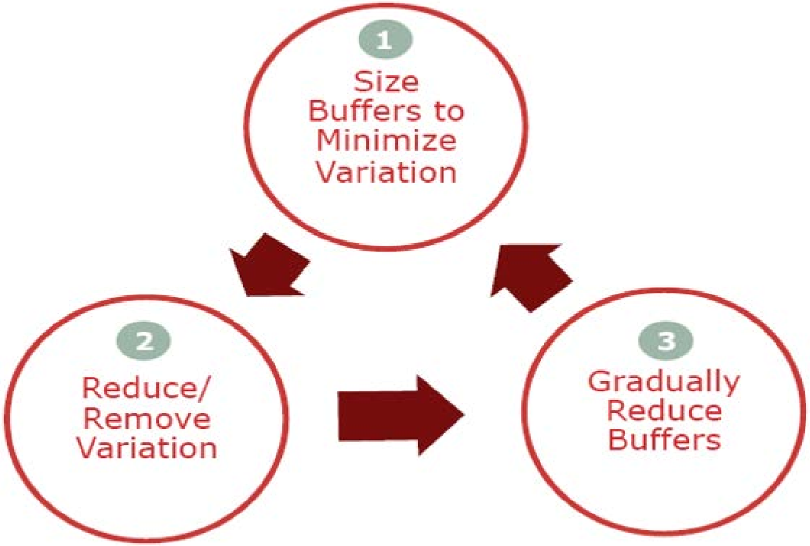
1. **Size buffers to minimize variation**
   a) **Inventory buffers**
      ❖ Keep excess materials on or **near the site**
   b) **Capacity buffers**
      ❖ Build a **reserve capacity** in crew or operation
   c) **Schedule buffers**
      ❖ Also known as **plan buffers** or **workable backlog**
      ❖ **Work not on the critical path** acts as a back up for planned work



Use buffer to reduce variation

2. **Reduce/remove variation**

- **Buffers** are not a **long-term solution**
- **Experimentation** and **continuous improvement** are needed to come up with ways to
  1. **Mitigate** variation and
  2. **Achieve** reliable workflow
- Tools include Plan, Do, Check, and Act



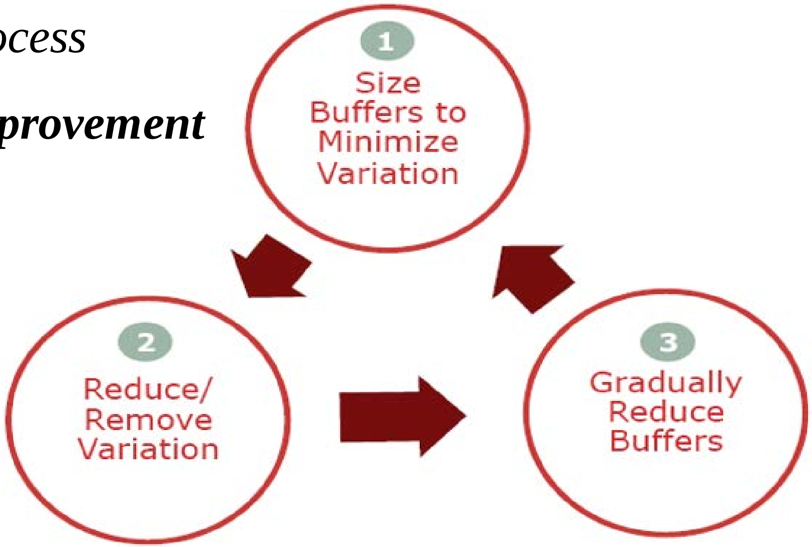
Use buffer to reduce variation

3. <u>**Gradually reduce buffers**</u>

- ❖ **Reduce buffers** to **<u>force</u>** **continuous improvement**
  - ✓ Allow us to identify system problems
  - ✓ Once identified we can try to eliminate them

    *An example of this would be to **gradually reduce** the **stock of materials** on site and:*

    - o ***Observe** what happens to your process*
    - o *Pay attention to **new areas for improvement***



Summary

- One of the **fundamental principles** of **lean construction** is

  reducing variation on construction sites.

- **Buffer variation** is to
  1. **Control** it, and then
  2. **Reduce** the level of buffers gradually to force process innovation

Variations as a source of waste– Assignment

ASSIGNMENT 1-4-1:

1. **Meet your team members online and identify variations that you see in your company or on your jobsite.**
   - ❖ **If you do not work, think of an example like pouring concrete.**
     - ✓ **It can be in an office setting, such as estimating or scheduling, or on a jobsite**
2. **Write down in one page:**
   - a) **Variations that you identified**
   - b) **Specify the causes of variations in two categories of (1) Common cause or (2) Special cause**
   - c) **Write about the solutions you recommend for each variation**
3. **Send your work (in PDF format) to ralavipour@gmail.com**

Due on the next week (next week with similar day)

اجرا و مدیریت پروژه به روش اصول ناب
(Lean Project Management)

فصل اول: مفاهیم، اصول و ابزارهای روش ناب (Lean)

بخش پنجم: چرخه بهبود مداوم (PDCA)

ارائه دهندگان:

سید محمدرضا علوی‌پور

(PhD, PMP, CMIT)

کامبیز کردانی

(M.Sc., PMP)

What we will learn?

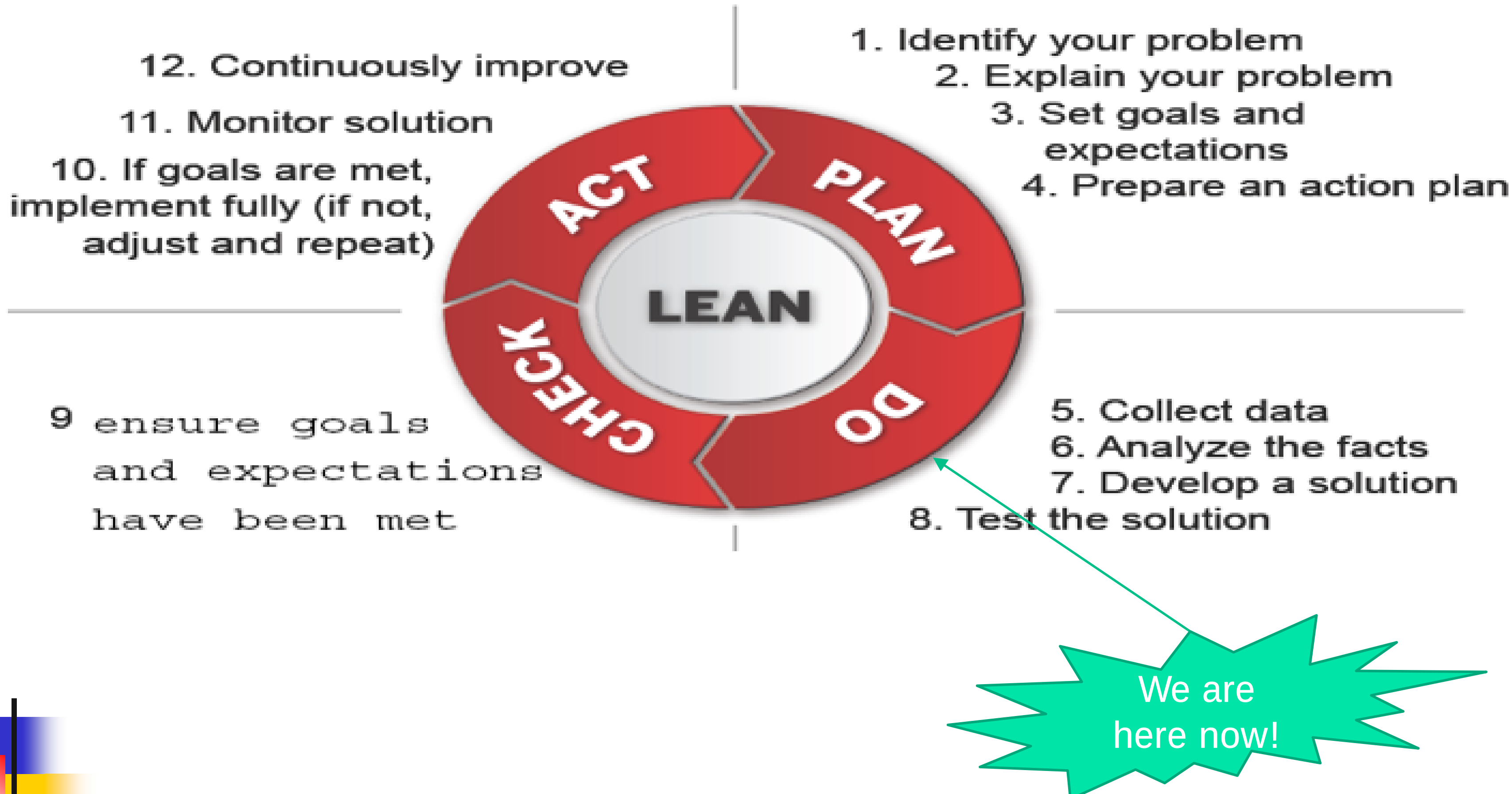
- Continuous improvement cycle
  - Concept
  - 12-Step PDCA Cycle
    - ✓ Plan
      1. Identify your problem
      2. Explain your problem
      3. Set goals and expectations
      4. Prepare an action plan
    - ✓ Do
      5. Collect data
      6. Analyze the facts
      7. Develop a solution
      8. Test the solution

ACEMI

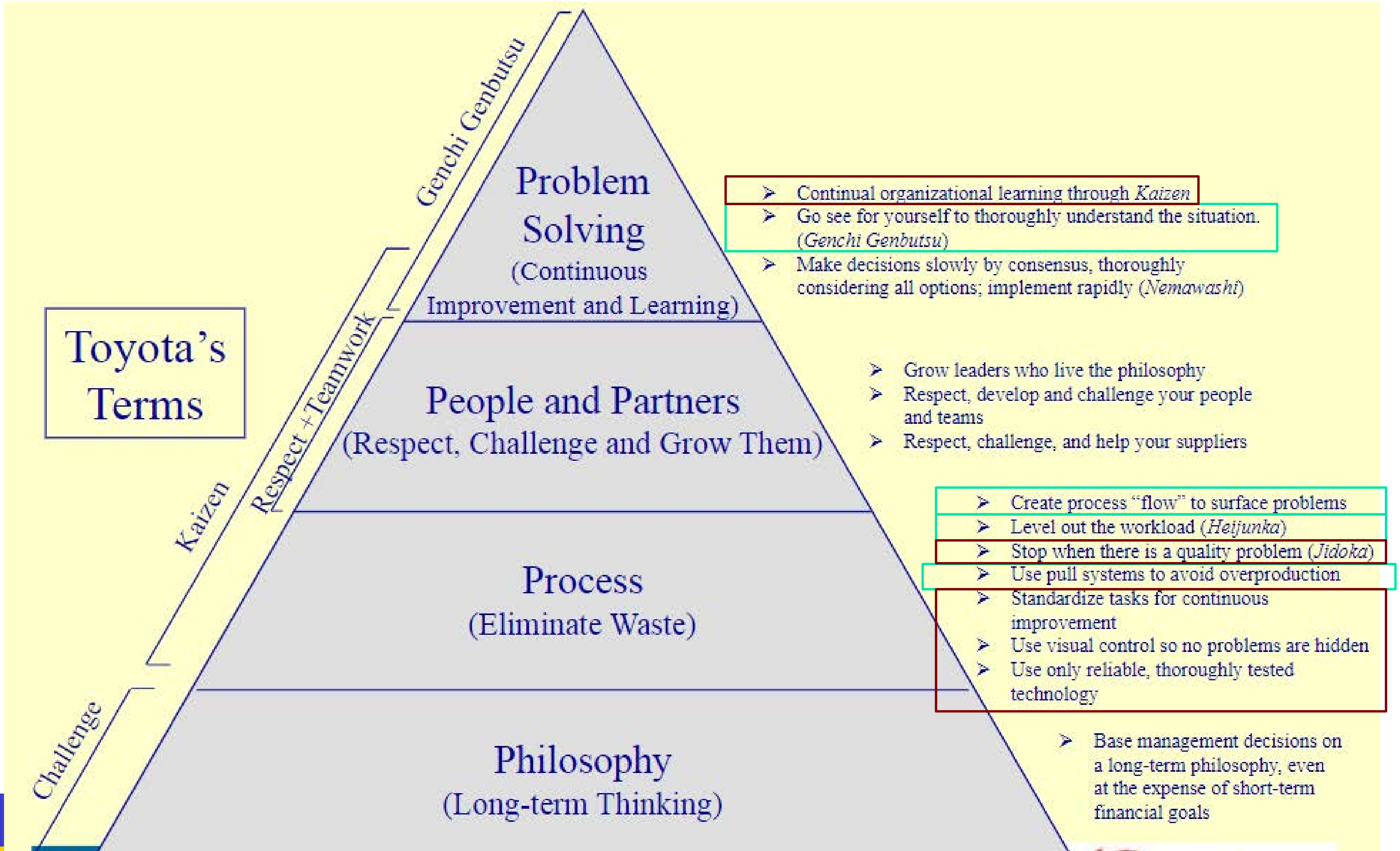
What we will learn?

- Continuous improvement cycle
  - Concept
  - 12-Step PDCA Cycle
    - ✓ Check
      9. Ensure goals and expectations have been met
    - ✓ Act
      10. Continuously improve
      11. Monitor solution
      12. If goals are met implement fully

Best practice



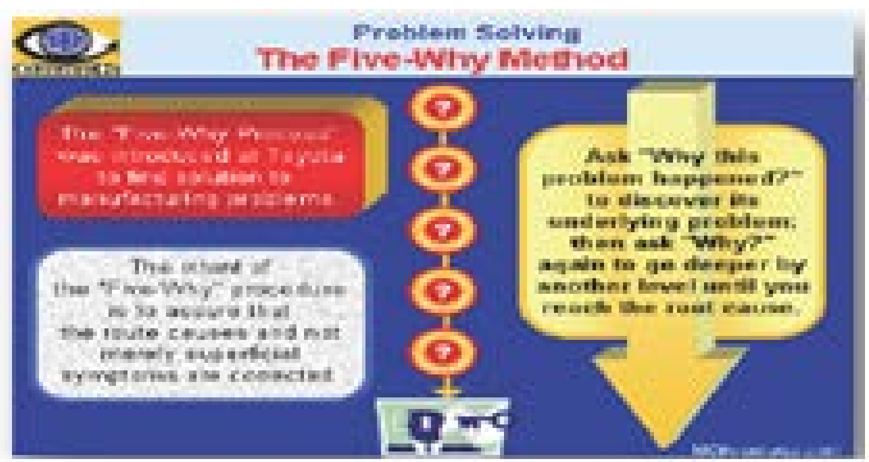
Lean – Principles (4P Model of the Toyota way)



Principle 5

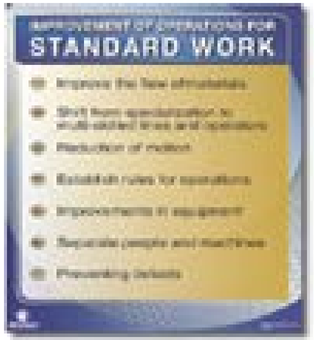
- **<u>Term:</u> Solve quality problems immediately (Stop-the-line)**
  - Finds quality for customers as a driver for value
  - Builds a culture of fixing problems

- **<u>Tool:</u> 5 Whys Process and Mistake-Proofing Devices, *Jidoka***



Principle 6

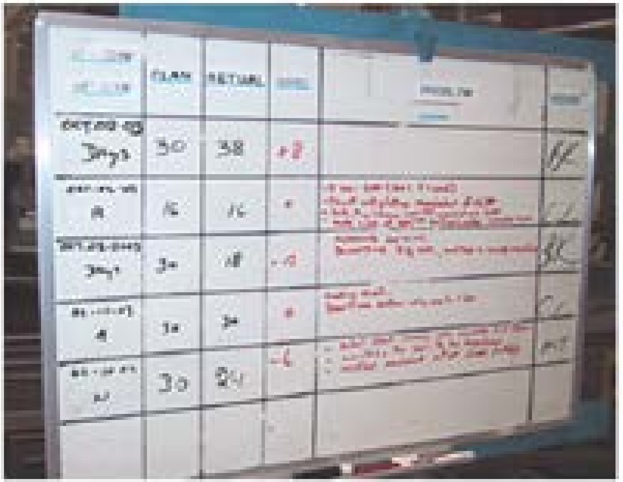
- **<u>Term:</u> Standardize work tasks and processes**
  - Uses stable, repeatable methods whenever possible to increase predictability
  - Captures the learning about a process by standardizing best practices
  - Allows creative and individual expression to improve on the standard, then incorporate it into a new standard
  - Uses checklists and procedural descriptions to show in pictures and tell in text how to complete a task
- **<u>Tool:</u> Standard Operating Procedures / Work Instructions**



Principle 7

- **Term: Implement visual control**
  - Use simple visual indicators to help people determine whether they are in standard conditions or not
  - Designs simple visuals (keep your site organized)

- **Tool: Visual Management**



Principle 8

- **Term: Use only reliable technology, processes, practices and people**
  - Uses technology to support activities (not to replace people)
  - Encourages innovation

- **Tool: Building Information Modeling (BIM)**

Principle 14

- **Term: Develop and excellent organization through continuous improvement and reflection**
  - Looks for the root cause of inefficiencies and apply countermeasures
  - Exposes failures and design a process of improvement

- **Tool: PDCA and Kaizen Events**

Continuous Improvement Cycle

(Concept)

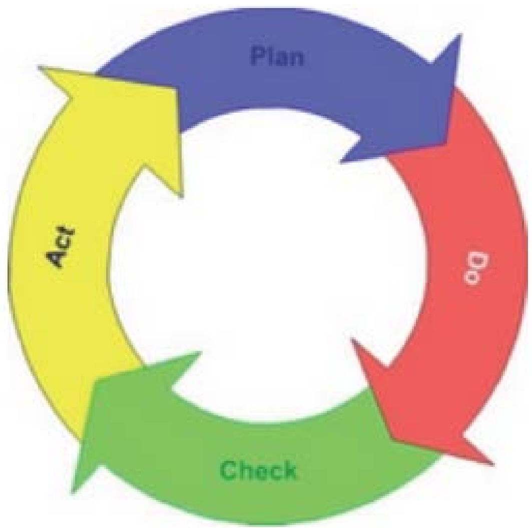
Introduction

1. 12-Step cycle of Plan-Do-Check-Act (**PDCA**)
2. Way of thinking (long-term philosophy (**next section**))

Introduction

Plan-Do-Check-Act (PDCA)

Plan Do Check Act (PDCA) is a framework that provides a methodical approach to problem solving and continuous improvement.



When should we use PDCA?

Introduction

When should we use PDCA?

- It should be used **before and after** conducting
  1. **Pull planning** adopted
  2. **Gemba Walk** performed

What PDCA consists of?

Plan-Do-Check-Act (PDCA) definition

- The **PDCA cycle** is an **improvement cycle** based on scientific method of
  1. **Proposing** a change in a process,
  2. **Implementing** the change, then
  3. **Measuring** the results and
  4. **Taking** appropriate action.
- **Continual improvement** **seeks** to
  1. **Eliminate** **waste** in all forms,
  2. **Improve** **quality** of products and services and
  3. **Responsiveness** to **customers** while reducing costs

Difference between problem solving and improvement?

Plan-Do-Check-Act (PDCA) definition

Note – problem solving is not necessarily improvement; it is maintenance. For example, if a process has quality levels of 95% and they are elevated to 99%, that represents improvement. If on the other hand quality levels fall to 50% and a team effort restores them o 95% then that would be maintenance.

Plan-Do-Check-Act (PDCA) cycle

1. **Plan:**
   i. Identify problem
   ii. Analyze the problem

Establish your goals and expectations

2. **Do:**
   i. Develop a potential solution
   ii. Test a potential solution

Run your process and test whether it works as expected

Plan-Do-Check-Act (PDCA) cycle

3. **Check/Study:**
   i. Measure how effective the test solution was
   ii. Analyze whether it could be improved in any way

Compare your expectations to your actual results

4. **Adjust/Act:**
   i. Implement the improved solution fully

Take action on what you learned; improve the process

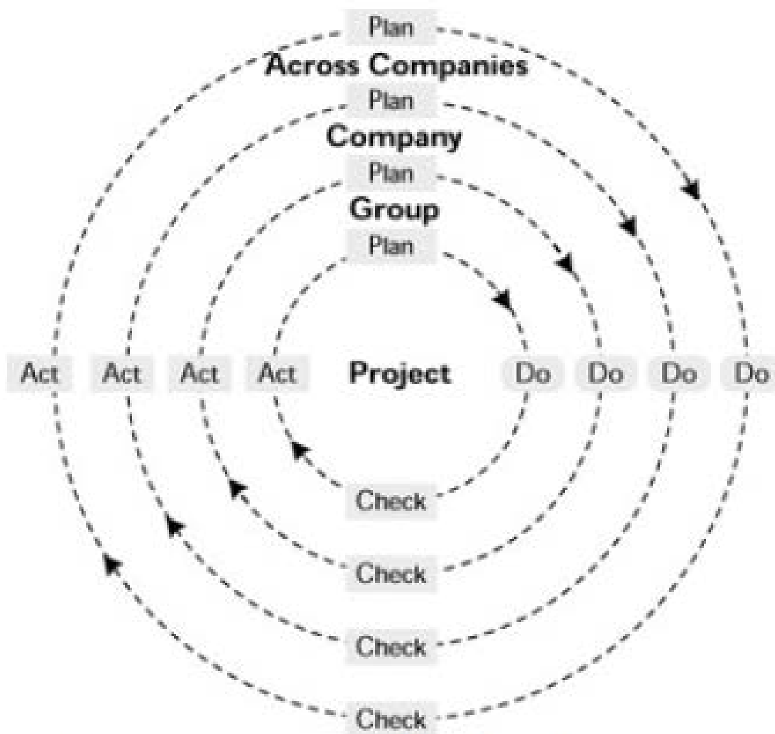
See Video #12

Plan-Do-Check-Act (PDCA) cycle – Example

- You are the electrical project manager on a job that seems chaotic
- Your foreman and workers are not meeting your estimated productivity rate
- You are currently losing money because of poor productivity

What should you do?

Plan-Do-Check-Act (PDCA) cycle at all levels of the enterprise



The Deming cycle at all levels of the enterprise

Plan-Do-Check-Act (PDCA) cycle – Example

What should you do?

Use PDCA to (1) analyze the problem, (2) develop a potential solution, (3) test the solution, and (4) implement the solution fully or adjust and try again

How?

Use 12-Step PDCA Cycle

موسسه مهندسی و مدیریت ساخت علوی پور

تهران، بلوار فردوس شرق، بعد از خیابان حسن آباد، مجتمع آبگینه، طبقه سوم اداری، واحد C42

+۹۸۲۱۴۶۱۰۰۴۵۰

+۹۸۲۱۴۶۱۰۰۴۴۵

www.dralavipour.com

info@dralavipour.com

@Acemi_social

@Alavipour_pm

youtube.com/channel/UC2vltk3T9m1X69hSWUwfp2Q

www.linkedin.com/company/iranacemi

ACEMI