Lean Principles

Training Guide

Learning to See the Waste

Learning to see value

The LeanMan

Learning to See the Waste amplifies upon the behavioral science based approach to understanding team communication, both visual and aural, and how the affect of introducing a change such as lean manufacturing into a team can sometimes cause team members to see and react negatively to the changes they don't understand.

Learning to See the Waste hopes to provide team members with the ability to understand the reasons for change and to participate in the change decisions themselves. The Toyota Production System, upon which lean principles are based, dwells upon the concept of "go and see," e.g. go to the process and see what is happening for yourself. This presentation will present two excellent tools to support this lean concept. The 10-Second Test and the 15-Minute Observation.

The objective of this presentation is to provide better understanding of the concepts of waste in a process stream, be it office or factory, and to make participants aware of the opportunities to reduce or eliminate waste from their work.

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Selective Perception and the Individual

Learning to See begins with understanding the sights and sounds within the work place, and that requires some understanding of the process of communication. Communication begins with perception, and our perception can give us a distorted vision of what is really taking place. Psychologist's say "we see what we need to see, and that is the perception which then becomes our reality." In other words, each perception and resulting interpretation of virtually any event is based on a combination of historical experiences, present needs, and the inherent properties of the scene being perceived by each single individual who looks upon the scene.

Because what we see is always a combination of what is actually occurring and what is happening within our own set of emotions at that moment, it is unlikely that any two people will ever perceive the same thing in exactly the same way. This is the basis of the *Gestalt Theory*.

"**Gestalt** is a German word meaning whole or configuration" (Simkin, 1976, p15).

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Selective Perception and the Individual

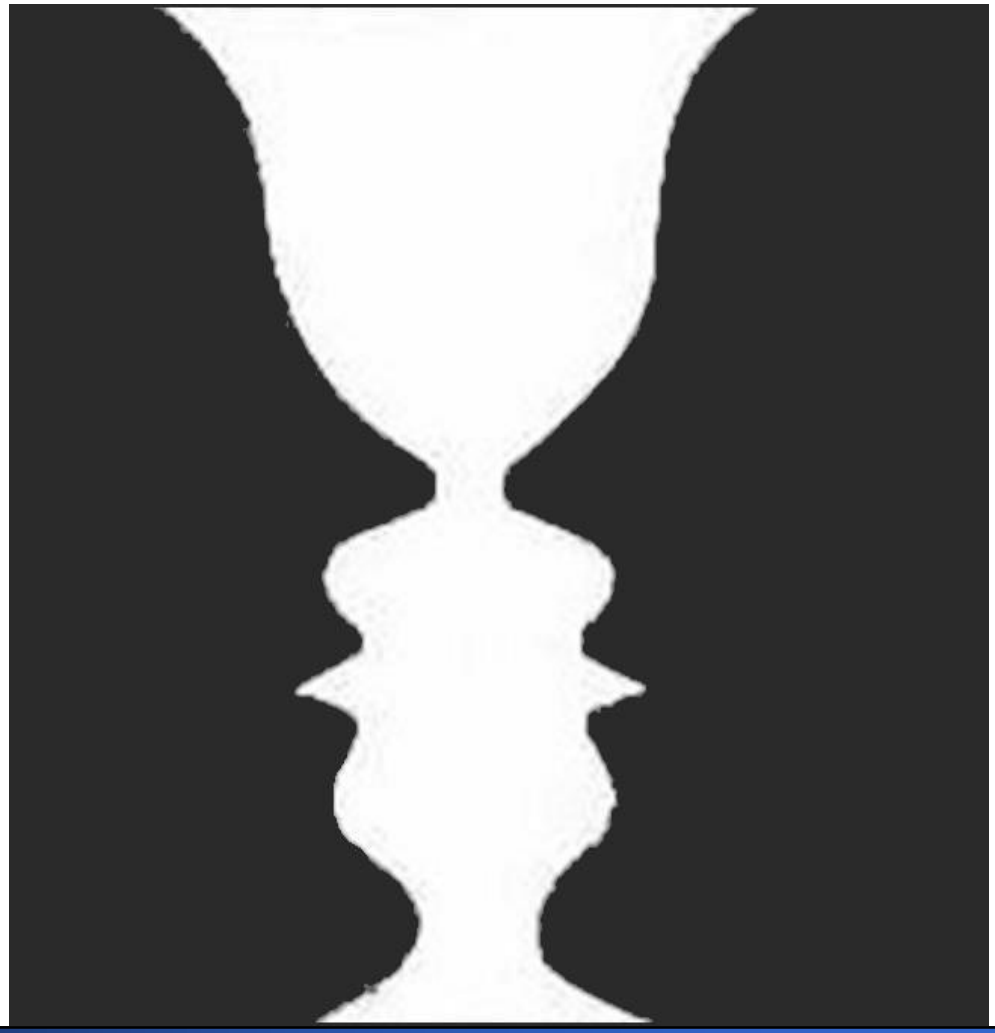
Gestalt therapy is based on the belief that the human being integrates parts and patterns into a perceptual whole. An individual's perception of the world is bounded by the subjective reality of his/her perceptions. Each person is a totality of his/her experiences. The focus is on the person's thoughts and feelings that they are having at that moment. This current experience of the individual, it is believed, is expressed by unwitting messages conveyed by the person's body position, gestures, voice, general demeanor, and content of communication.

A couple simple concepts developed by the Gestalt psychologists can help us understand what occurs when people get together in a team. We tend to create figure-ground relationships. That is, our instant perception of what is seen gets grouped, certain figures are drawn forward into positions of dominance while other figures are reduced to the background. In a team, experience levels of certain individuals will clearly become part of the foreground where their presence is highly visible, while others will for a variety of reasons remain in the background.

Selective Perception and the Individual

To see what we need to see, it is necessary to base our understanding of how we perceive our experience on the assumption that we distort; then we can proceed to build on these distortions.

Even with the most objective task, it is nearly impossible to keep our subjective views from altering our perception of what reality really exists.



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Selective Perception and the Individual

It's apparent that the process of communicating is tied to our perceptions of reality. Our distortion of reality, and the meaning that may have on how we perceive events around us, is distorted even further when we become a part of a group or a team. Once within a group, individuals express and display behaviors that are markedly different from their out-of-group behaviors.

It seems that in groups, peoples individuality becomes altered by anxiety, a feeling of uneasiness, brought on by a conscious or unconscious feeling of danger, not necessarily real, and a readiness to meet that danger.

The need to come together as a team in manufacturing is obvious. And the need to bring everyone to a common level of perception of the operation, the goals, and the needs requires everyone develop a new way of looking at how they approach their work.

Developing Lean Eyes

Manufacturing is all about processes. How effectively those process operate is a function of good teamwork, good communication and the elimination of waste. An effective process is one that is value adding - VA – something the customer is willing to pay for. Waste is the non value adding activities – NVA – that we attach to our processes, often because of our false perceptions of reality and need.

The ability to eliminate waste in production requires each team member, at all levels, to develop Lean Eyes in order to see the opportunities.

Lean Eyes means having the ability to recognize the VA and NVA activity in the shop, and since that is the basic starting point for implementing Lean Manufacturing, let's take a look at just what we mean by waste and at a couple of useful tools to help us uncover it in our processes.

Let's start with a review the definitions of lean manufacturing.

Definition of Lean Manufacturing

Leanness (as in lean mfg.) is concerned with doing everything with less. Less waste, less travel, less space, less excess inventory, less cycle time, etc.

Lean manufacturing is being very good at doing the things you can control.

Lean initiatives embrace doing everything with less, and concentrating on speed.

Lean is all about timing, and time has become the key performance driver of manufacturing strategies for high performance companies.

Lean is a systematic approach to identifying value by eliminating waste (the non value adding activities) through continuous improvement by flowing the product at the pull of the customer in pursuit of perfection.

Five principles of lean: Specify Value, Eliminate Waste, Flow the Product, Pull Demand, Pursue Perfection

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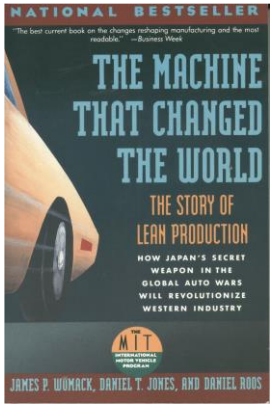
Lean Thinking



The Machine That Changed the World

MIT researchers coined the term "Lean Manufacturing" in their 1990 book to describe the Toyota Production System.

This is the manufacturing system developed by Toyota which pursues optimum streamlining throughout the entire system through elimination of waste.

Attributes of a Lean System

- Human resources at all levels focused on value-added activity
- Reliable, ready, and capable processes focused on adding value
- Constant flow of product in the value stream (one piece flow method)
- Compression of complete value stream to reduce lead time to closely match process time
- Market-paced production - build only what is sold
- Pull vs. push systems
- Pressurized, visible, transparent operations with high-performance focus
- Built-in quality
- Culture of continuous improvement

Relentless elimination of waste

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What is Waste?

WASTE (lean definition): anything other than the minimum amount of equipment, materials, parts, space, and worker's time, which are absolutely essential to add value to the product.

"If it doesn't add value - - it's waste."

Waste in Japanese is Muda

MUDA (lean definition): any human activity which absorbs resources but creates no value: mistakes which require rectification, production of items no one wants, a build up of excess inventories, processing steps which aren't needed, movement of employees to transport goods without purpose, people waiting idle in downstream processes waiting for a delivery, and goods which don't meet the needs of the customer.

Taiichi Ohno (1912 - 1990)

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8 Kinds of Waste

Overproduction

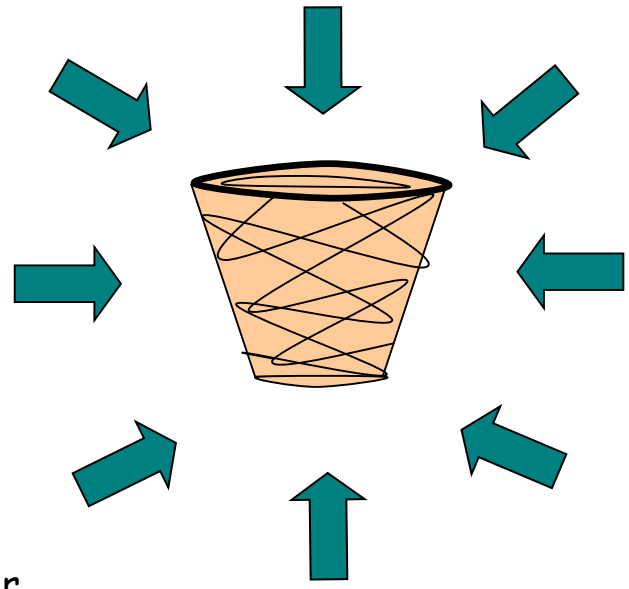
Producing too much, or producing too soon

Intellect

Any failure to fully utilize the time and talents of people

Conveyance

Any nonessential transport is waste



Motion

Any motion that does not add value

Inventory

Any more than the minimum to get the job done

Correction

Any rework or repair

Waiting

Waiting on parts, waiting for a machine to finish a cycle

Over Processing

Any unneeded or inefficient steps

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Sorting out Waste

Waste -- Overproduction

Preparing Reports Which Are Not Acted Upon

- Producing too much
- Producing too soon
- Designing but Not Making
- Multiple Copies
- Multiple Data Storage
- Excess Inventories
- Excess Work in Process

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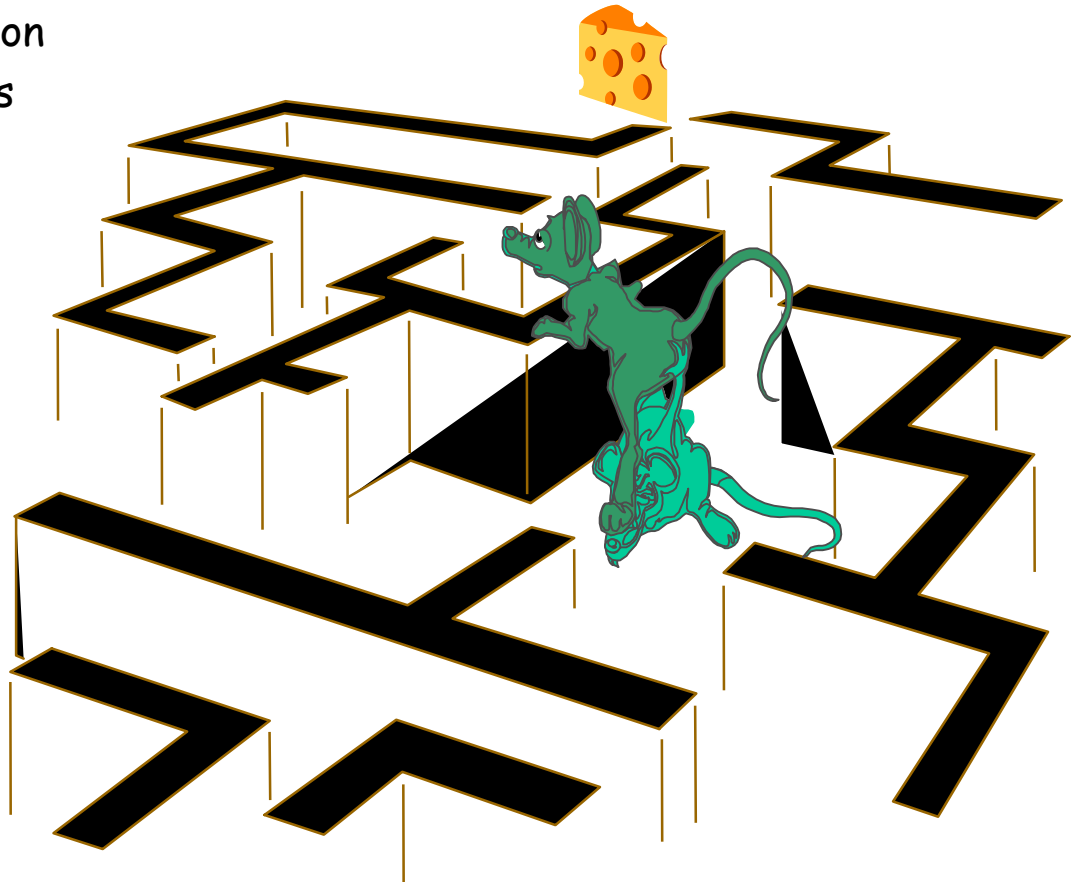
Sorting out Waste

Waste -- Conveyance

- Nonessential Transportation
- Extra Steps in the Process
- Distances Traveled
  - Worker
  - Product
- Hand Off of Data
- Paper Copies
- Products Lost or Damaged



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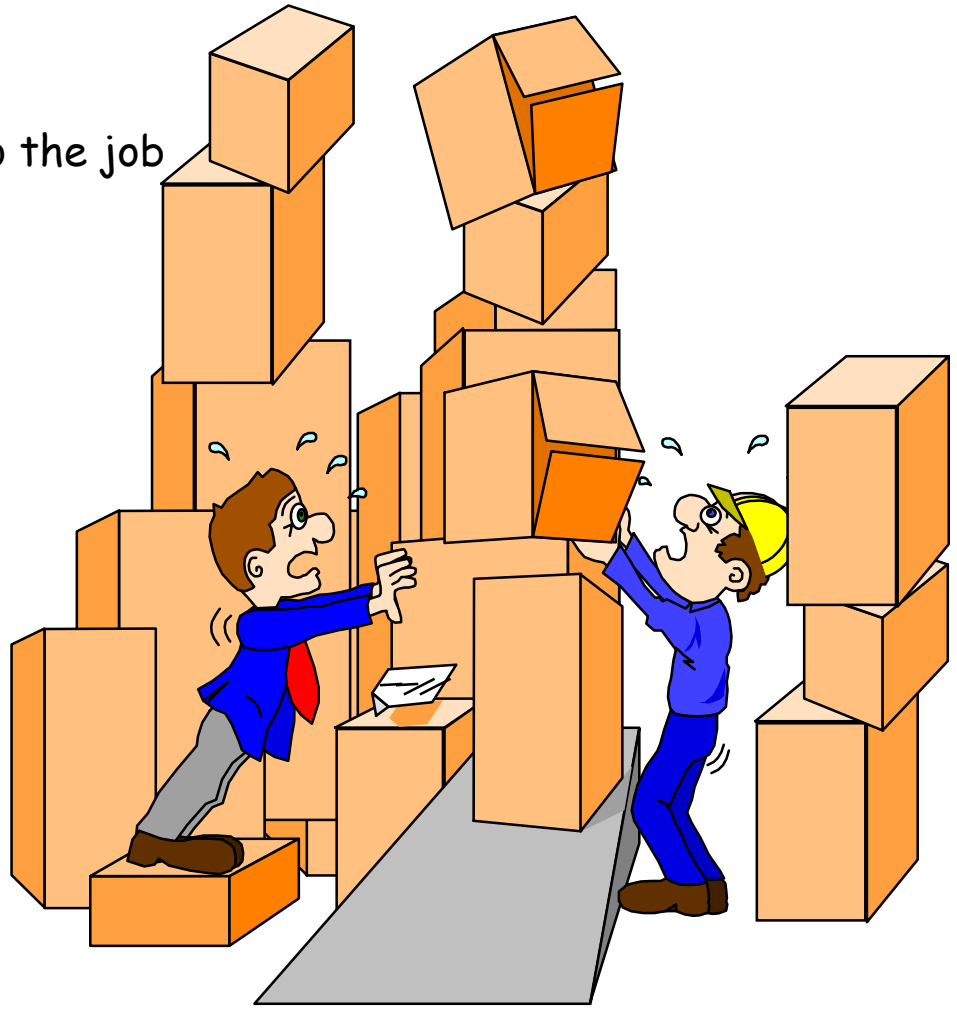
Sorting out Waste

Waste -- Inventory

- Any more than the minimum to do the job
- Design Data
- Transaction Not Processed
- Hold Box
- Stacks of Stuff
- Money Tied up
- Storage Costs
  - Handling
  - Auditing
  - Finding



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Sorting out Waste

Waste -- Waiting

- For Other
  - Elements
  - Functions
  - Disciplines
- For Enough to Build
- Watching Machines
- For Parts to Arrive
- For Computer Time

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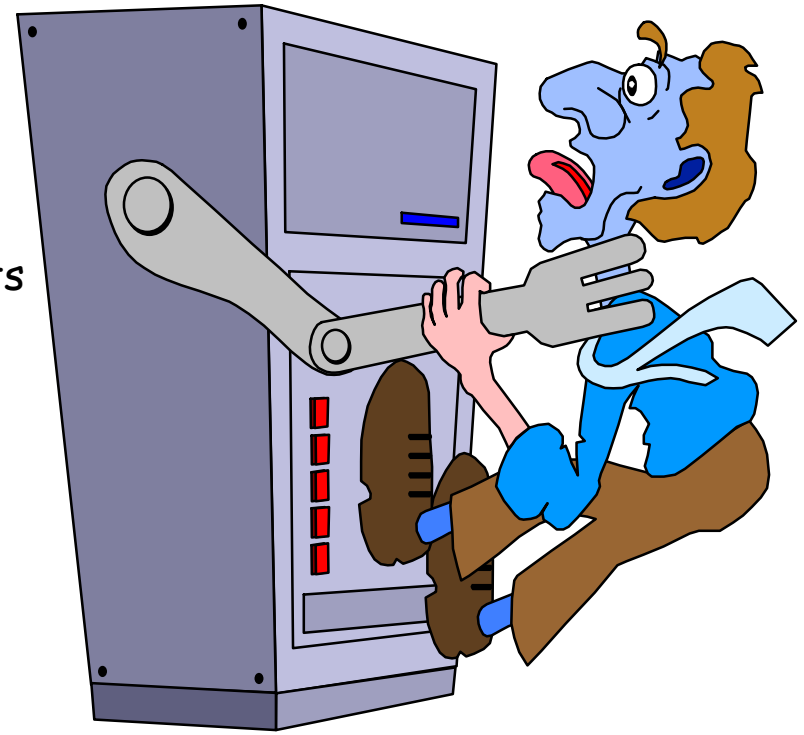
Sorting out Waste

Waste -- Over Processing

- Redesign
- Not Organized
- Not Fully Utilized
- Signoffs
- Reports Etc. Which Are Not Read / Used
- Unneeded or Inefficient Steps
- Delivering More Than the Customer Wants



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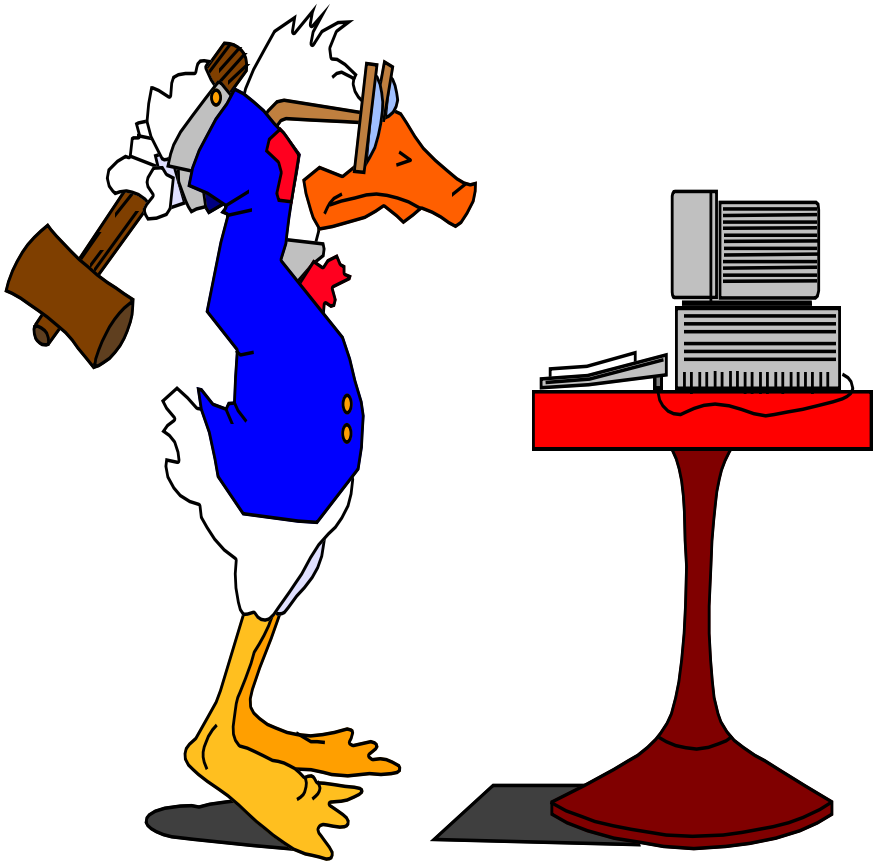
Sorting out Waste

Waste -- Correction

- Defects
- Incorrect Data Entry
- Drawing Errors
- Miscommunication
- Rework
- Repair
- Inspections
- Warranty Costs
- Customer Dissatisfaction



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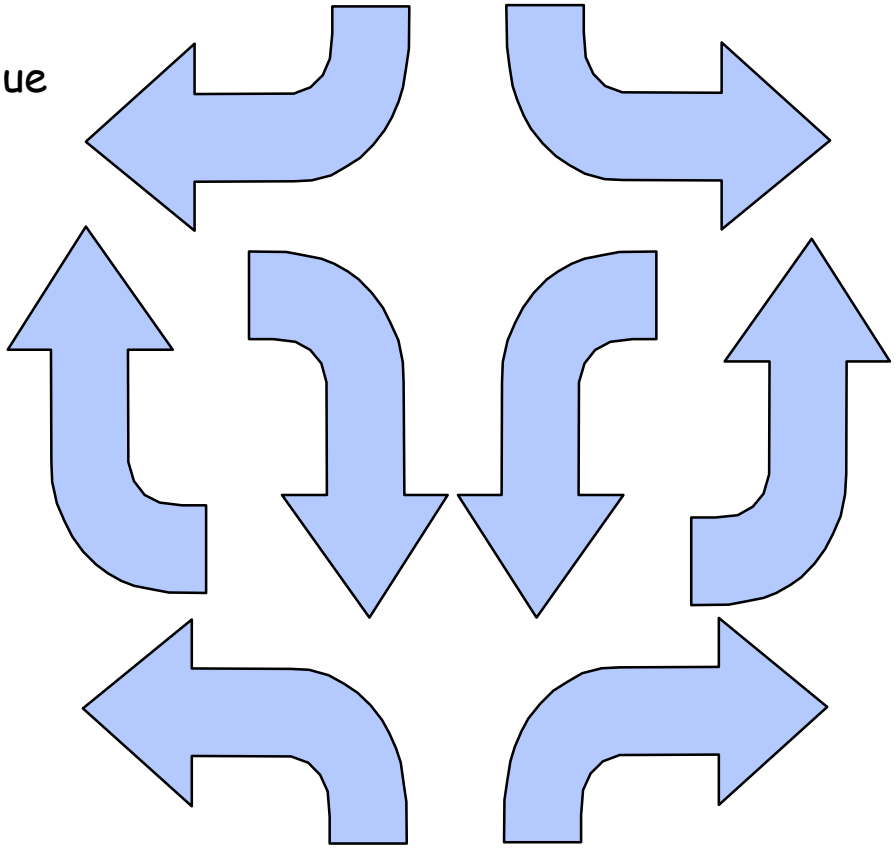
Sorting out Waste

Waste -- Motion

- Any motion that does not add value
- Unnecessary Analysis
- Unneeded
  - Testing
  - Steps
  - Data Entry
- Looking for
  - Tools
  - Plans
- Stacking
- Unstacking



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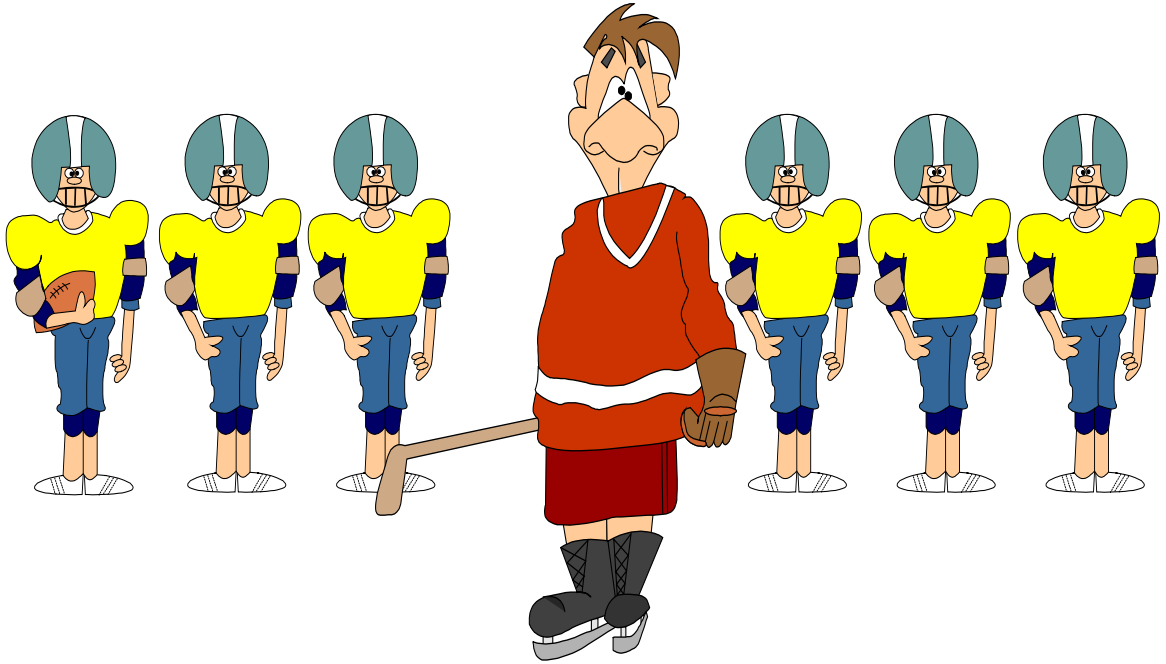
Sorting out Waste

Waste -- Intellect

- Failure to fully utilize time or talent of people
- Underdeveloped Talent
- Poor Quality
- Unplanned Absence
- Turnover
- Independent Actions
- Under Utilization
- Focus on Status Quo
- Ambiguous Standards
- Unresolved Problems
- Accidents



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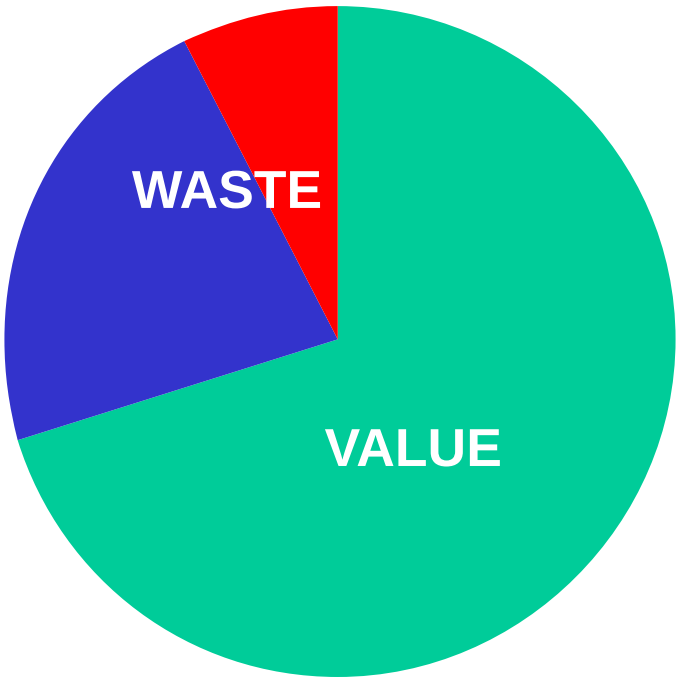
Waste - Where is it?



WASTE: waiting for materials, watching machines run, producing defects, looking for tools, fixing broken fixtures or cables, producing unnecessary items, etc…

WASTE: transportation, storage, redundant inspection and rework, etc…

WASTE: unnecessary movement of anything, set up activities, searching for documents, etc…

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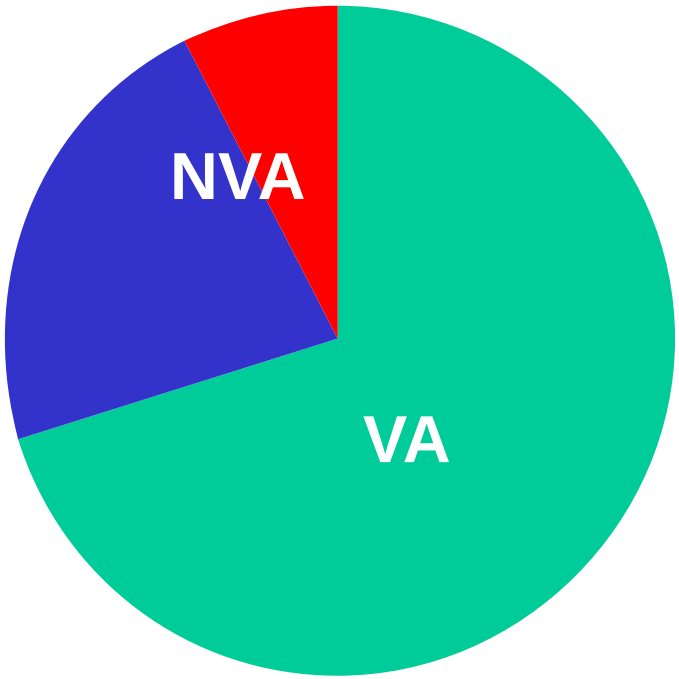
Waste - Non-Value Adding



The goal is to do only **Value Adding** activities that actually go directly into producing the product

The opportunity is to eliminate the **Non Value Adding** activities that are associated with producing the product.

The NVA time can be broken into two parts: About 75% is **INCIDENTAL** time that is non-value adding but necessary, and 25% is **PURE WASTE** and therefore presents an opportunity for elimination.

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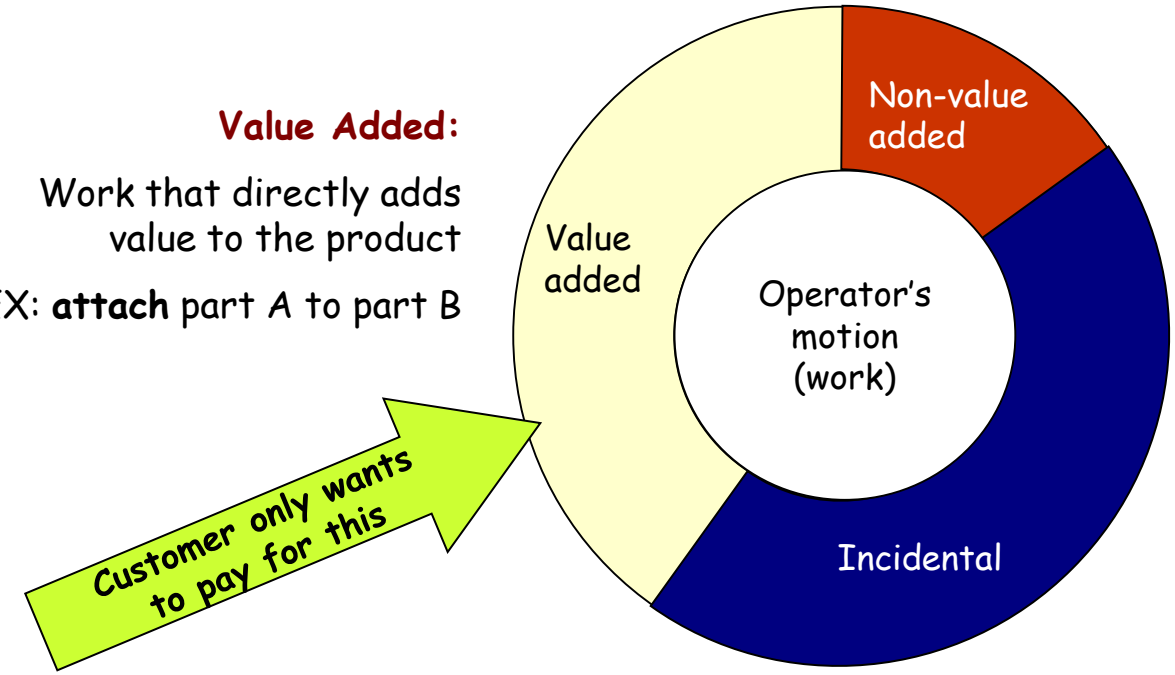
VA / NVA -- Managing Productivity

Value Added:

Work that directly adds value to the product

EX: **attach** part A to part B



Non Value Added:

Work that does **not** add value to the product

EX: **walking** to get Part A that could have been located at point of use

About 25% of all NVA is pure Muda!

Incidental NVA:

Work that **does not add value** but must be done to accomplish value added work

EX: **picking up** Part A to be installed

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Waste – you will find it everywhere a process exists

Manufacturing

- Machine a Part
- Assemble Parts
- Package
- Heat Treat
- Identify Parts
- Move Part to Next Unit
- Walk to Tool Crib
- Deliver Paperwork
- Walk to Parts Crib
- Inspect the Part /Assembly
- Check Paperwork
- Verify Stamps
- Check Tooling

Business Process

- Fill Out a Form
- Post to a Record
- Look up a Customer
- Make Entry in File
- Sort Orders
- Take to a Person's In- Basket
- Walk to Copier
- Deliver a Package
- Walk to File Cabinet
- Check Form for Completeness
- Verify Figures on Report
- Check Design Drawing
- Proofread Memos

All of these are opportunities for observation and improvement. The tools presented in Learning to See the Waste aren't just for the manufacturing shop, they also apply to the office or anywhere else a process exists.

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Lean Thinking

Lean Thinking (lean definition): provides a way to specify value, line up value-creating actions in the best sequence, conduct these activities without interruption whenever someone requests them, and performs them more and more effectively.

"In short, lean thinking is lean because it provides a way to do more and more with less and less waste."

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Specifying Value – Sorting out Waste

The critical starting point for lean thinking is value. Value can only be defined by the ultimate customer. **Value** is only meaningful when expressed in terms of **a specific product** which meets the customer's **specific needs** at a **specific price** at a **specific time**. That's the only value that the customer is willing to pay for. All the other NVA activities performed in the shop to produce the product are waste.

We must all develop the ability to recognize and identify Waste;

to Have the Courage to Call It Waste;

to Have the Desire to Eliminate It;

to Eliminate Waste;

to Understand

That Waste Simply Raises Cost,

Produces No Corresponding Benefit, and

Threatens All Of Our Jobs

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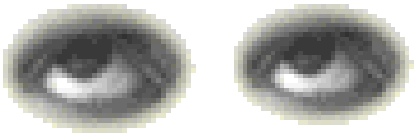
Waste Identification



I..Seeing Waste

1. 8 types of Waste
   Do a Waste walk
2. Movement
   Draw a Spaghetti chart
3. Material Flow
   Draw the Value Stream Map
4. Information Flow
   Post some Visual Systems

II..Measuring Waste

5. High Level Opportunity
   Do the 10 Second Test
6. Position Opportunity
   Do the 15 Minute Observation
7. Operator / Materials
   Do a Process Study
8. Data Organization
   Draw out a 2 x 2 Matrix
9. ROI Analysis
   Fill out the ROI Sheets

III..Capturing Waste

10. Setting the Time Line & Responsibility
    Milestone Chart
    Milestone Tracking
11. Capturing & Sustaining Improvement
    Shop operator involvement
    A3 Development
    Actual vs. Expected
    Standardization Forms

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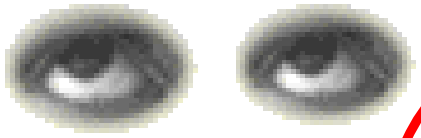
Waste Identification



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10 Second Test - How to

Pick a group of workers in a small section of the shop or office area, and count how many.

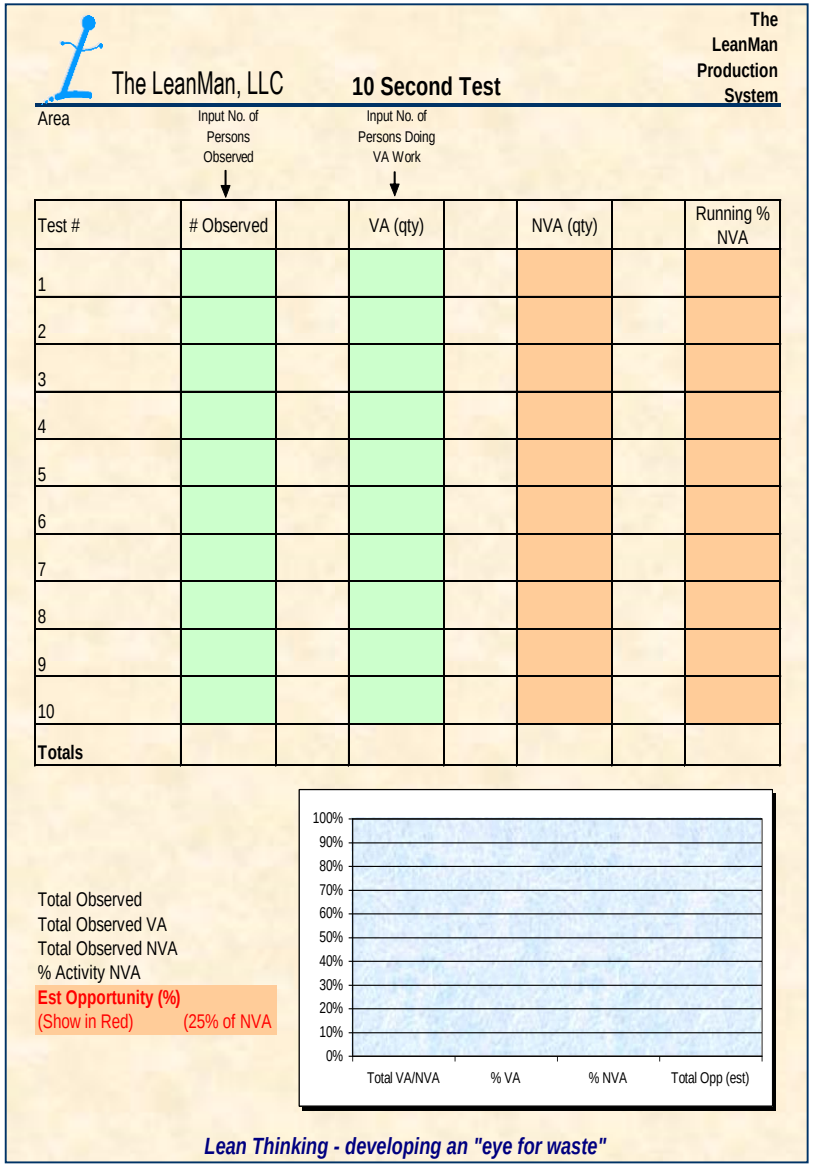
Do NOT disturb the workers, you need true data and asking them what they are doing will defeat the test.

Look at the group for 10 seconds.

Each person is either working the process or not (doing something the customer would pay for). Anyone working on the process is considered to be doing Value Added (VA) work and is added to the VA quantity.

Record the total number observed, and the number doing VA activity.

Sum totals on form provided.



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The 10-Second Test

The results, when graphed, show the total activity, the portion that is Value Added, and the total portion that is Non-value Added.

Of the Non-value Added time, the empirical formula for incidental versus pure waste is 75% to 25%. In the example shown, the pure waste is approximately 8% of the observed time, which is the opportunity for improvement through Kaizen or Continuous Improvement events.

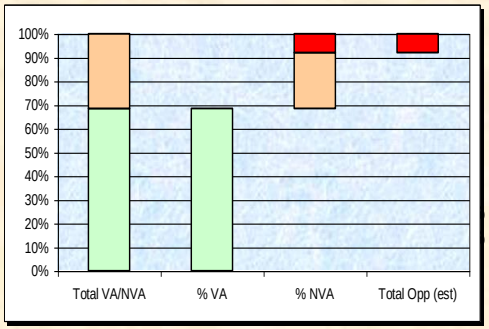
The LeanMan, LLC — **10 Second Test** — The LeanMan Production System

Area

Input No. of Persons Observed ↓ Input No. of Persons Doing VA Work ↓

Test #	# Observed		VA (qty)		NVA (qty)		Running % NVA
1	4		4		0		0%
2	3		2		1		33%
3	4		4		0		0%
4	3		3		0		0%
5	4		3		1		25%
6	2		0		2		100%
7	4		2		2		50%
8	4		1		3		75%
9	4		3		1		25%
10	3		2		1		33%
Totals	**35**		**24**		**11**		**31%**

Total Observed	35
Total Observed VA	24
Total Observed NVA	11
% Activity NVA	31%
Est Opportunity (%) (Shown in Red)	**8%**



Lean Thinking - developing an "eye for waste"

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10 Second Test - Benefits

Discussion Points

- What was observed about the process?
- Common themes observed?

Applications

- This test is only to get a quick top level idea of opportunity that may exist in the process. However, it lacks specificity and cannot by itself direct change.

Summarize key points (based on observations)

- Identifies a few limited forms of obvious waste
- Lumps incidental and pure waste into NVA
- Great for large areas to highlight specific areas of interest to zoom in on.

To get specific detail on a small areas, use the 15 Minute Observation

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The 15 Minute Observation

A 15-Minute Observation Team is formed to collect specific detail.

The team usually consists of

a shop operator familiar with shop transactions,

a salaried materials support person familiar with material movement and transactions, and

a process engineer familiar with the process.

The observation team and the work cell team are brought together and given a review of the 10-second test method and results, the ideas behind learning to see waste, and instructions on how the 15-minute observation works.

Using the 15-Minute Observation Form, record a brief description of the process being observed, just enough detail support later discussion. Indicate the process and queue (wait) times and distance traveled. Indicate how much time is value adding, and how much time is required (incidental) and pure waste.

The 15 Minute Observation - How To

The work cell is instructed to perform as trained, and not to be interrupted by the observers. They are asked to handle the daily situations, make the usual decisions, and do whatever they normally do as they perform their work.

The observers are to pull up stools and sit and watch the work cell function over a period of time, taking particular note of any non-value adding activities. They are asked not to disturb the work cell with questions, but simply make notes of any questionable activity for later discussion.

After the observation period, the observation team and work cell members are to discuss the observations, clarify activities, and look for opportunities for improvement.

15-Minute Observation Sheet

Step No	Process Description	Process Time	Queue Time	Distance Traveled	Value Added	Required Waste	Pure Waste

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Shop Floor Courtesy[1] – *just a word or two before we go to the shop…*

Carefully observing a process means that you will be spending time at the process you are trying to improve. You will be a guest in the "office" of the people who work there. Please use the same courtesy you would when entering anyone's office:

Introduce yourself
Explain what you are doing
Don't take notes in front of production associates without showing them what you have written
Say "thank you"

It may be best to do this through the team leader or supervisor so you don't interrupt the operators and affect their safety, quality, and productivity. Always keep in mind that you are not watching people or evaluating their performance. You are watching the process or how the product is made. You are figuring out what are the steps and then the times required to make the product.

Although we say these things when we gather observations on the shop floor, we know it takes time for this sort of thinking to sink into the culture of a company. When people are observed while they are working it is a natural reaction to think they are being critiqued. And sometimes we tend to blame people for problems rather than working to understand the details of a process.

Always remember that the question is not, "How is that person doing?", but rather, "What is the work?" This is the objective question that people should focus on – out on the shop floor – in a non-judgmental way.

[1] From the book Creating Continuous Flow by Mike Rother and Rick Harris. The Lean Institute, Brookline, MA June 2001

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Process Flow

Historical implementation of functional departments in almost any organization was based on a theory that said optimizing each point process in the work flow for its own best interest would also be best for the company, but we now know that this method came at a cost of excess waste. The coordination between these business functions became dependent upon a mutually agreed upon exchange.

Usually, this exchange required some excess of *time*, *space*, and *material* in a "buffer zone" between the two functions.

> Example, if the stock room performs cycle count in the first two hours of the day, and picks kits after cycle count is finished, then their first kit of the day is not available until some time around mid day. If the assembly operation starts at 6:00 am, then it needs to optimize by having some kits picked a day or two in advance and available in a queue.

As the number of functions in the transformation process increase, the excess of time, space and material is amplified at each exchange if the resources at each point process are to be kept continuously optimized.

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Why do Lean Manufacturing?

The concept that this "optimize for the point process" approach missed was that while improving the process steps at each individual point, it was creating havoc on the overall door-to-door process flow.

The assumption that the whole of the operation would, by default, somehow become optimized was wrong !

Large work order kits cause huge amounts of material to stack up in queue areas waiting for someone to touch it, and take up large sections of floor space with holding racks.

Populating all boards in parallel cause the subsequent workers in the process sequence to have to wait, which lengthens cycle time, causing long delays before delivery.

Keeping large batches of material together causes excess inventory at each stage in the process, which consumes vast amounts of working capital ($$$) tied up in material sitting in the shop.

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Using Lean Eyes

Lean manufacturing looks at the production process with a different set of eyes from those relevant at the turn of the last century.

Lean looks at the door-to-door transformation process as a *Value Stream* and attempts to optimize for the good of the whole, rather than the good of the individual.

Picking kits from a point of use area gives maximum control of the timing of the process to the team.

Building in one piece flow feeds work to all members of the team, not just one person.

One piece can move at a higher velocity to FGI, satisfying the customer's need for product faster.

Faster flow enables the shop to build only what is sold, holding WIP Inventory and finished goods at a minimum.

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Using Lean Eyes

If Lean is so much better then the old batch process methods, then why does it feel wrong? Why do the Lean methods seem to be in conflict with all of the logic and training we have used all of our life? Let's test our knowledge:

Is expert knowledge always available for our use once we acquire it?

Try listing the seven days of the week, starting with Sunday and time how long it takes. A few seconds, right? That's because you were asked to retrieve and use the knowledge in a way that is familiar and therefore one that makes "sense to you".

Now name them again, alphabetically. Hard to do?

Even though a few seconds before the person was an expert on the seven days, probably has used the seven days all his/her life, now the knowledge is apparently useless. The knowledge is being used in a totally foreign way and even if the person can eventually come out with the proper sequence it will take a long time.

Using Lean Eyes

This is why it's so hard to teach lean principles to an already "expert team," and why perhaps it's often easier to take inexperienced people and set up a lean flow.

The knowledge isn't different, just how you are asked to use it. When lean principles are first introduced to your team, your long time knowledge seems to somehow conflict with this new use – and it can feel wrong until you are able to adjust and make it part of your new reality. Perceptions and fears are unique to the individual.

For example, lets discuss a long term employee working in a machine shop. In the process flows of the last century modeled after Frederic W Taylor, all cutoff saws are located together, all mills are together, all lathes, all drill presses etc. A worker in this department probably has worked up a job ladder from utility operator to machinist and has, say, become expert on the mill operations, and knows that optimum efficiency is obtained when the mill is running a large batch process.

Using Lean Eyes

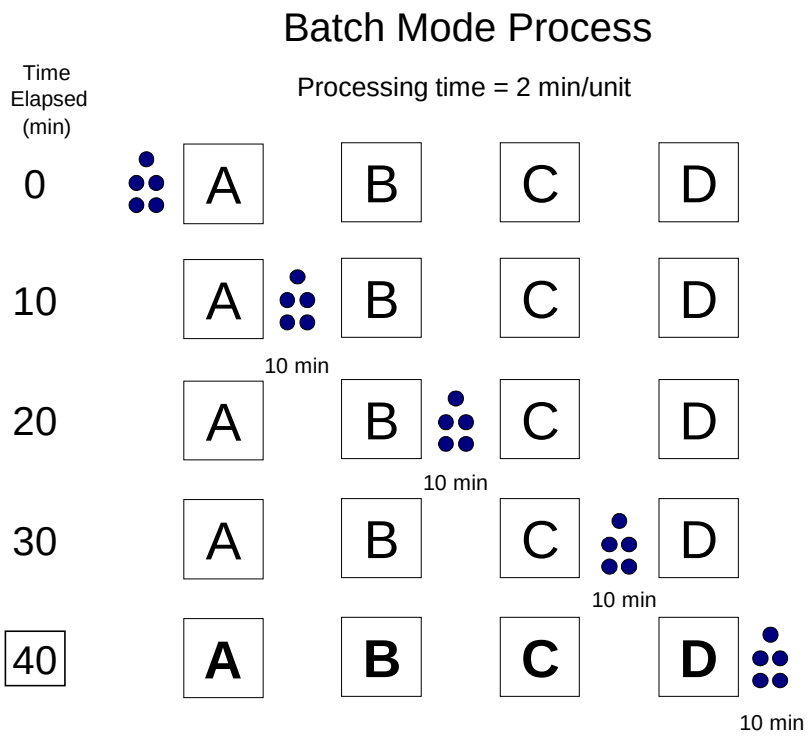
Now we want to implement lean manufacturing. We bring the machine shop operators into a room and begin talking about lean methods. We want to rearrange the shop and place a saw, a mill, a drill press and a debur station all in a row and have a single operator run all four stations in a 1 piece flow.

The operator says no. That is absolutely nonsense. Every bit of experience says this is wrong and should be resisted. Why? It is because of the way this persons experience and knowledge about the process has been stored in long term memory. All of the recall mechanisms about mill processes are coming back into working memory (conscience thought) and are being battered against the incoming nonsense being seen and heard.

The machine shop apprentice training, job ladders, and classifications of work elements taught over the last century are all in conflict with the flexible worker concepts of lean.

Batch 'n Queue Mfg. 1911 - 1990

Taylor's Manufacturing Flow



The typical Batch Mode process flow. Each point in the process is optimized for its own efficiency.

Note the idle time of each functional area waiting for material to arrive, and also note the amount of material at each function "untouched" while each piece is individually processed.

1st Piece moves to next process in 10 minutes, last operation complete in 40 minutes

A, B, C and D are different operations in the process flow

From Kiyoshi Suzaki – The New Manufacturing Challenge

The LeanMan

Batch 'n Queue Mfg. 1911 - 1990

The graphic depicts a Batch 'n Queue flow process using Taylor's optimized flow, based on the division of labor.

There are four functional areas in example. Stockroom, Assembly #1, Assembly #2, and Final Inspection. Each function is unique, and therefore each operates according to their own One Best Way.

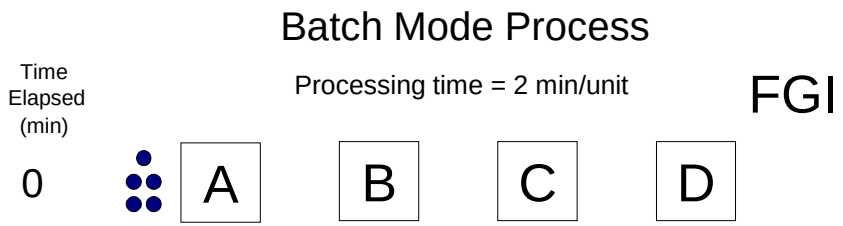
The order size required is five pieces. The material moves as a batch of five through each functional area until the entire job is delivered. Note how only one area is busy at any one time, and note that within an area, only one piece of the five is actually touched at any one time. The remaining material waits in queue to be processed.

With a two minute process time per piece at each function, the full delivery to the "customer" is in 40 minutes.

The LeanMan

Batch ‘n Queue Mfg. 1911 - 1990

Taylor’s Manufacturing Flow



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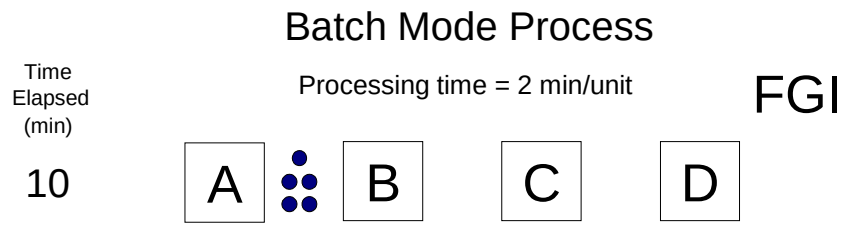

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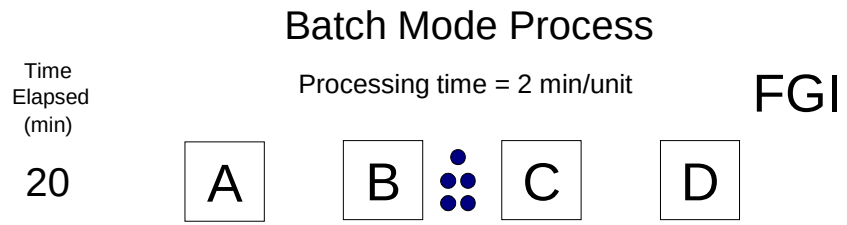

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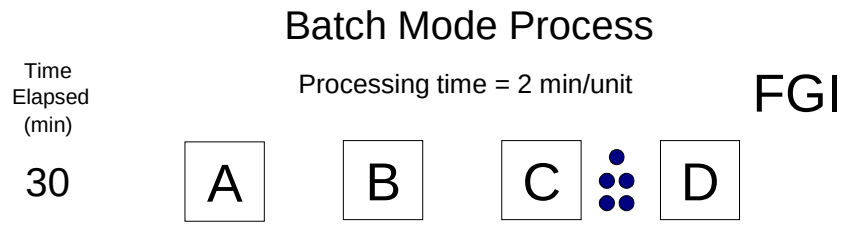

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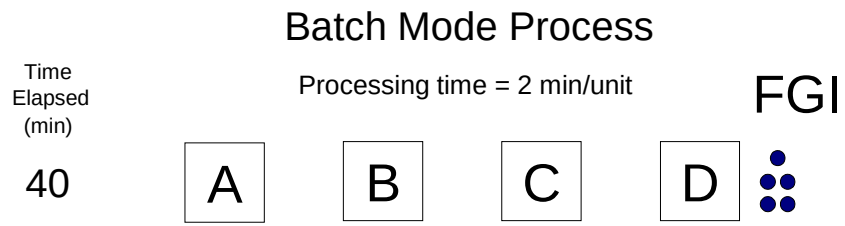


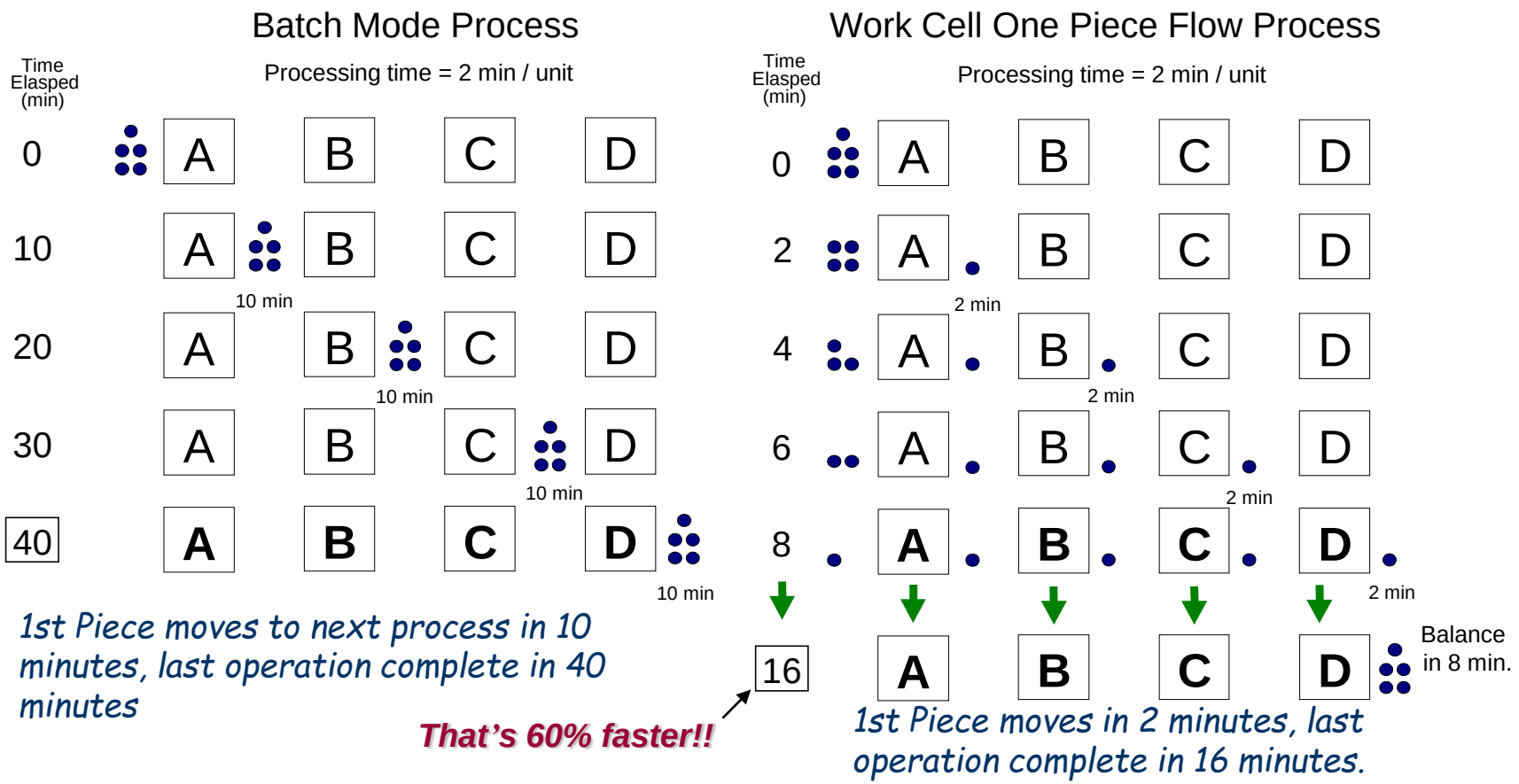
A, B, C and D are different operations in the process flow

From Kiyoshi Suzaki – The New Manufacturing Challenge

The LeanMan

Continuous Flow Mfg. circa 1995

Transitioning from Batch to Continuous Flow



A, B, C and D are different operations in the process flow

From Kiyoshi Suzaki – The New Manufacturing Challenge

The LeanMan

Continuous Flow Mfg. 1911 - 1990

The graphic depicts the transformation of the Batch 'n Queue flow to a one-piece flow through each function in a work cell. There are four functional areas in this example. Stockroom, Assembly #1, Assembly #2, and Final Inspection. Each function is unique and operates according to their own One Best Way.

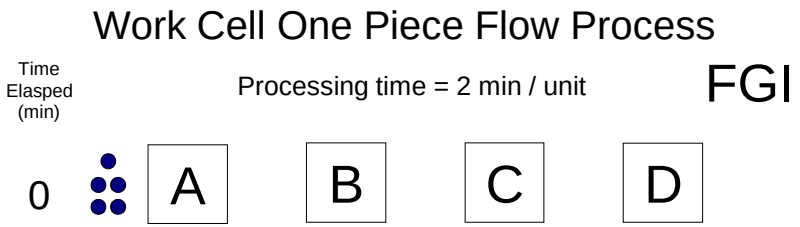
The order size required is five pieces. This time the material moves as a single piece through each functional area until the entire job is delivered. Note how this time each succeeding area becomes busy more quickly as the "pipe-line" fills, and that within any area only one piece is touched at any one time. The remaining material flows continuously until all is processed.

With a two minute process time per piece at each function, the full delivery to the "customer" is in 16 minutes, ***that's 60% faster!!.***

The LeanMan

Continuous Flow Mfg. circa 1995

Continuous Flow in a Work Cell



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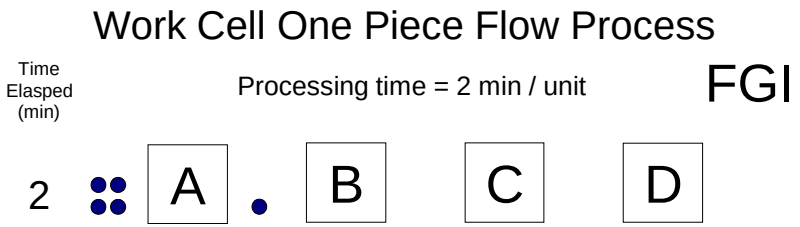

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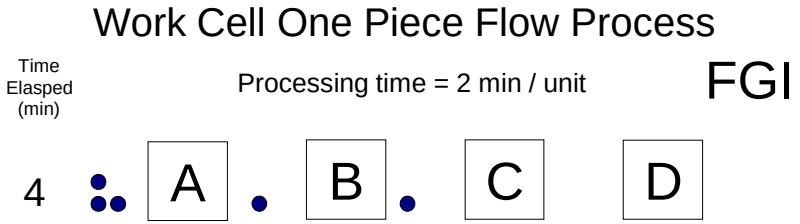

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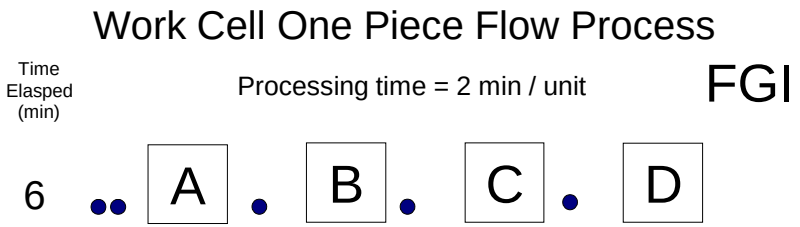

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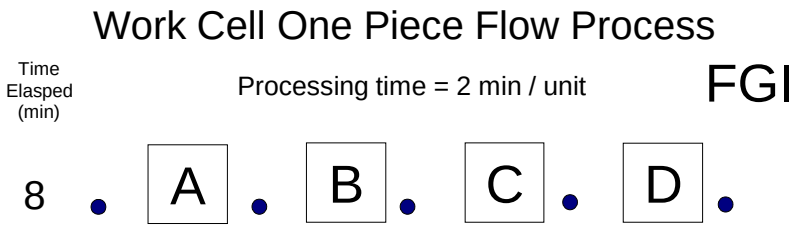

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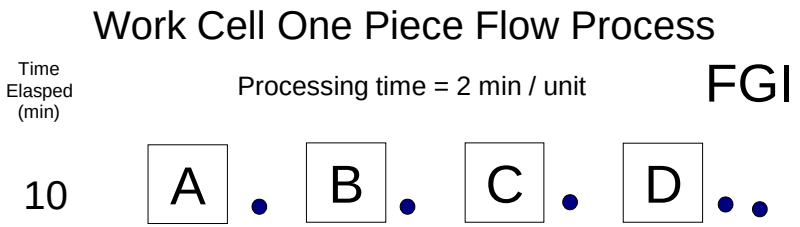

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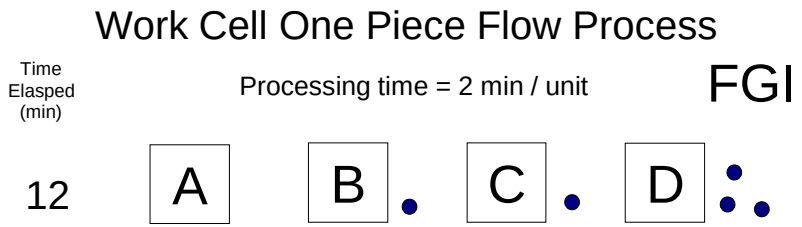

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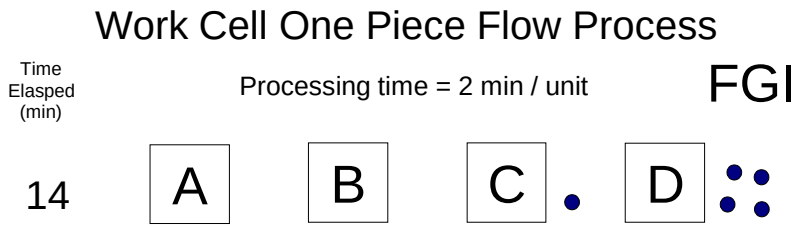

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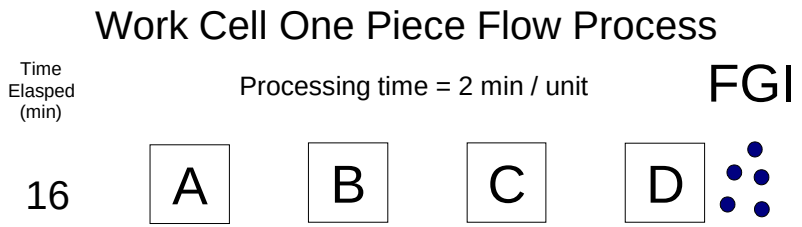

A, B, C and D are different operations in the process flow

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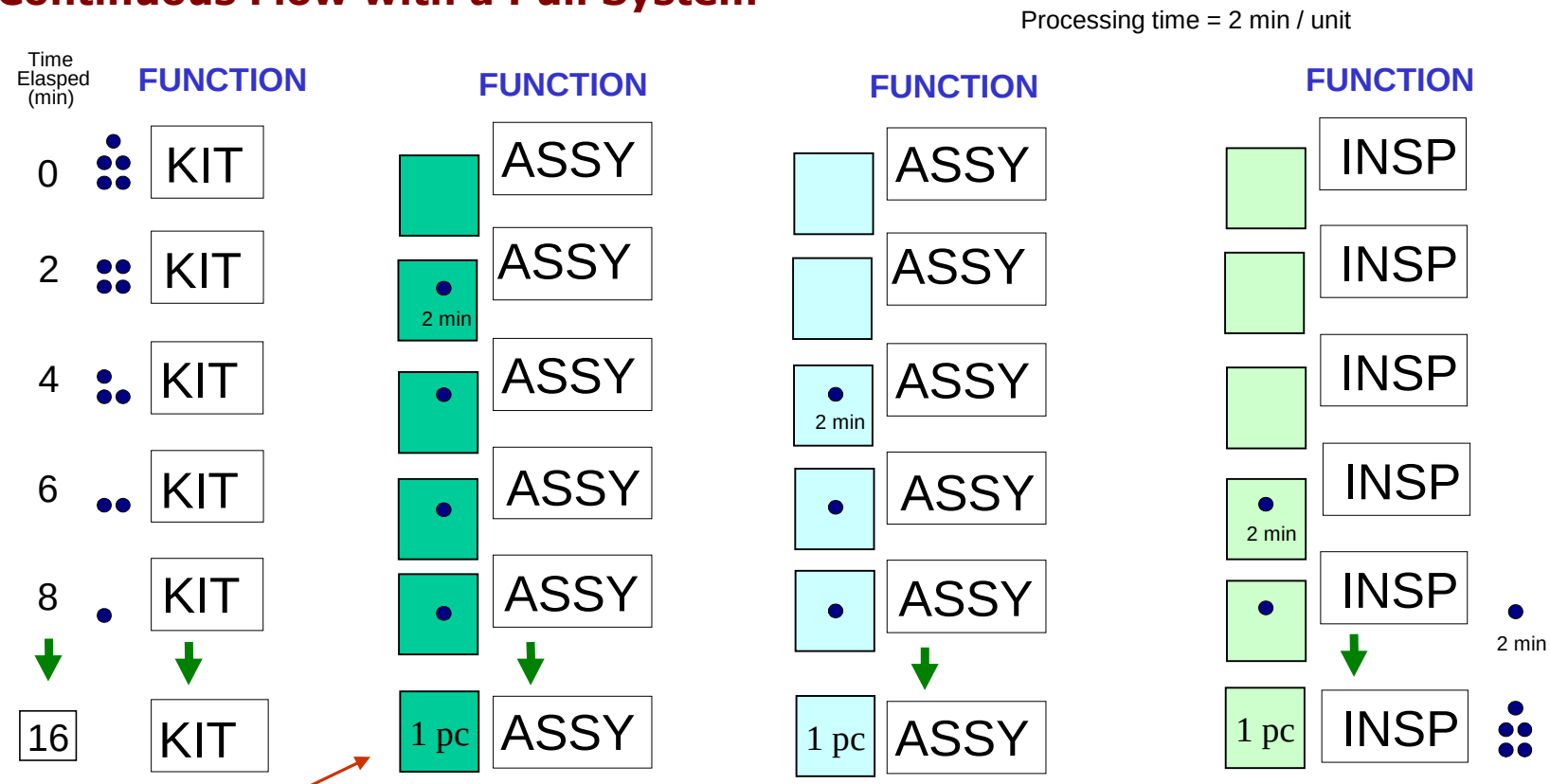
Continuous Flow Mfg. circa 1999

Continuous Flow with a Pull System



A pull system can be implemented by setting a Kanban Square in front of each process step that states the maximum number of items allowed in Queue

The LeanMan

Continuous Flow Mfg. circa 1999

The graphic contrasts the simple one-piece flow with a work cell using one-piece flow and a coordinating pull system. There are four functional areas in this example. Stockroom, Assembly #1, Assembly #2, and Final Inspection.

The order size required is five pieces. This time the material moves as a single piece through each functional step, but only when the next process needs it. Each process step has a Kanban Square at it's output, with instruction on how many items it should hold. As before, each succeeding area becomes busy one stage at a time as each process seeks to fill it's output Kanban.

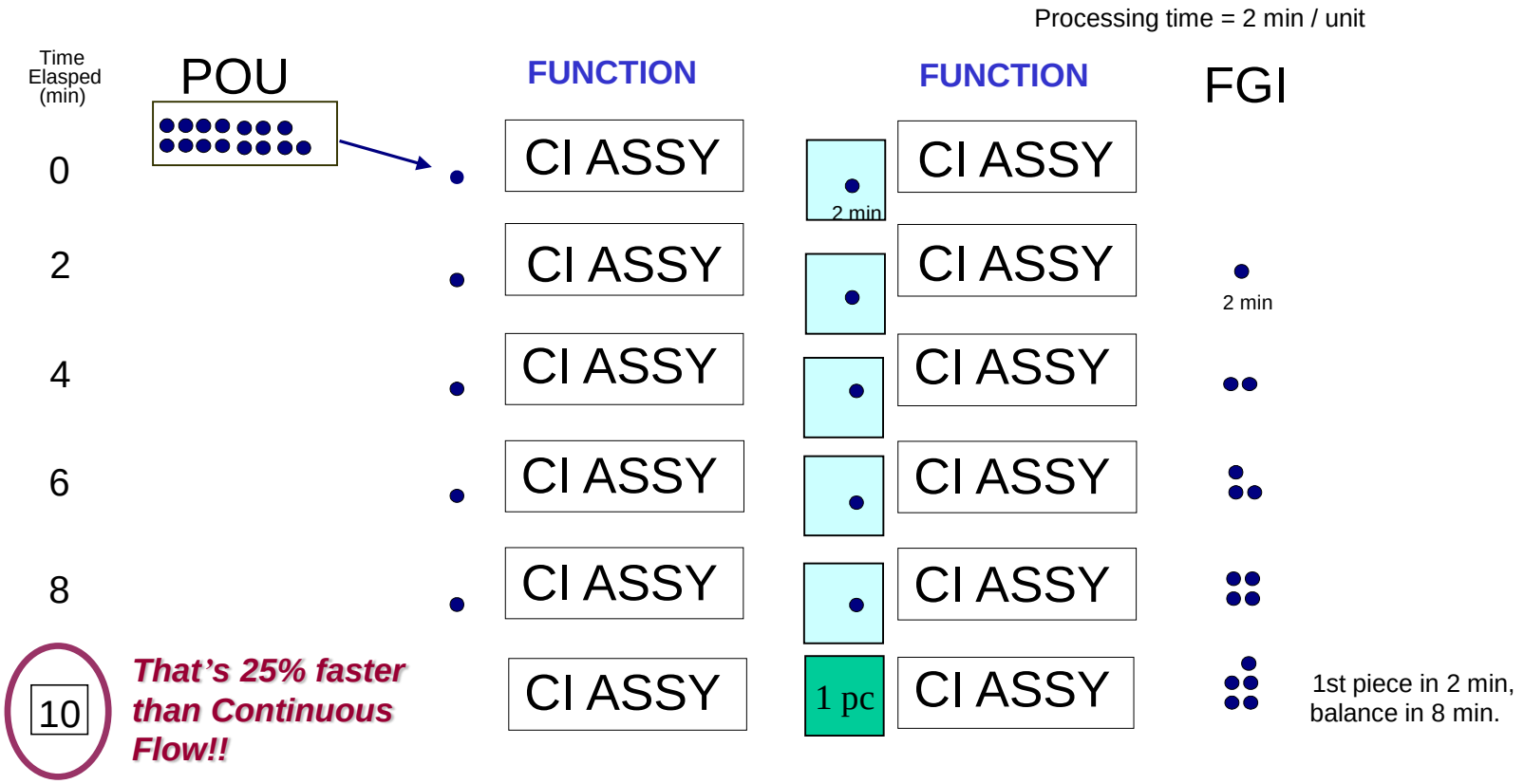
Note how the material level is regulated throughout the process, never more than the allowed amount of inventory at any one stage. Material balance in achieved. What can happen to the work balance if process time at each step is unbalanced? Answer: underutilized workers. While a better process method, it is still not quite lean.

With a two minute process time per piece at each function, the first delivery to the "customer" is still 16 minutes.

The LeanMan

Lean Mfg. circa 2001

Lean Flow with a Pull System and Certified Operators (CI)



A pull system with Point of Use inventory and Flexible Operators enables the team to be the best at what they can control .

The LeanMan

Lean Mfg. circa 2001

The graphic contrasts the simple one-piece flow and a coordinating pull system, and flexible worker cross training. The point is, once you take control over everything you can control, you can begin to fine tune the process to optimum efficiency without waiting for others outside your influence to act. There are now two functional areas in this example. Assembly #1 & Assembly #2.

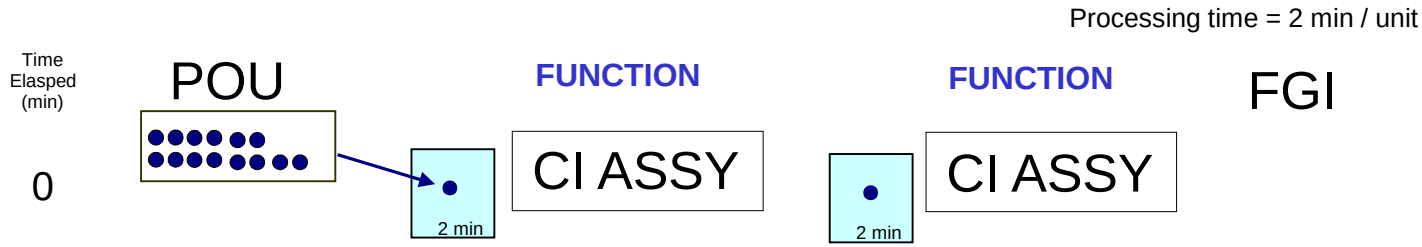
The order size required is still five pieces. This time the material moves as a single piece through each functional step, only when the next process needs it, and work has been balanced between the two functions. A Kanban Square is used to regulate balance and material usage.

With a two minute process time per piece at each function, the full 5 pc delivery to the "customer" is just 10 minutes – ***38% faster than continuous flow alone!***

The LeanMan

Lean Mfg. circa 2001

Lean Flow with a Pull System and Certified Operators (CI)



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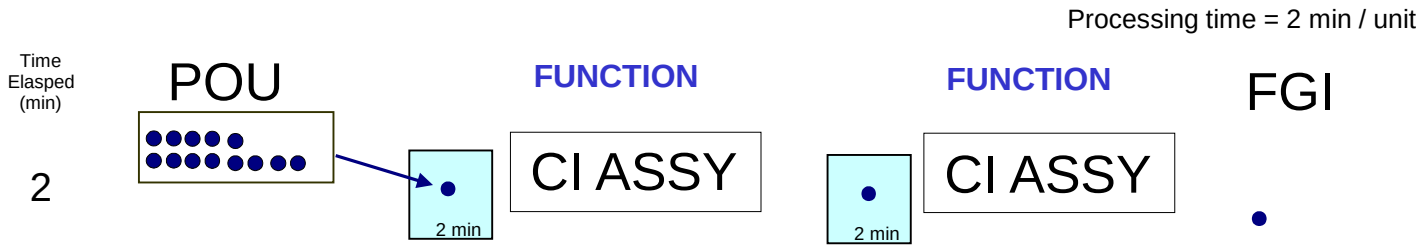

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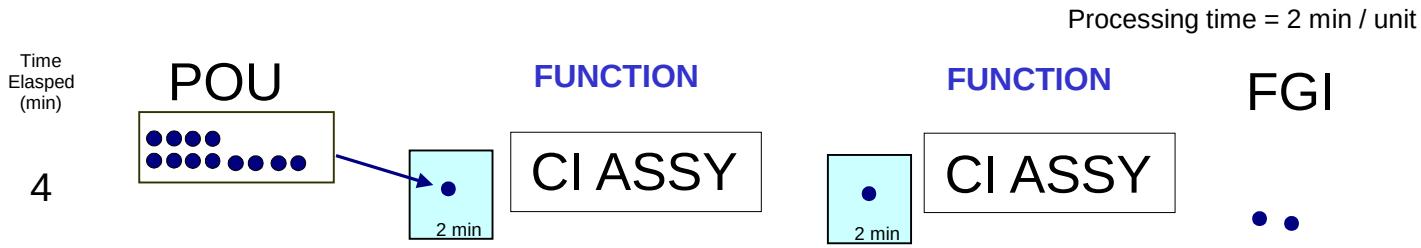

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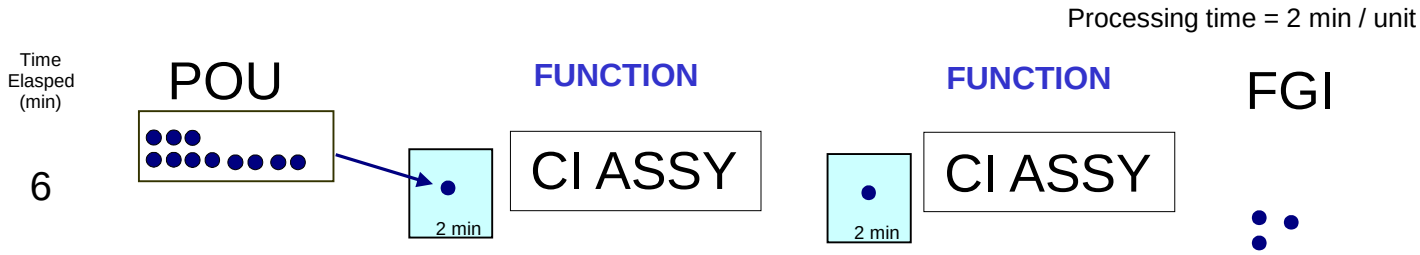

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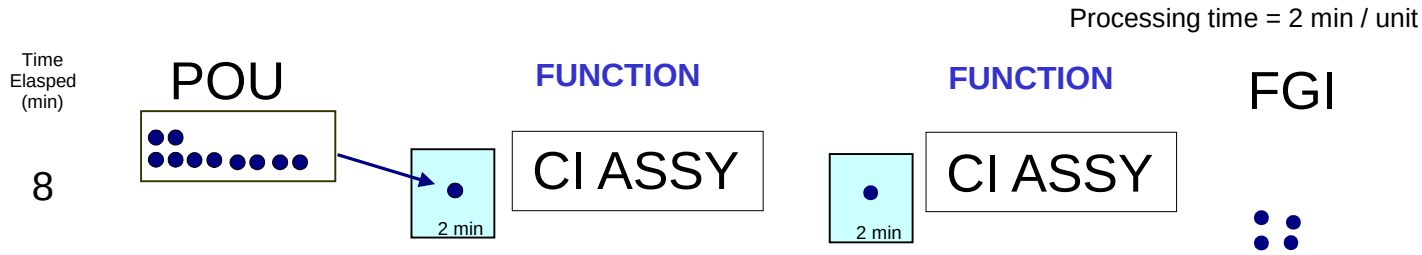

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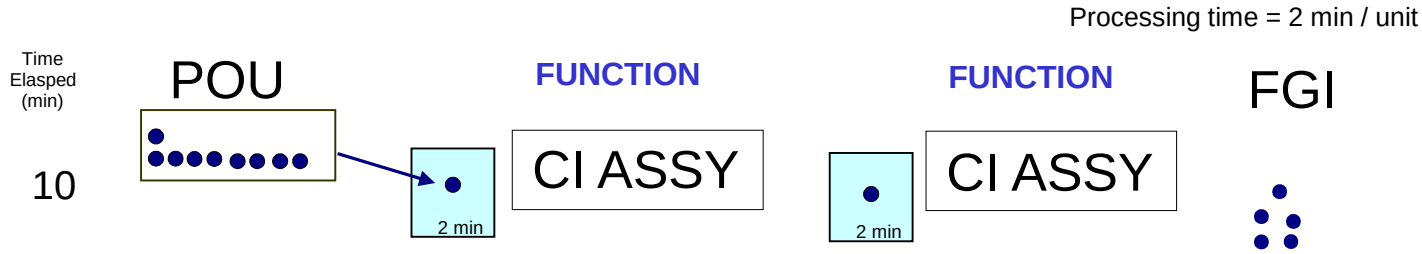

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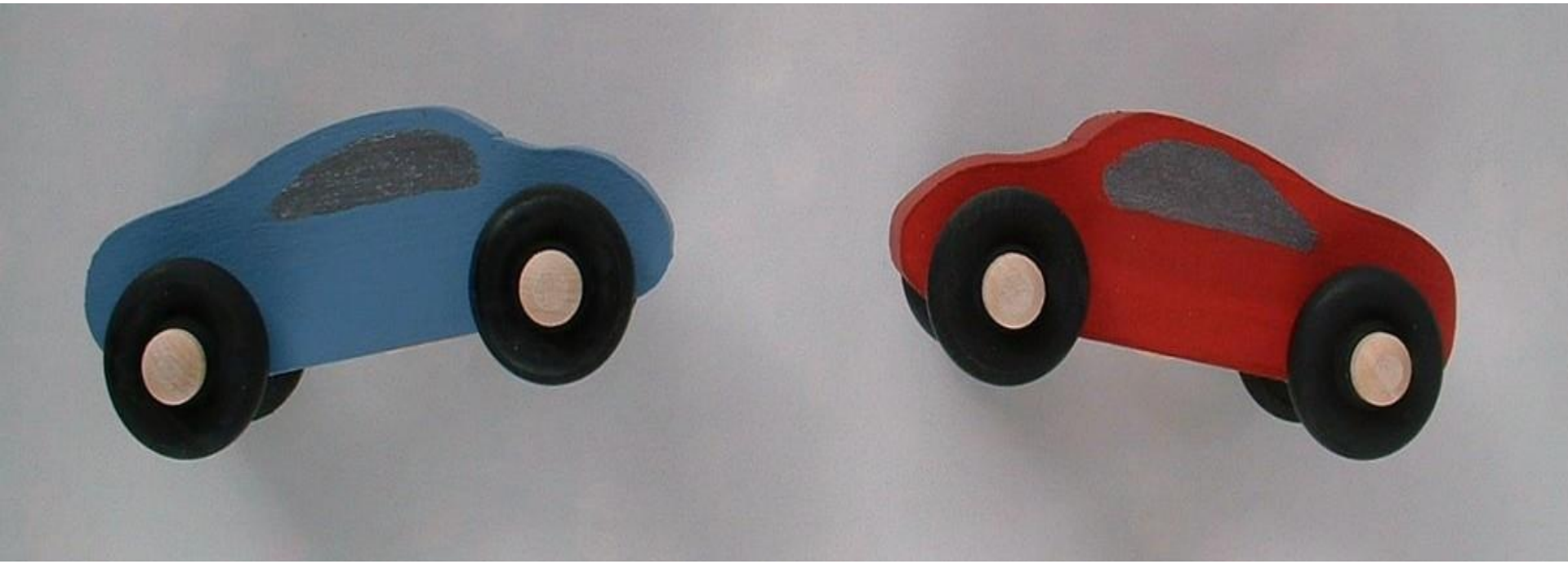
Participation Event

Let’s test the theory with the Learning to See Car Simulation Exercise

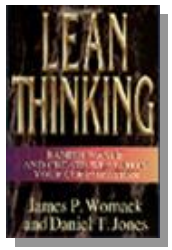


The LeanMan Lean Factory Simulation Kit

The LeanMan

Lean Thinking

Author: Daniel Jones, James Womack
Publisher: Simon & Schuster
Publication Date: 9/9/1996

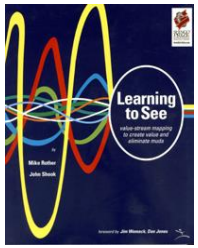


New Manufacturing Challenge: Techniques for Continuous Improvement

Author: Kiyoshi Suzaki
Publisher: The Free Press, a division of Simon & Schuster
Publication Date: 1987

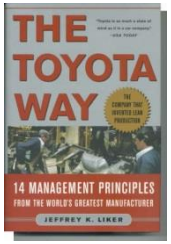
Learning to See: Value-Stream Mapping to Create Value and Eliminate Muda

Author: Mike Rother, John Shook
Publisher: The Lean Enterprise Institute, Brookline, MA
Publication Date: 2003 Version 1.3



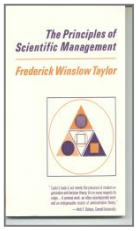
The Toyota Way

Author: Jeffrey K. Liker
Publisher: McGraw-Hill
Publication Date: 2004



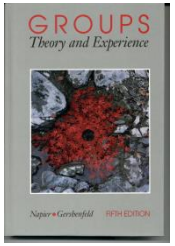
The Principles of Scientific Management,

Author: Frederick Winslow Taylor,
Publisher: New York: Harper & Brothers,
Publication Date: 1911



Groups Theory and Experience,

Author: Napier, Rodney W., Gershenfeld, Matti K., 5th ed.,
Publisher: Houghton Mifflin Company,
Publication Date: 1993.



The LeanMan

