Introduction to **Demand-Flow** manufacturing, **Level & Balanced Scheduling, Level Loading, & Running "Cycles"**

Every Part Every Interval

A 1-DAY AWARENESS COURSE

from

next level TRAINING

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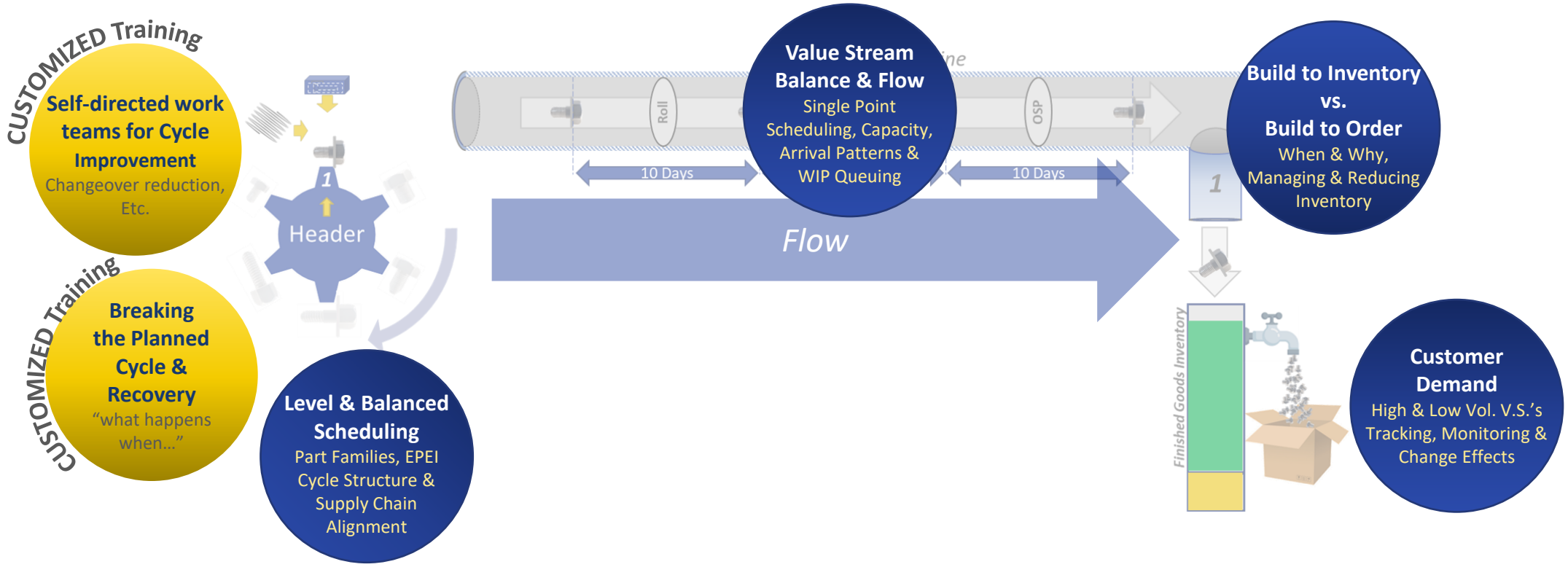
This Visually Engaging and Informative Course Will Cover…



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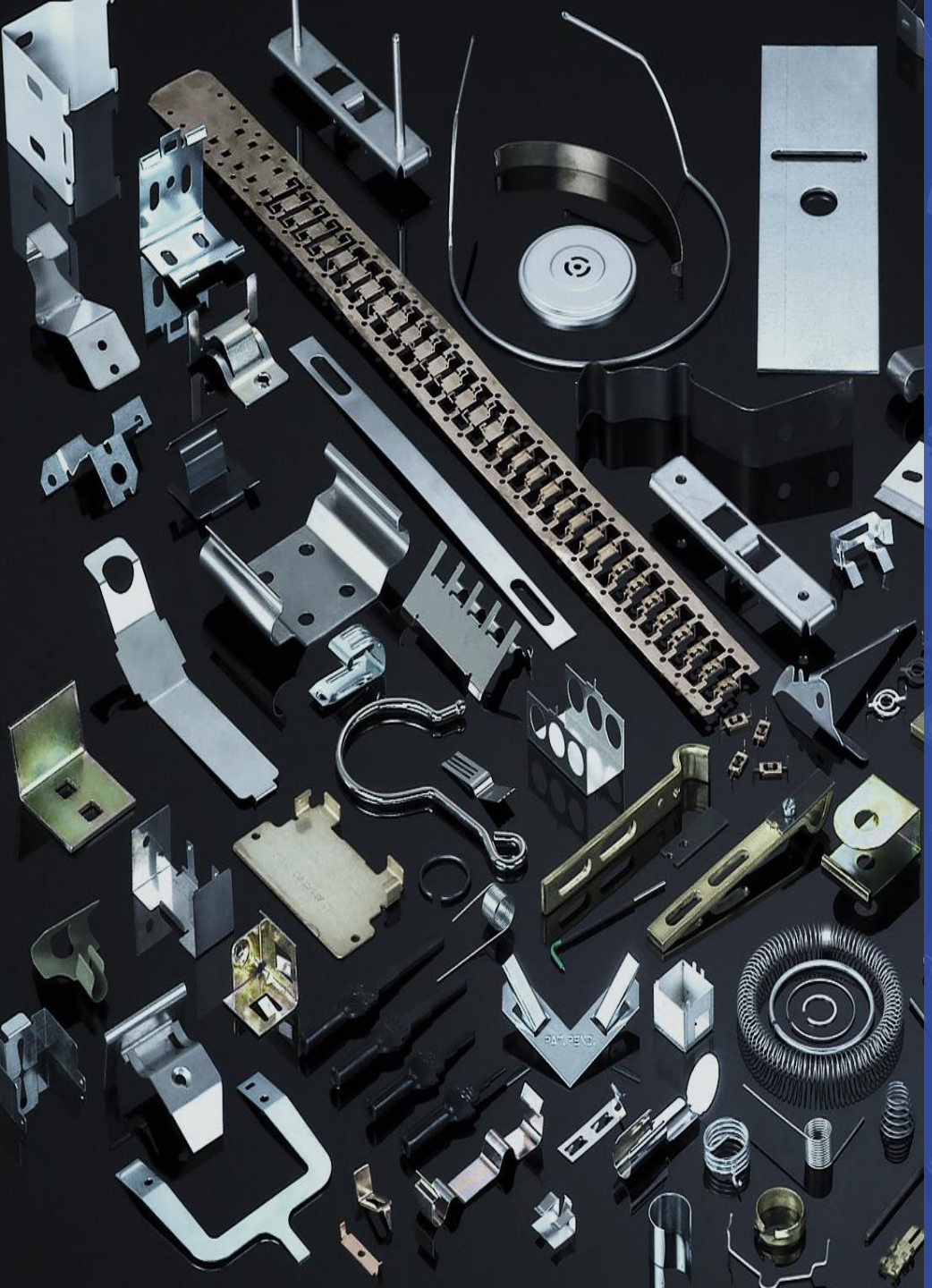

INTRODUCTION

What is EPEI?

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Forward. Upward.

WHAT IS **EPEI**?

Every Part Every Interval

- EPEI is a system for **scheduling production**, focused on meeting customer needs, while minimizing inventory & creating a predictable, manageable routine, for higher volume parts made in our shop.

- *Nearly all **customer orders fluctuate**…sometimes wildly**.** These **order pattern fluctuations induce randomness** into our shop which creates inefficiencies when we use MRP to schedule and purchase materials… in other words, it can create a level of chaos in our plant and among our supply base that becomes difficult to manage.*

- *To combat the randomness of customer orders, **EPEI uses a technique called level-loading**. Combined with a method to schedule parts in a logical sequence or "interval", it helps bring rhythm to our shop and our material suppliers that is easier to align with and manage.*

- *EPEI is **critical to our future success**. It requires a **departure from traditional MRP management** at key areas in our shop.*

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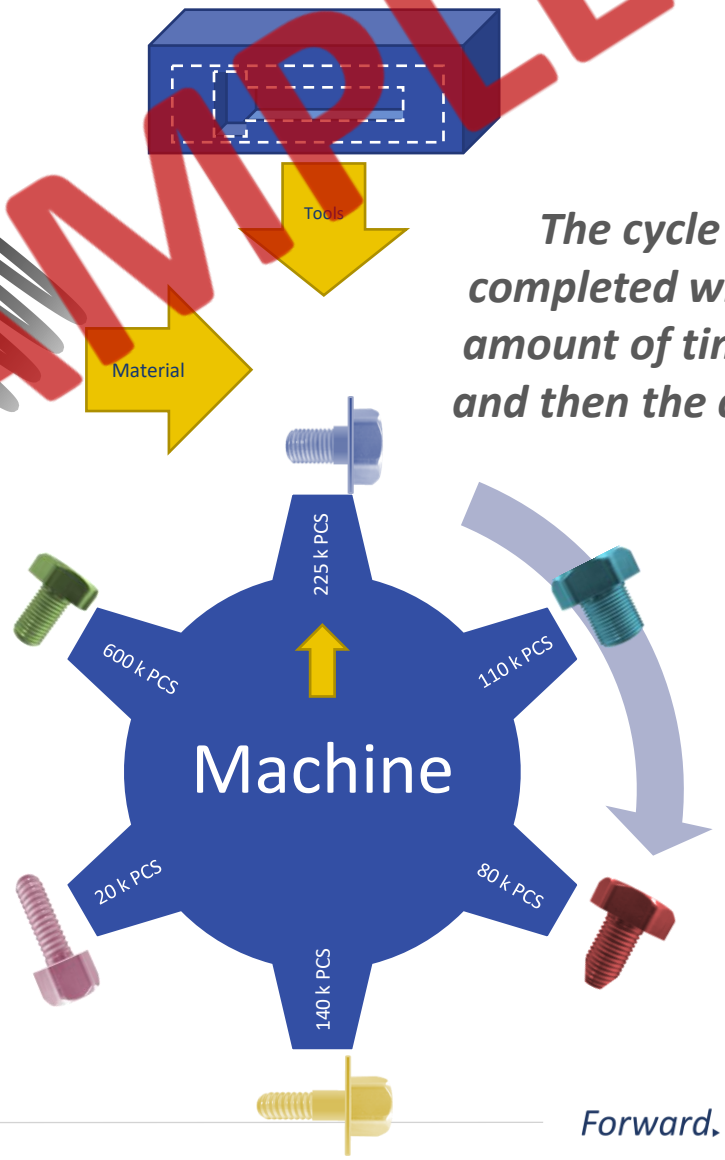
HOW IS EPEI DIFFERENT FROM MRP?

EPEI *Every Part Every Interval*

- *An **EPEI Interval** is like a spinning gear…*
- *Each machine is a given a set of parts to build on a standard – repeating cycle , and a **standard quantity** of each part to produce based on level loaded customer demand.*
- *The goal is to minimize inventory, increase efficiency, and build rhythm and routine into our operations to make it easy for our wire suppliers and tool room to **synchronize** with our production schedule.*
- *We do that by cycling through the production of these **parts in a planned sequence**, on a regular and predictable **interval** (period of time)*



The cycle must be completed within the set amount of time (interval) and then the cycle repeats

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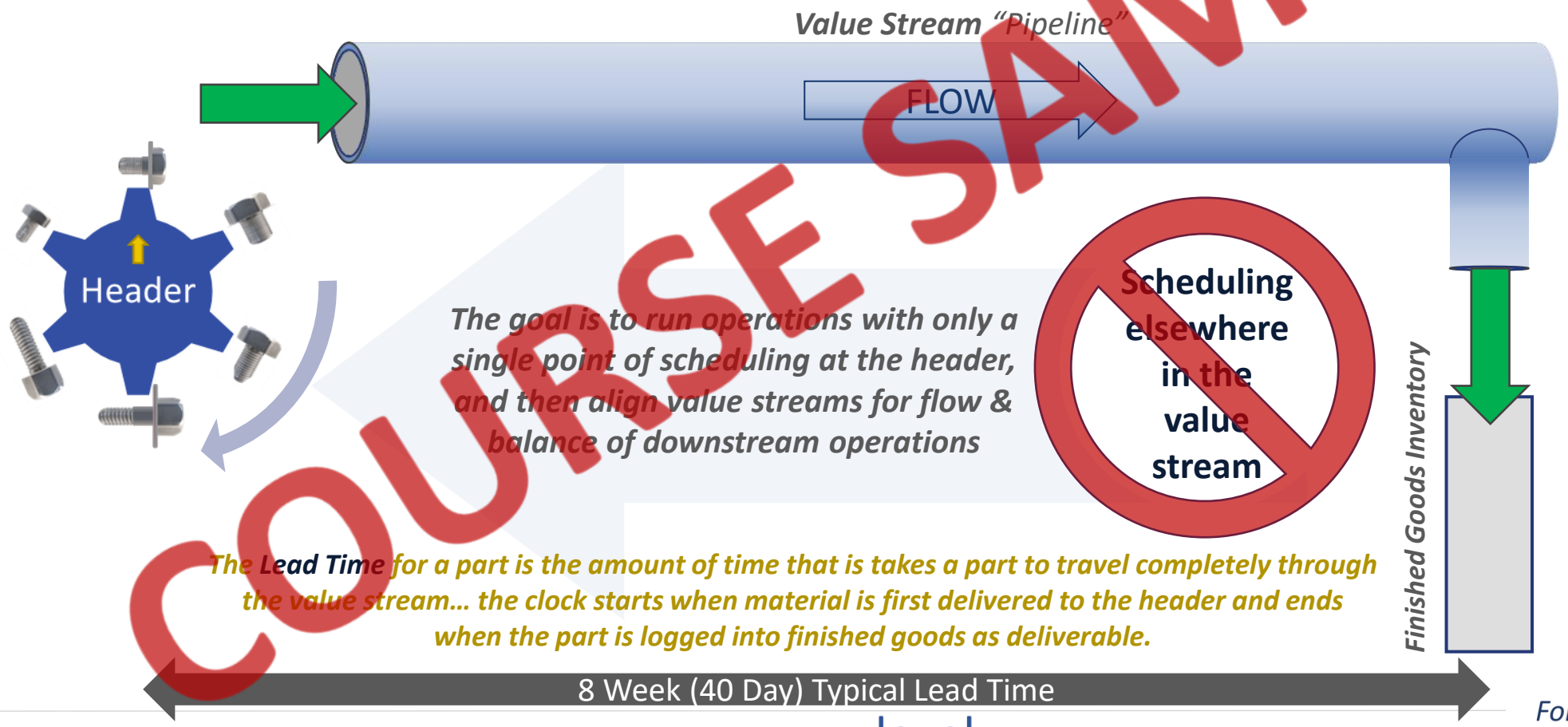
Let's look at how a single part flows through the value stream…

The Value Stream is simply the series of operations (or routing) that the part continues to go through after heading until it becomes a finished product



The Lead Time for a part is the amount of time that is takes a part to travel completely through the value stream… the clock starts when material is first delivered to the header and ends when the part is logged into finished goods as deliverable.

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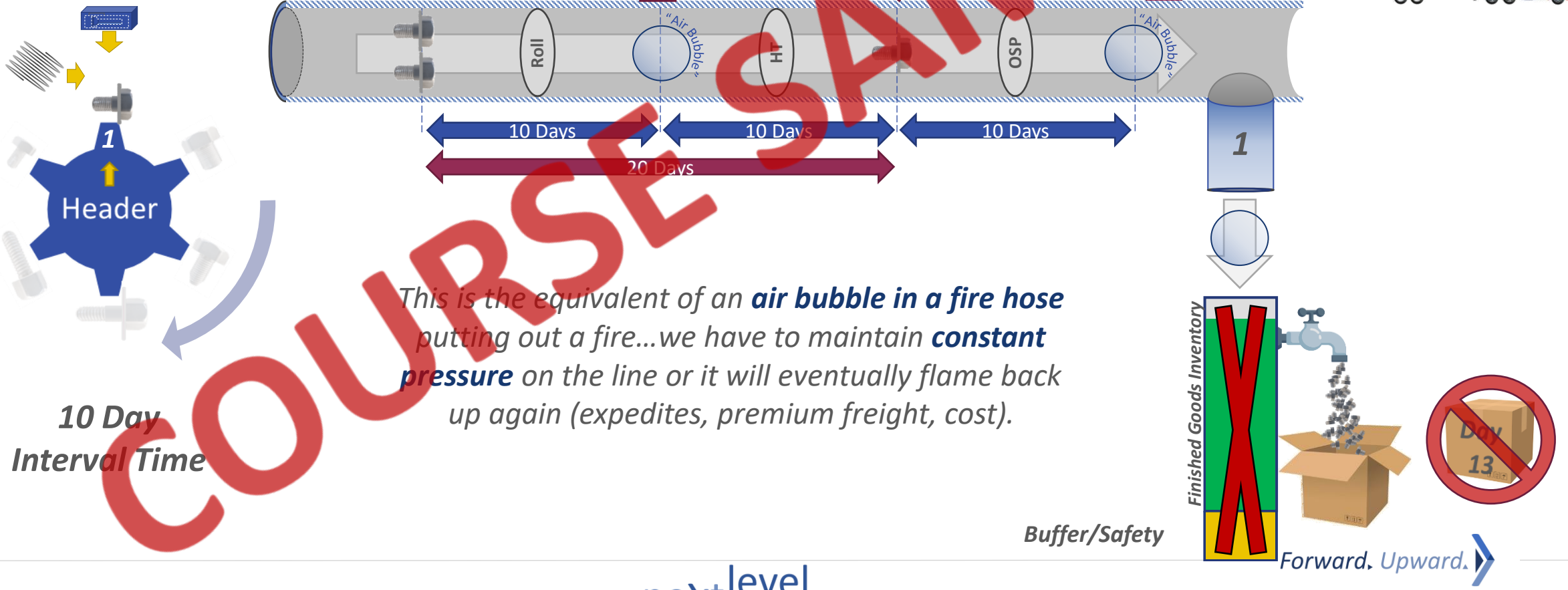
When our value stream isn't **"primed"…**

*We **aren't in cycle,** and haven't achieved **rhythm from cycle to cycle…***



*This is the equivalent of an **air bubble in a fire hose** putting out a fire…we have to maintain **constant pressure** on the line or it will eventually flame back up again (expedites, premium freight, cost).*

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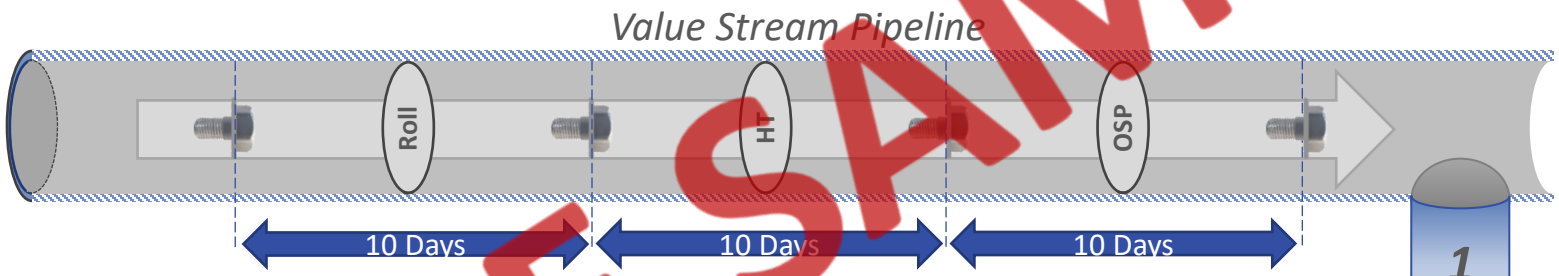

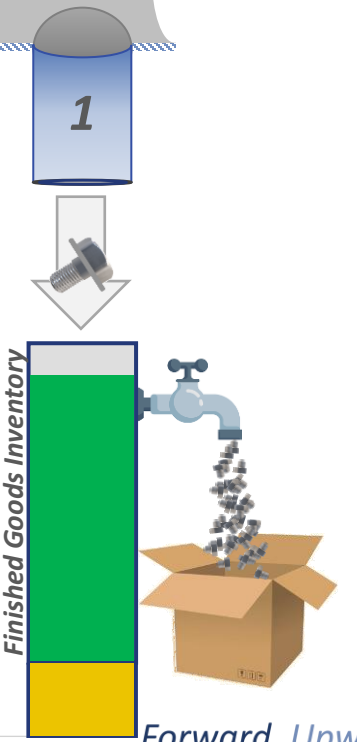

EPEI

Is *the* Fundamental Process for:

- *Reducing inventory while delivering customer orders*
- *Controlling expedite costs while meeting customer timelines*
- *Taming production chaos to deliver on-time, in-full*

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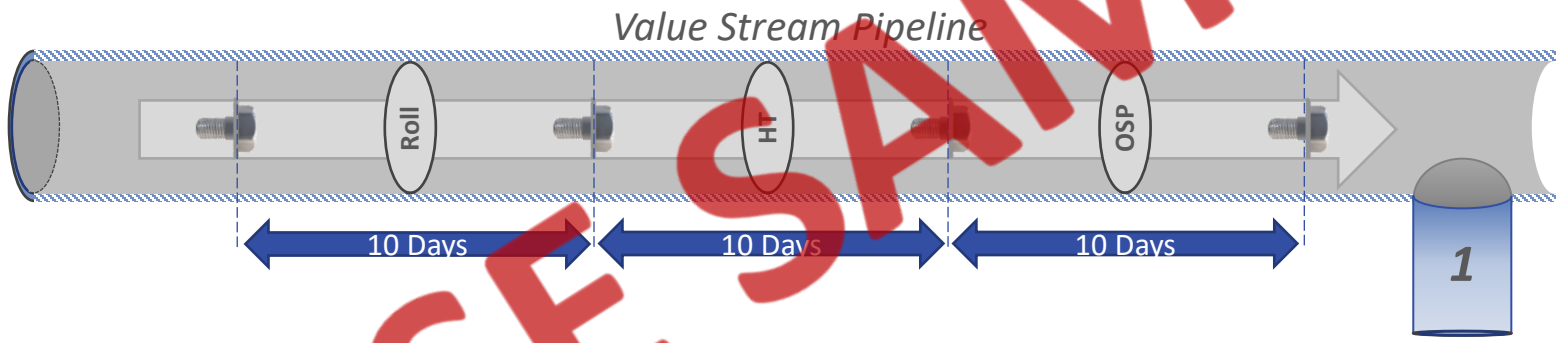
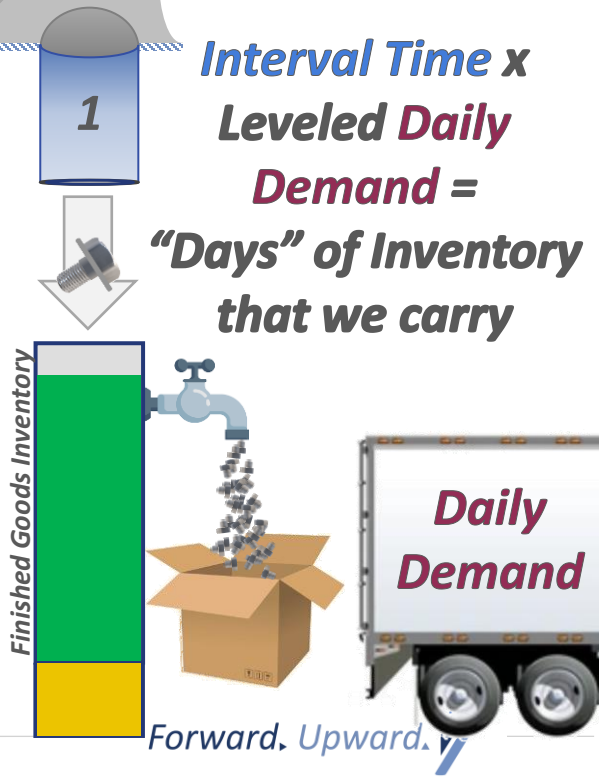
Lead Time Variation x Daily Demand = Buffer / Safety Stock



Header Loading, Prescribed Sequence, Changeover times, & Run Rates determine our Interval Time

EPEI is a system that manages the balance between customer demand, production, & inventory

Interval Time x Leveled Daily Demand = "Days" of Inventory that we carry



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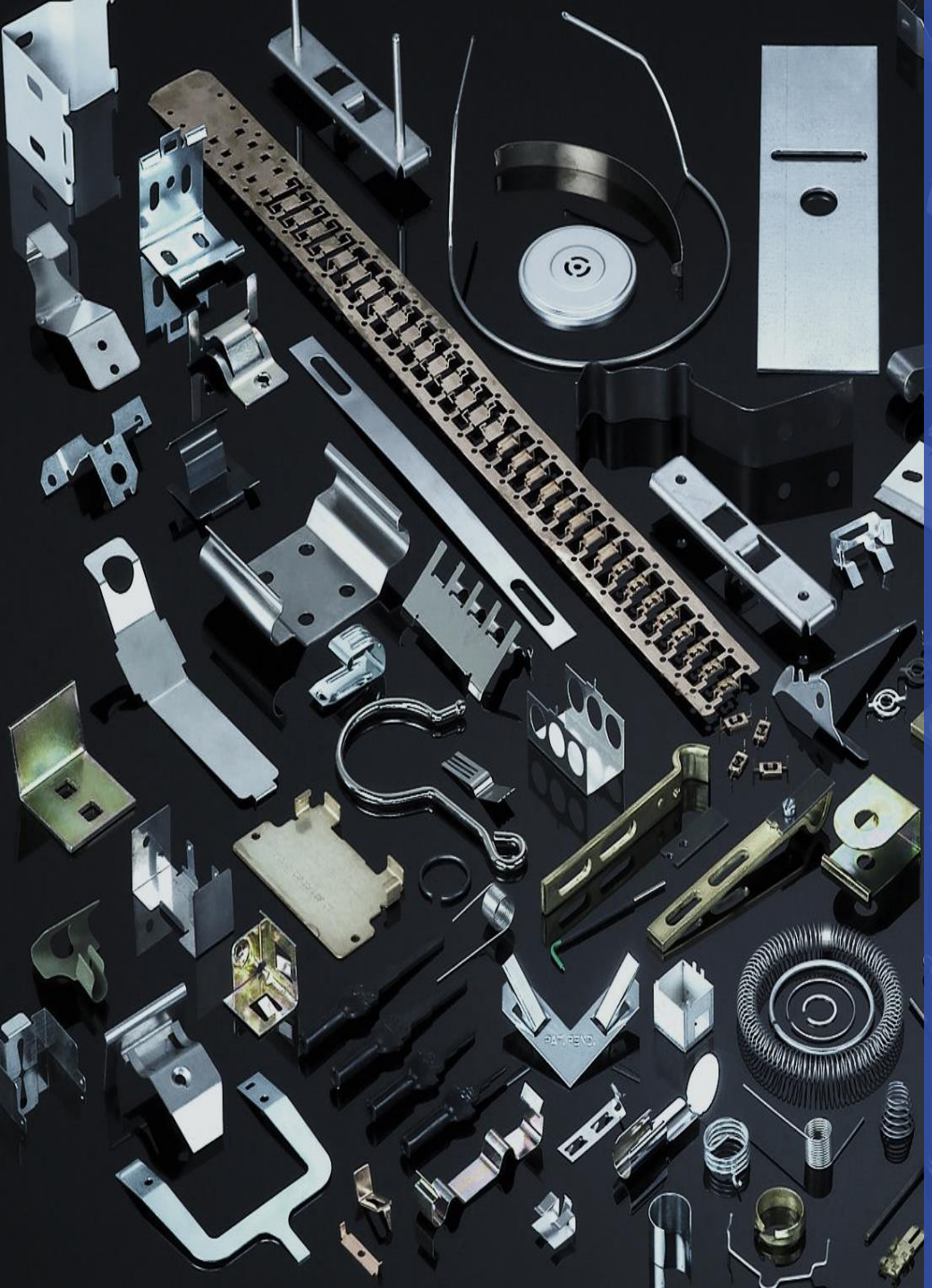

TOPIC #1

Customer Demand

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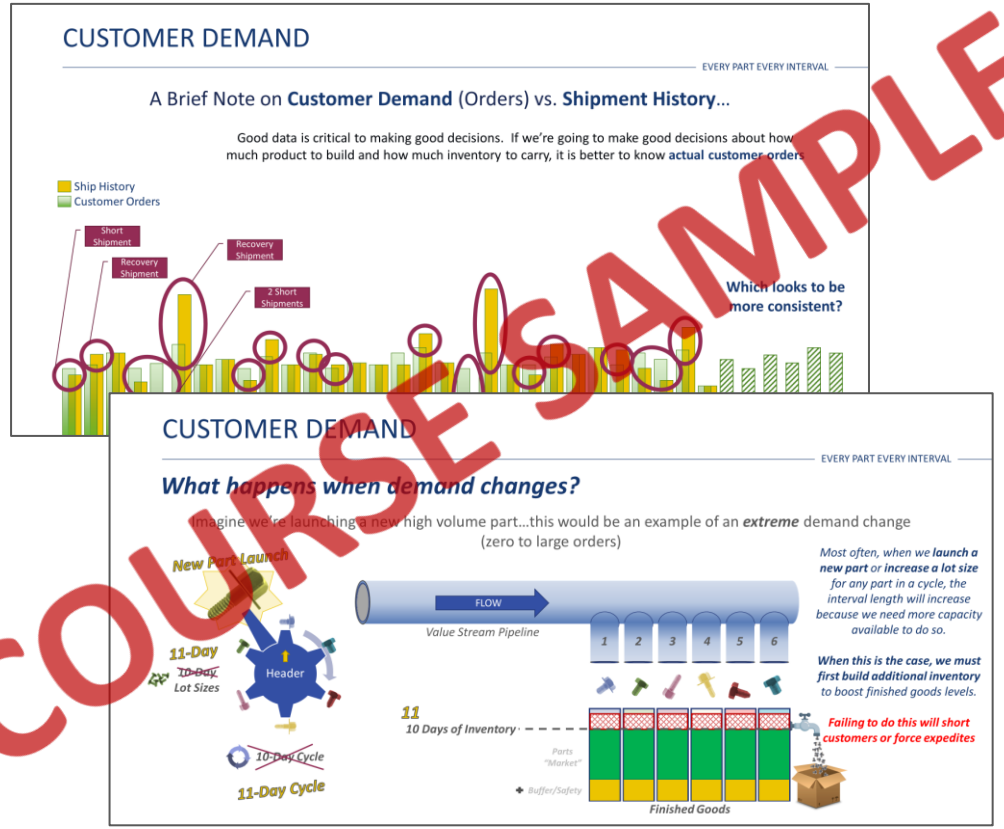

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Demand-Based Level-Loading, Including:

- Product Volumes & Order Consistency
- Customer Demand Patterns
- How to Set & Manage Demand Levels
- Ripple Effects of Demand Changes

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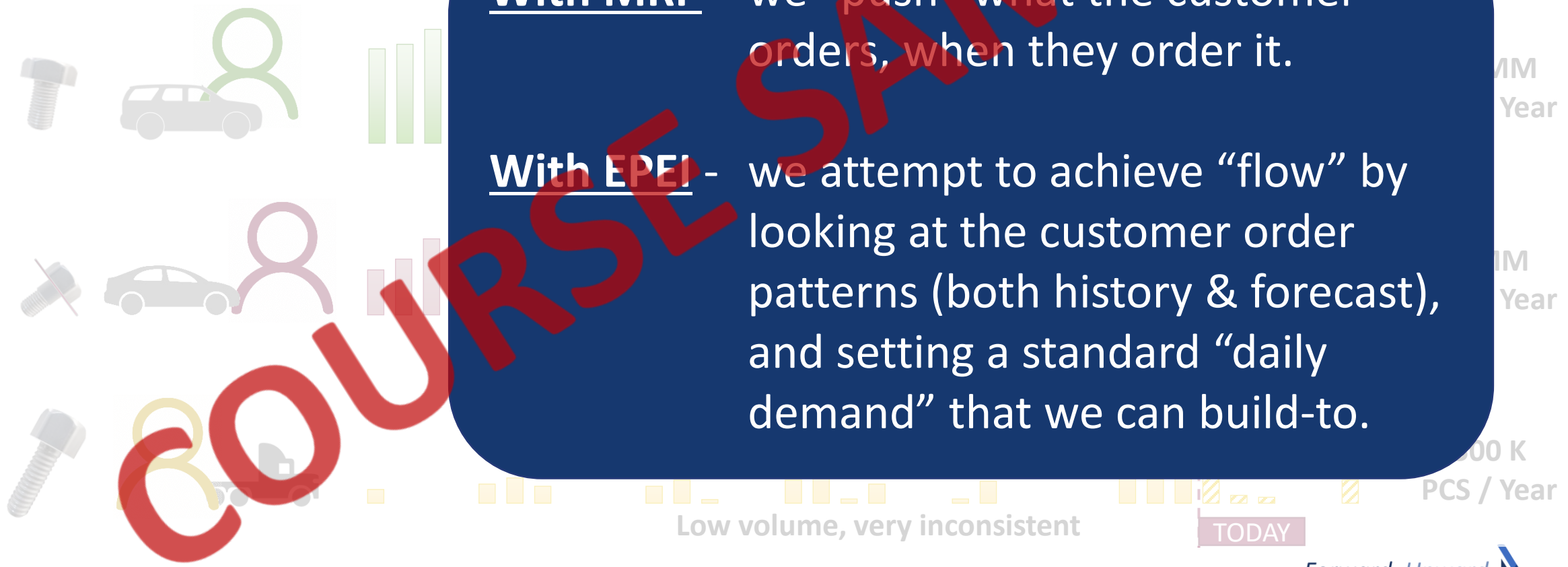
CUSTOMER DEMAND

The best way to do that is to look at customer order patterns over time. Usually by visually graphing daily or weekly orders by date and quantity.

With MRP - we "push" what the customer orders, when they order it.

With EPEI - we attempt to achieve "flow" by looking at the customer order patterns (both history & forecast), and setting a standard "daily demand" that we can build-to.



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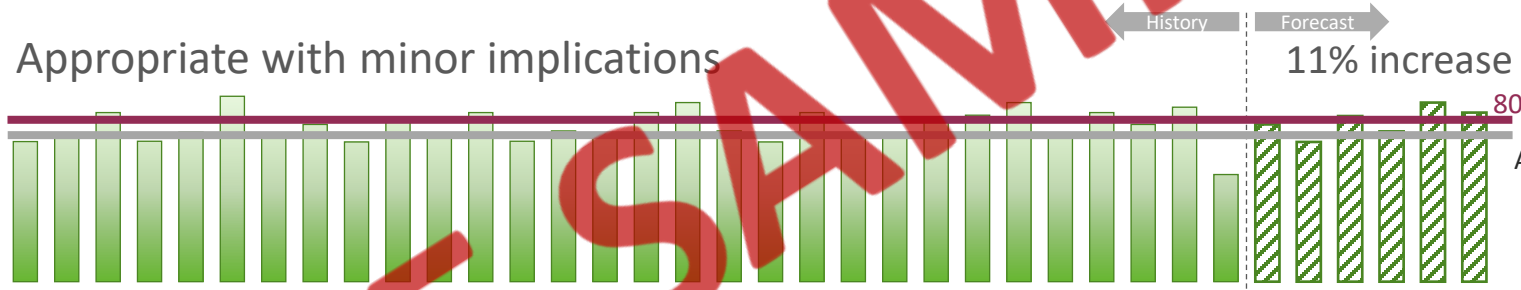
CUSTOMER DEMAND

Let's return to our demand patterns and see how this applies to our other customers…

(weekly orders)

Appropriate with minor implications



11% increase from average

80th Percentile = 71k pcs/day

Average = 64k pcs/day

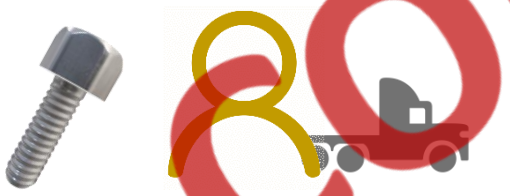
The 80th Percentile *might* build inventory too quickly

Easily managed through an inventory High "water-mark" in finished goods

22% increase from average

80th Percentile = 19,500 pcs/day

Average = 16,000 pcs/day



Level-Loading might not be the right way to handle this part

Calls for a different strategy, like one build per quarter… no level loading

465% increase from average

80th Percentile = 11,300 pcs/day

Average = 2,000 pcs/day

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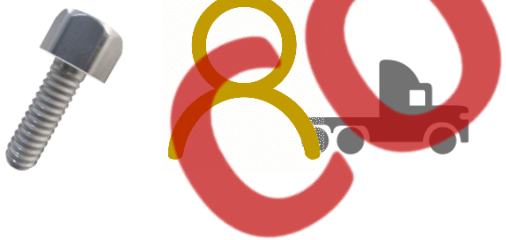
CUSTOMER DEMAND

These different parts are commonly referred to as…

(weekly orders)

A "RUNNERS"

B "REPEATERS"



C "STRANGERS"

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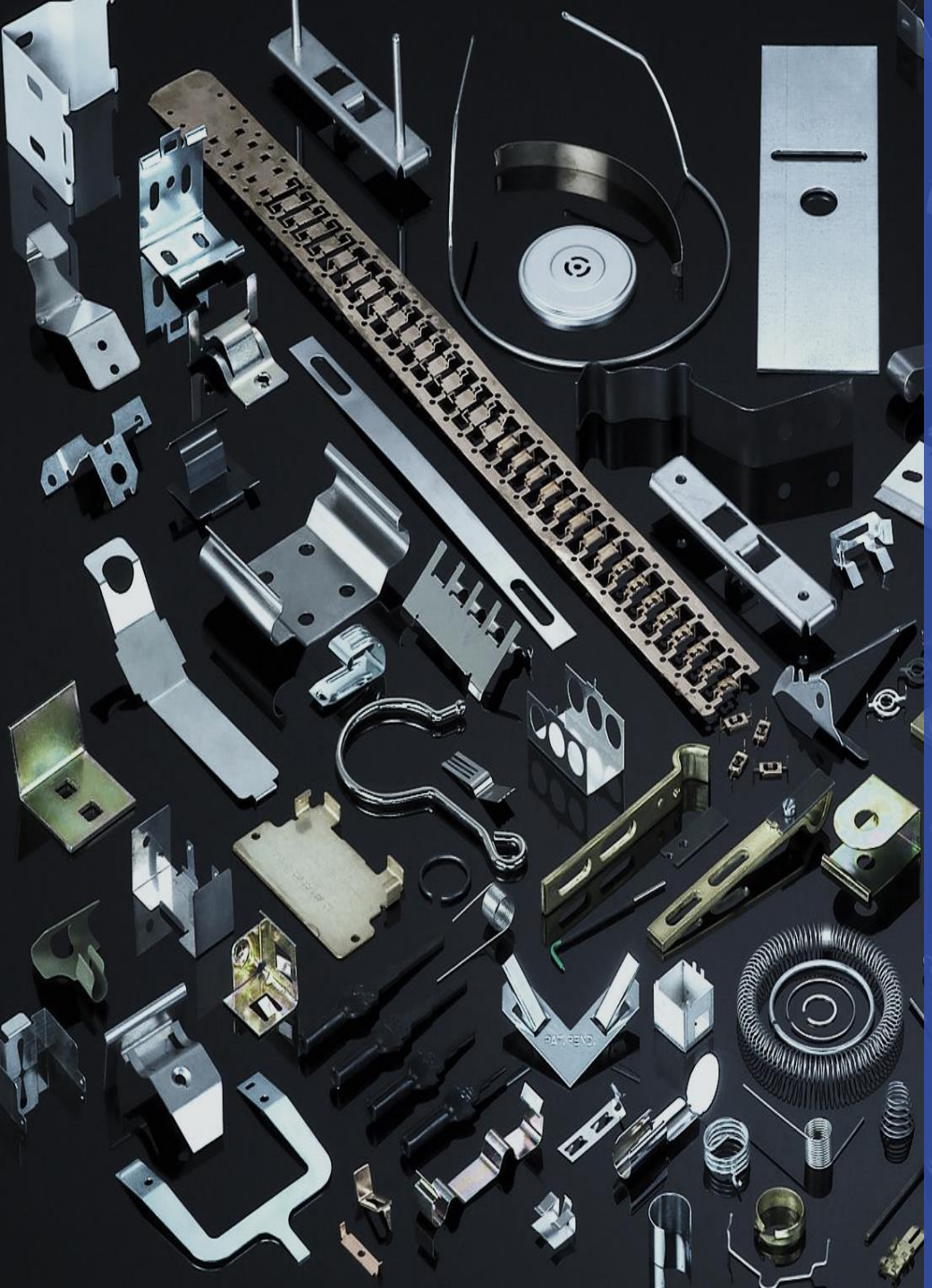

TOPIC #2

Level & Balanced Scheduling

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STUDENTS WILL LEARN THE BASICS OF…

COURSE SAMPLE

Level & Balanced Scheduling, including:

- Segmentation of Products by Volume
- Part Families & How to Determine Them
- Machine Cycle Setup to Minimize Setup & Changeover
- "Stacking" Demand For Low Volume Products
- Importance of Aligning the Supply Chain

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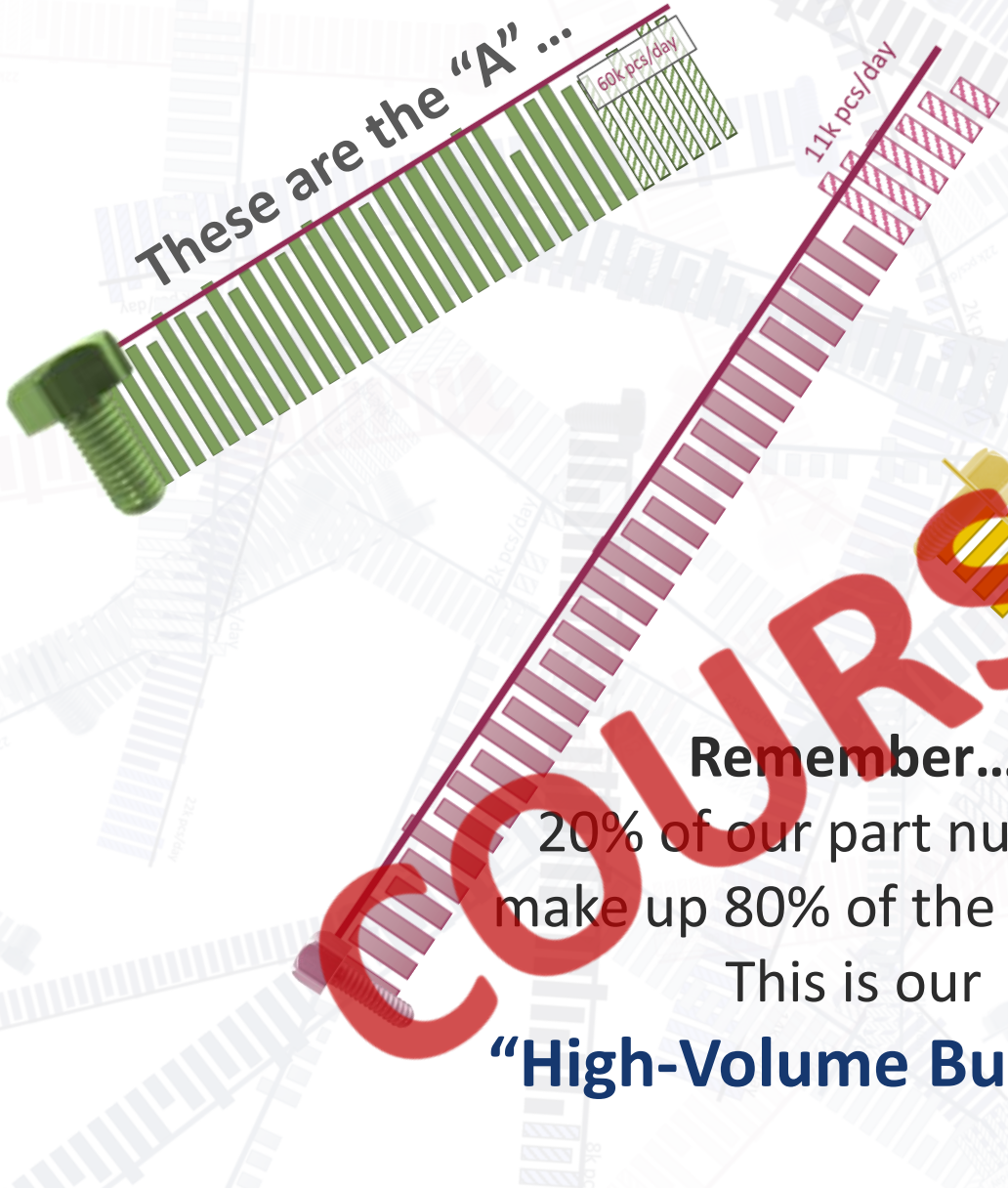
Customer Demand for each of our parts is the critical data that we use to dedicate our production capacity…



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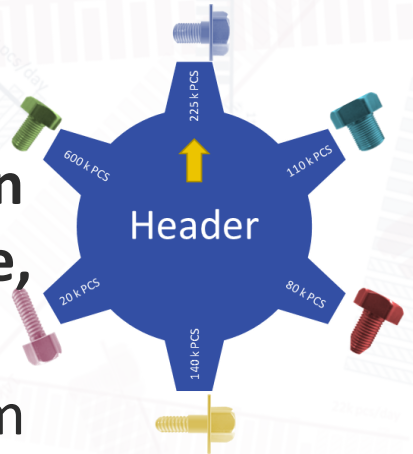
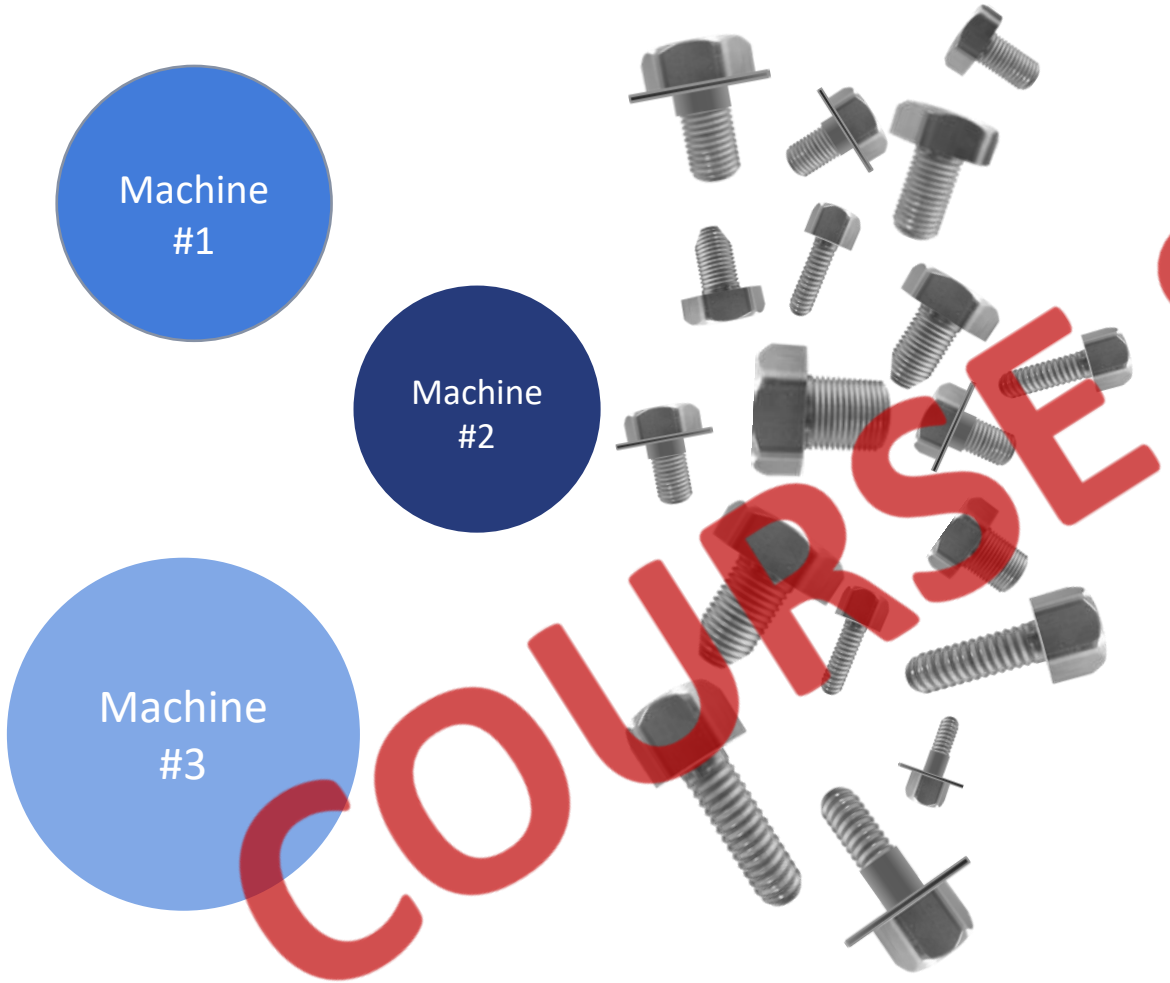
Remember…
20% of our part numbers
make up 80% of the volume.
This is our
"High-Volume Business"

We want to
"just run"
these parts on
a regular cycle,
and not
schedule them



LEVEL & BALANCED SCHEDULING

How should we schedule production?



We start with the **A/Runner High-Volume Parts**.

We may have multiple machines that *could* make them…*but what is optimal?*

We start by grouping parts into "families"

A **part family** is a collection or group of parts with key similarities like **geometry, tool/die configurations, material/wire type,** and **value stream**, etc.

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LEVEL & BALANCED SCHEDULING

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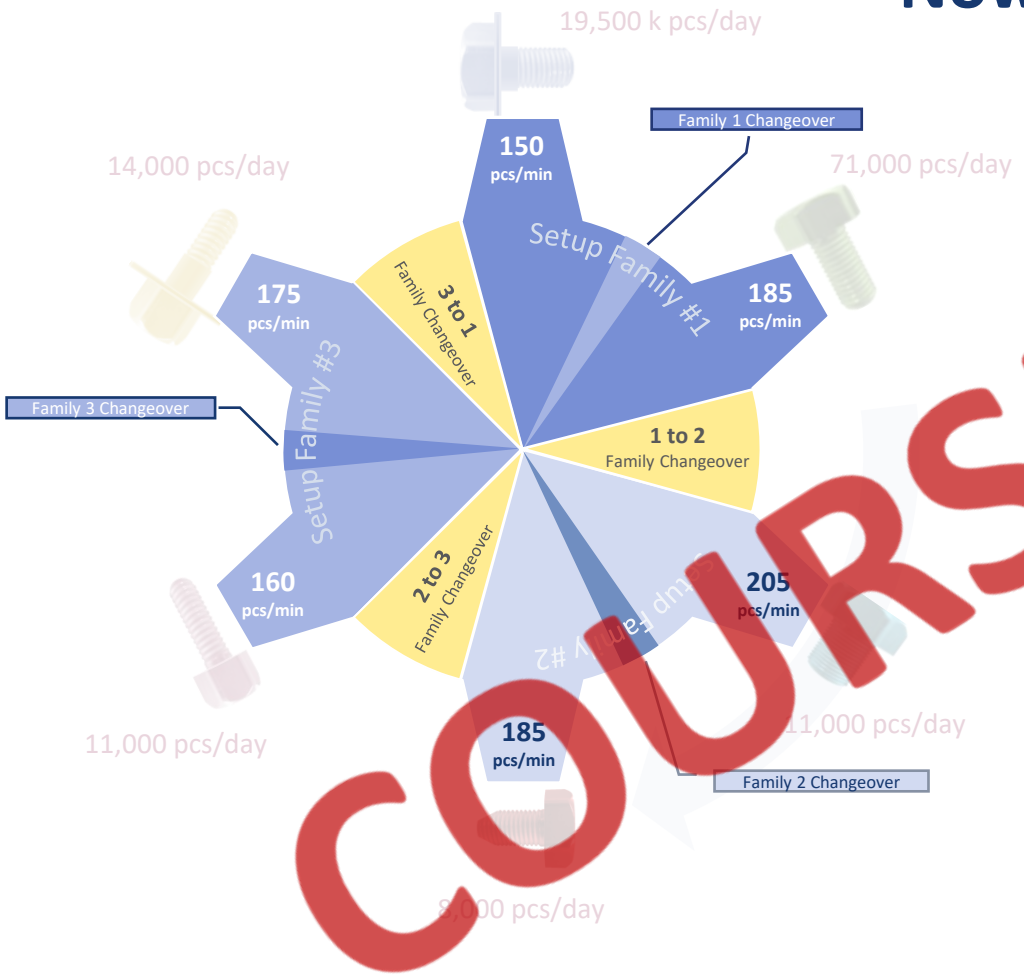

Now We Have the Basic Building Blocks of a Cycle:

- A **Daily Demand** Level For Each Part
- Parts **Assigned** to a Machine or Machines
- Parts **Grouped** into Value Stream & Setup Families
- Parts **Sequenced** to minimize setup time

*If we measure **run rates** for each part, and **changeover times between parts and families**, we can calculate an **Interval** or the time required to build **Every Part** in the **Interval** (cycle).*

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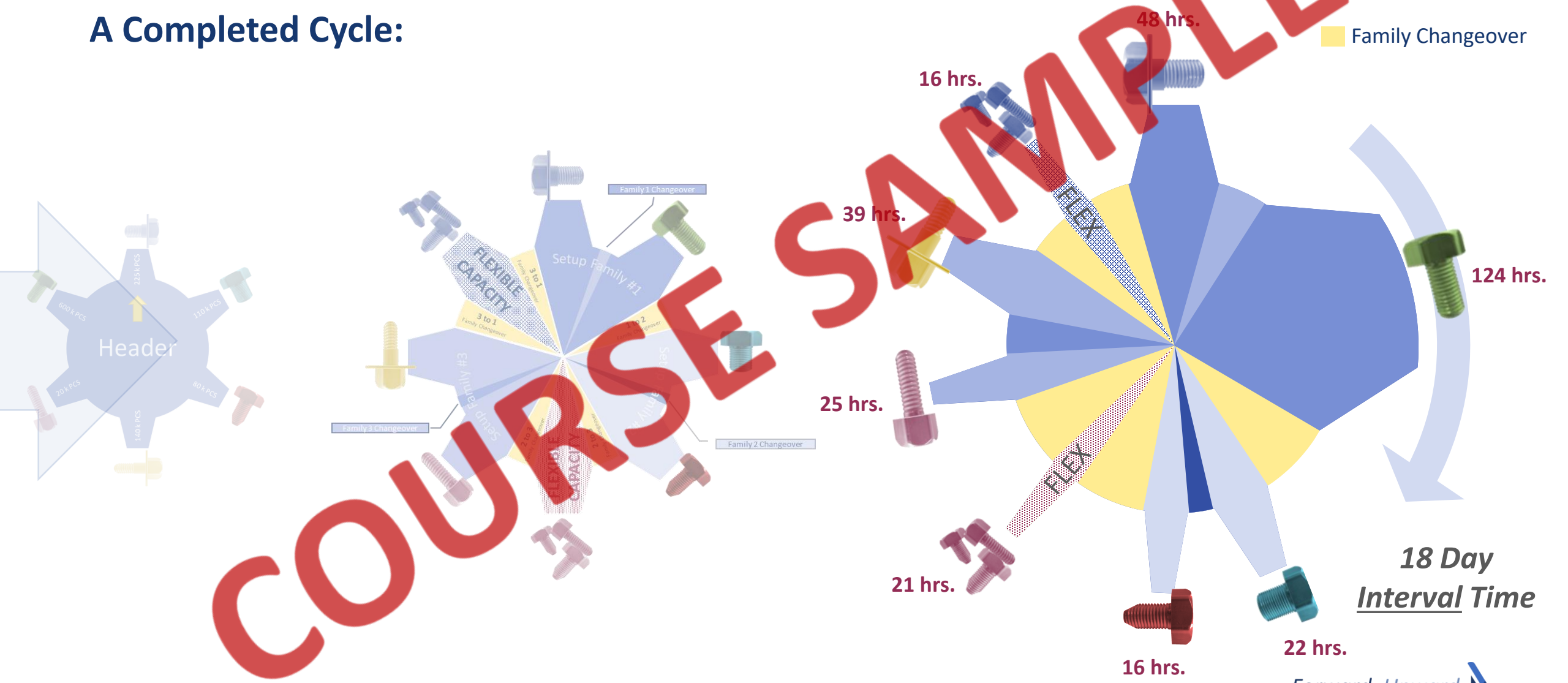
LEVEL & BALANCED SCHEDULING

A Completed Cycle:



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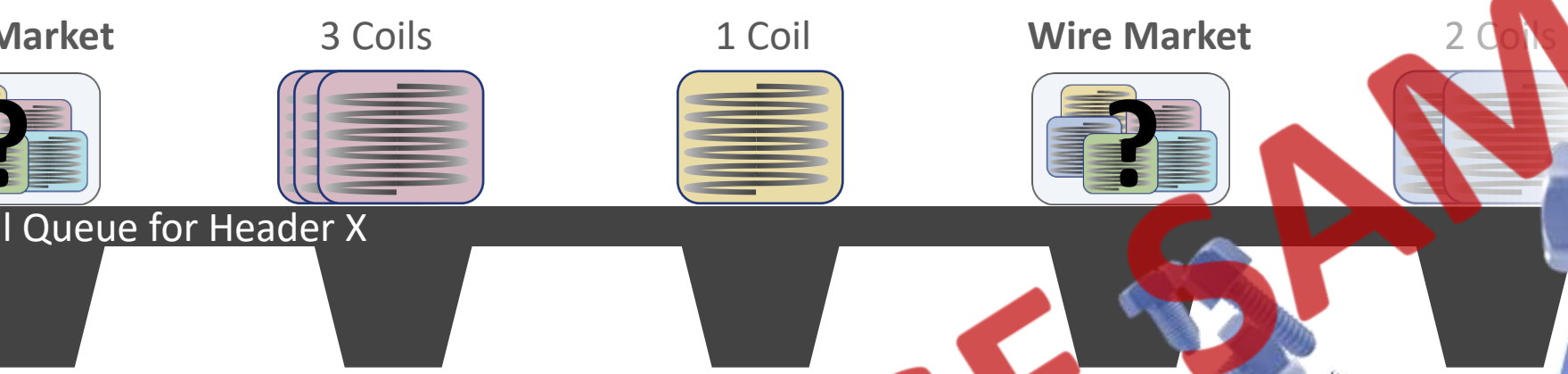
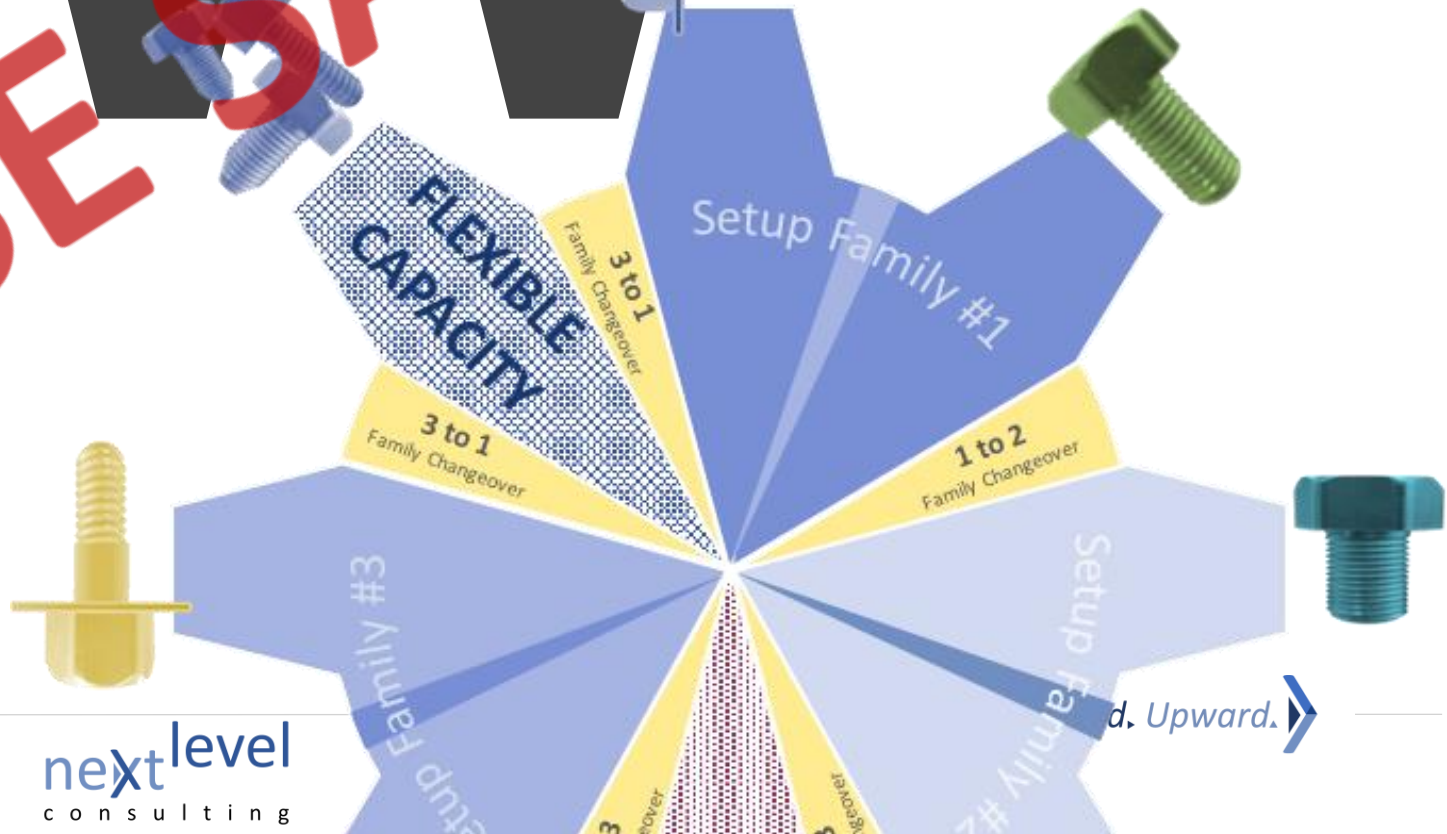
LEVEL & BALANCED SCHEDULING

Aligning the Supply Chain:



As the Machine Operator runs the Cycle, they can pull material from the queue for their machine for A and high B parts…

… or draw from the material market for low volume B & C parts that are scheduled within the flex capacity windows



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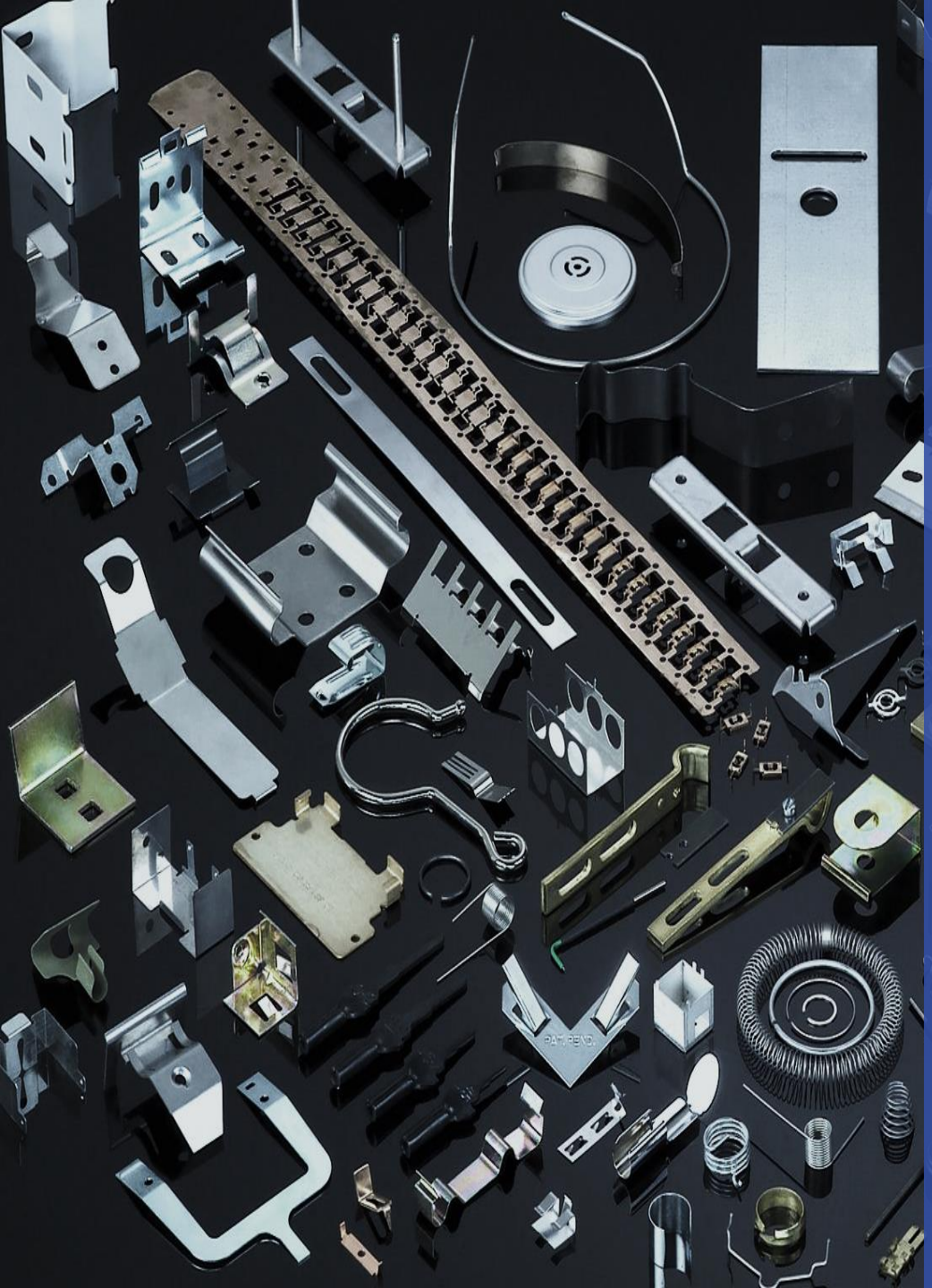

TOPIC #3

Building to Inventory

Vs

Building to Order

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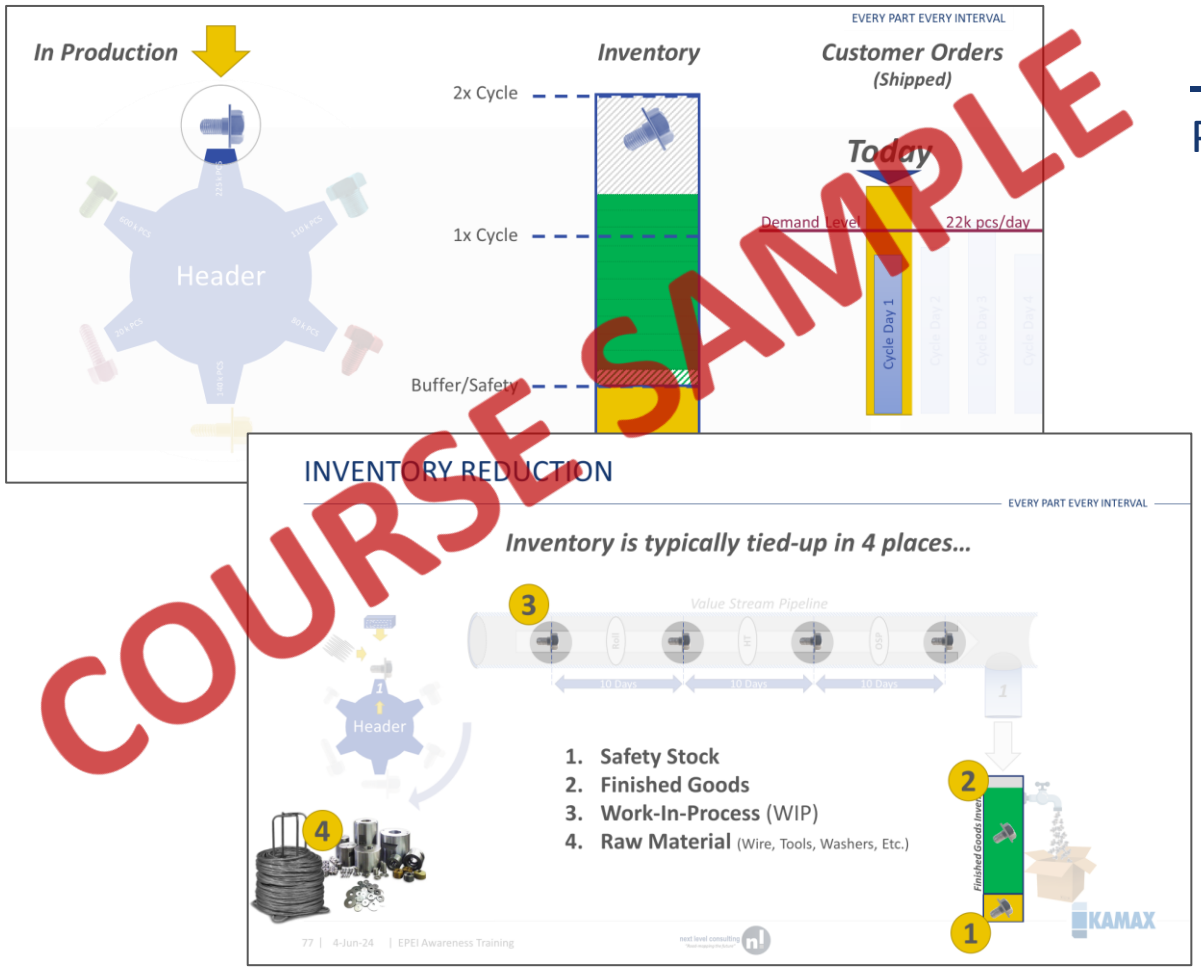

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Production Scheduling & Inventory Management, including:

- Building to order vs. building to replenish inventory
- Measuring Inventory – Days of Demand vs Units
- Maintaining Inventory Health
- Inventory "Turns" & Business Cash Flow
- Inventory Reduction – Continuous Improvement

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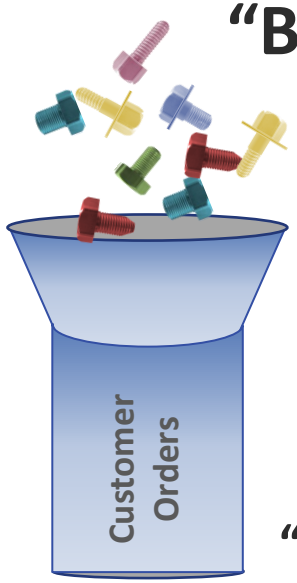
Forward. Upward.

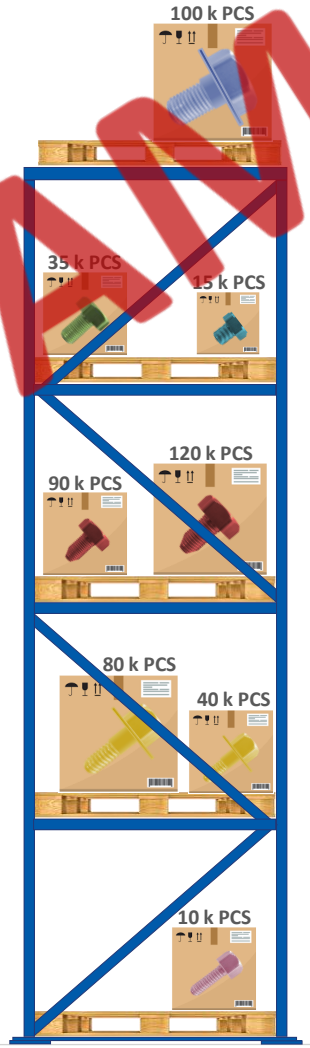
BUILDING TO INVENTORY VS BUILDING TO ORDER

"Building to Order" is Driven by MRP



Lot Size typically = Order Quantity

Production Schedule = Shuffled, prioritized and "laid-out" for the shop by Due Date & Lead Time



Often, every Piece in Inventory is built to fulfill a specific customer order

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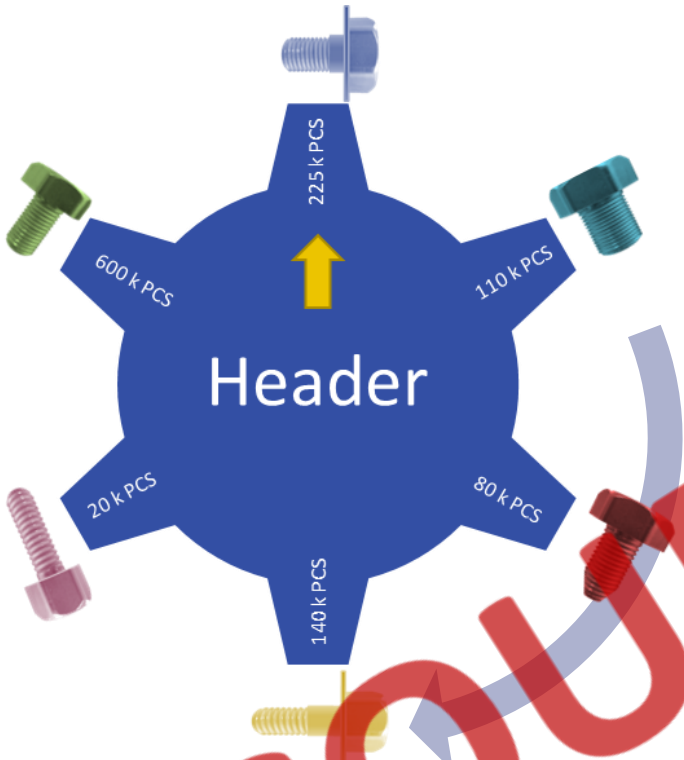
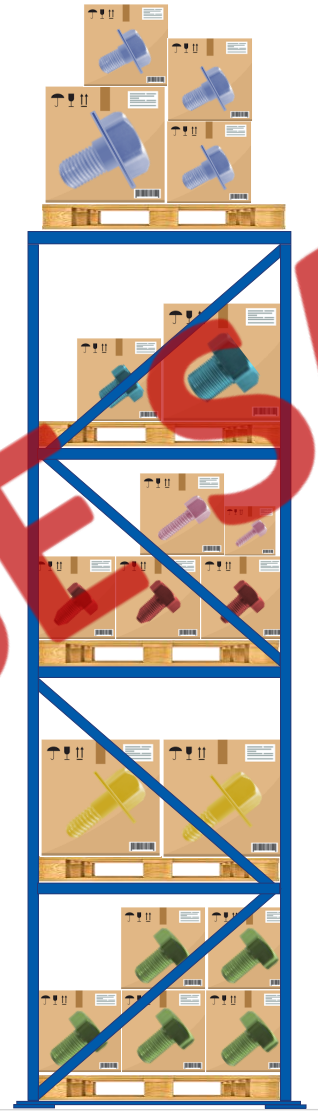
BUILDING TO INVENTORY VS BUILDING TO ORDER





"Building to Inventory" is Different.

We still care about customer orders, but we look at individual part ***order patterns over time*** in order to set a standard quantity of each part to build on a regular interval.

Then, as our customers pull from our inventory, we **monitor customer demand** and inventory levels and **maintain a routine in production aligned with our customer's needs** in order to maintain healthy inventory levels for each part

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INVENTORY TURNS

Think of **inventory** in our plant as **cash in jail**

This is money we have *already spent* on material, labor, and overhead, that is "locked-up" and that *we don't get back until we sell it* to a customer.

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CALCULATING INVENTORY TURNS

Method #1

Inventory Turnover = Total Annual Cost of Goods Sold / Average Inventory at Cost

Reducing the ***number of pieces*** in inventory increases the number of turns which frees-up cash to be invested elsewhere

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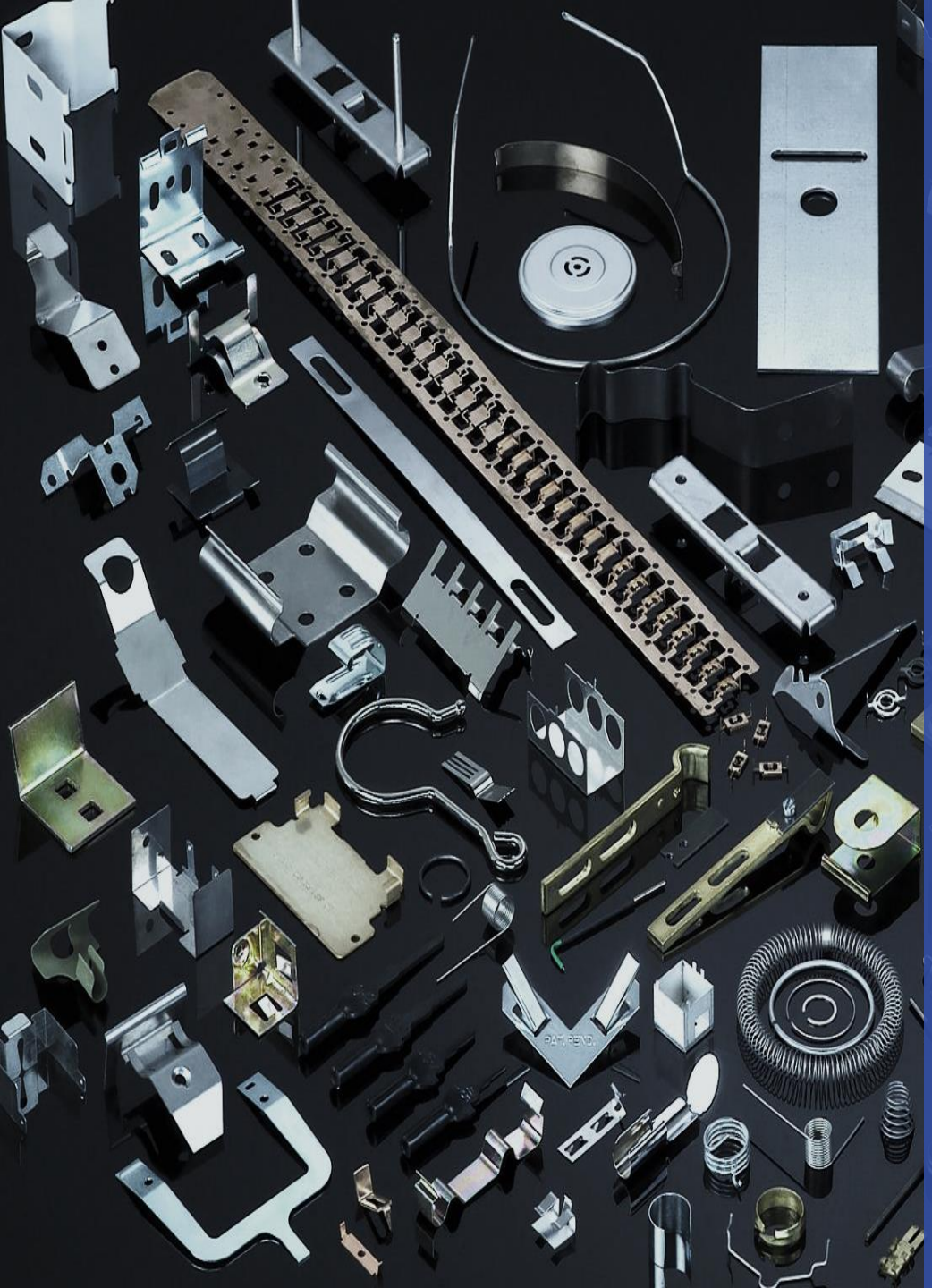

TOPIC #4

Value Stream Balance & Flow

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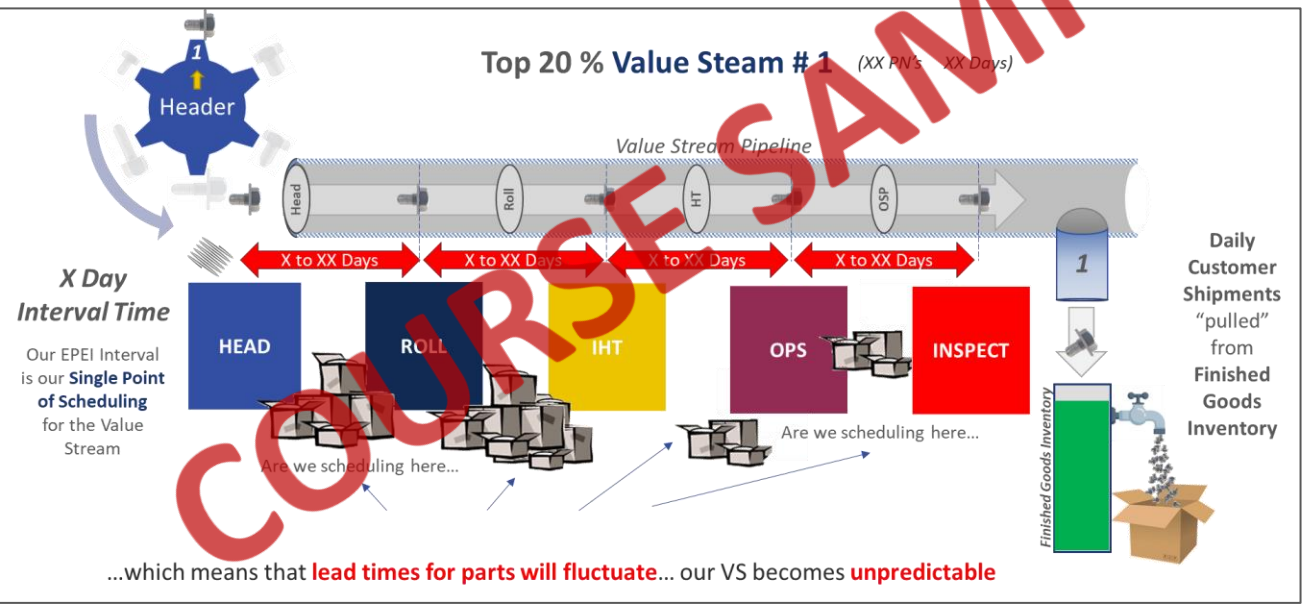

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Value Stream Balance & Flow, including:

- What is a Value Stream & What is "Flow"?
- Complexities of
- Maintaining Inventory Health
- Inventory "Turns" & Business Cash Flow
- Inventory Reduction – Continuous Improvement

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VALUE STREAM BALANCE AND FLOW

Low-Volume Business **VS.** **High-Volume Business**

Low-Volume Business

PARTS

make up 20% of or production volume

High-Volume Business

PARTS

make up 80% of our production volume

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VALUE STREAM BALANCE AND FLOW

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- **Value-stream –** In a production environment, can be *generalized* as all of the critical steps or processes taken at each stage in production to build a product until it becomes a deliverable finished good.

- The *production value stream* contains both the necessary **value-added activities** which transform materials and components into an end item, as well as **non-value-added activities** that may be necessary to stage, move, prep, or prepare materials and components during the production process until the end item is ready for sale.

- An example might be the transformation of a raw material, such as a coil of steel wire that is cut, headed, rolled, heat treated and joined with a washer to produce an end item for sale. The fit, form, and function has changed. Those activities are **value-added to your customer**, and they are willing to pay for them.

- **Non-value-added** activities are those that are not important to your customer, nor are they willing to pay for them. Non-value-added activities such as staging, material handling, cleaning, etcetera can be thought of as **waste** and **need to be minimized or eliminated.** Your customers don't want to pay for any inefficiencies in your value stream.

- **Value stream maps** are used to diagram the flow of both materials and information as they progress through a product's value stream as well as the quantities and time that it takes to progress from each step in the process from start to completion.

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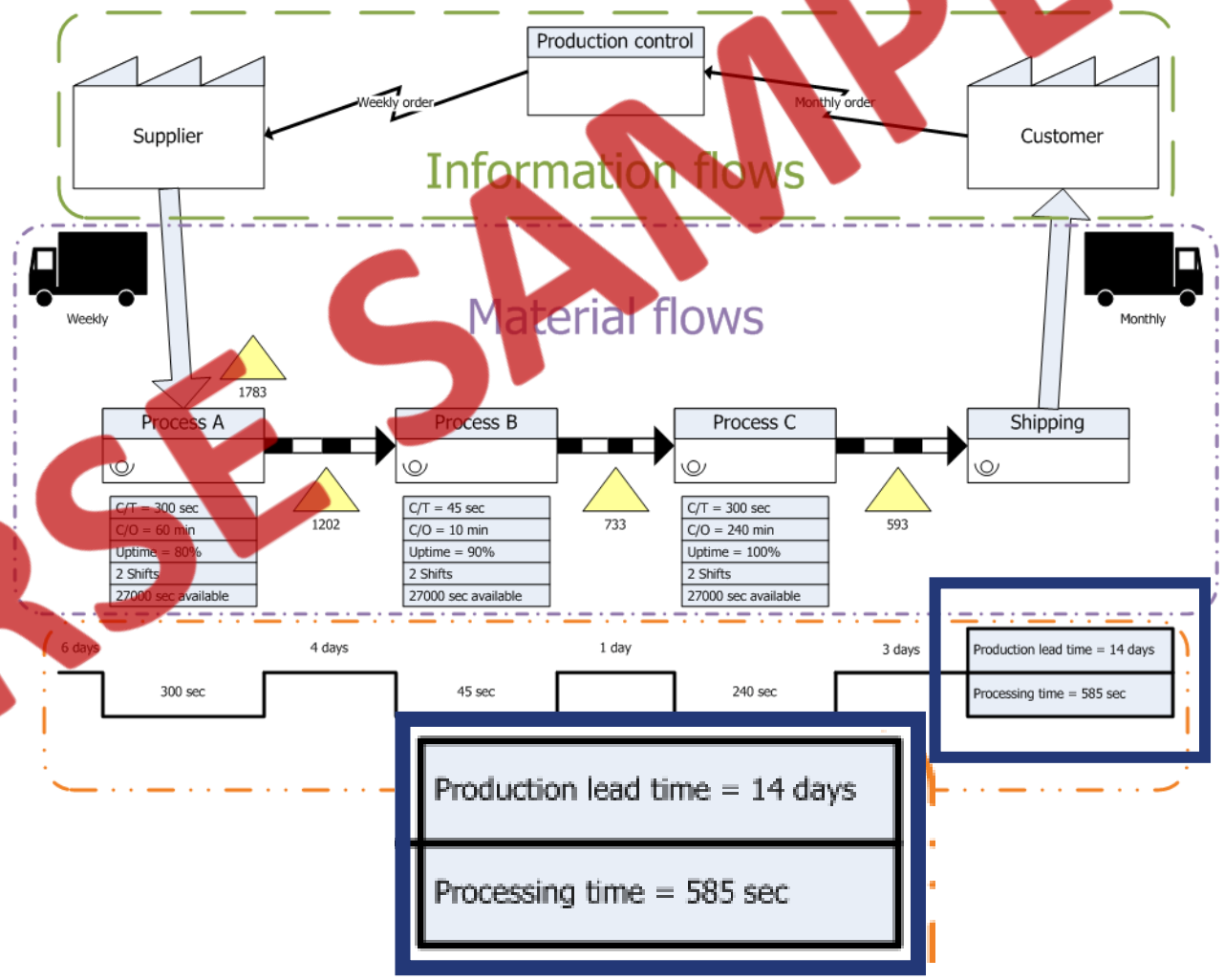
VALUE STREAM BALANCE AND FLOW

The value stream map (VSM) is the **format in which the stream of value-added activities is represented**. It begins with your customer and ends with your customer.

While most VSMs include all the activities in the process, including material and information flow, **the identification of both value-added and non-value-added activities is done.**

The value stream is concerned with **how and where value is added** rather than how the process itself is completed.



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Total Business ~780 Active PN's (non-zero volume)

Cut #1 (Top 20% of Parts)
(83% by **volume**, 87% by **weight** - ~241 Part #'s)

Cut #2 (Top 20% of Top 20%)
(70% by **volume**, 73% by **weight** ~153 Part #'s)

Header – 54%

Roll 30% (9% by Wt.)

IHT 13% (20% by Wt.)

Point 7% (8% by Wt.)

EHT 3% (2% by Wt.)

Boltmaker 10%

IHT 8% (13% by Wt.)

EHT 2% (1.5% by Wt.)

Cell 6%

IHT 5% (1.5% by Wt.)

IHT 22% (17% by Wt.)

EHT 5% (1% by Wt.)

OSP 1%

Roll 11%

OSP 1.5%

Roll 6% (6% by Wt.)

OSP 7% (13% by Wt.)

Wash 1.5%

OSP 3.5%

OSP 21% (17% by Wt.)

Wash 1%

OSP 7% (11% by Wt.)

Wash 3%

Roll 1%

Roll 1.5%

EHT 2.5%

Inspection 1%

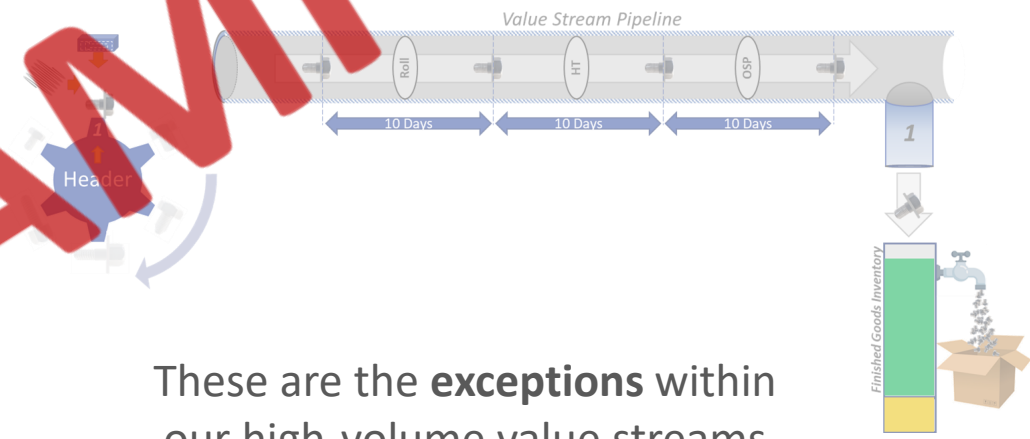
Insp. 5% (7% by Wt.)

Touch Roll 1% (3%)

Insp. 16% (11% by Wt.)

Touch Roll 1%

IND - HT 1%



These are the **exceptions** within our high-volume value streams

Additional 13% by volume or 14% by weight ~88 Additional Part #'s – Routing Analysis TBD

Top 20%

Bottom 80% of parts (550 Part Numbers)
17% by volume or 13% by weight

Bottom 80%

COURSE SAMPLE

Total Business ~780 Active PN's (non-zero volume)

HIGH-VOLUME BUSINESS

241 PN's
83%

153 PN's
70%

Cut #1 (Top 20% of Parts)
(83% by **volume**, 87% by **weight** - ~241 Part #'s)

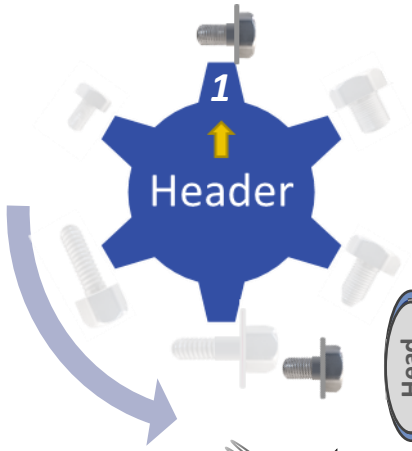
Cut #2 (Top 20% of Top 20%)
(70% by **volume**, 73% by **weight** ~153 Part #'s)

Lead Time = 42 DAYS ???

TOP 20 % VS # 1	XX PN's ?	HEAD	ROLL	IHT	OPS	INSPECT	XX DAYS ?
TOP 20 % VS # 2	XX PN's ?	HEAD	IHT	ROLL	OPS	INSPECT	XX DAYS ?
TOP 20 % VS # 3	XX PN's ?	HEAD	POINT	ROLL	IHT	INSPECT	XX DAYS ?
TOP 20 % VS # 4	XX PN's ?	BOLT-MAKER or CELL	IHT	OSP	INSPECT		XX DAYS ?

COURSE SAMPLE

Top 20 % Value Steam # 1 *(XX PN's XX Days)*

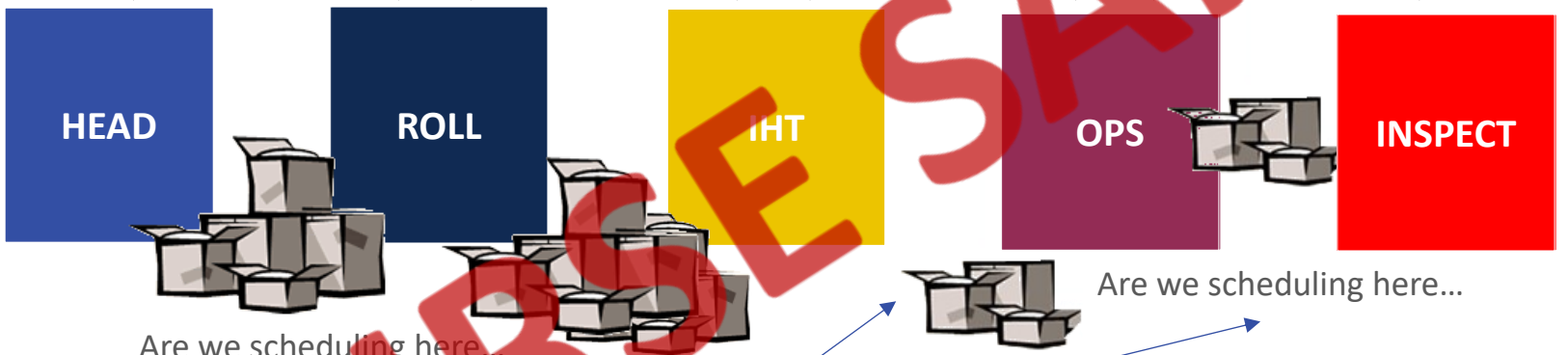


Value Stream Pipeline

X to XX Days | X to XX Days | X to XX Days | X to XX Days

X Day Interval Time

Our EPEI Interval is our **Single Point of Scheduling** for the Value Stream



Are we scheduling here…

Are we scheduling here…

Daily Customer Shipments "pulled" from **Finished Goods Inventory**

Work in Process (WIP) between operations indicates that **"flow" has been interrupted…**

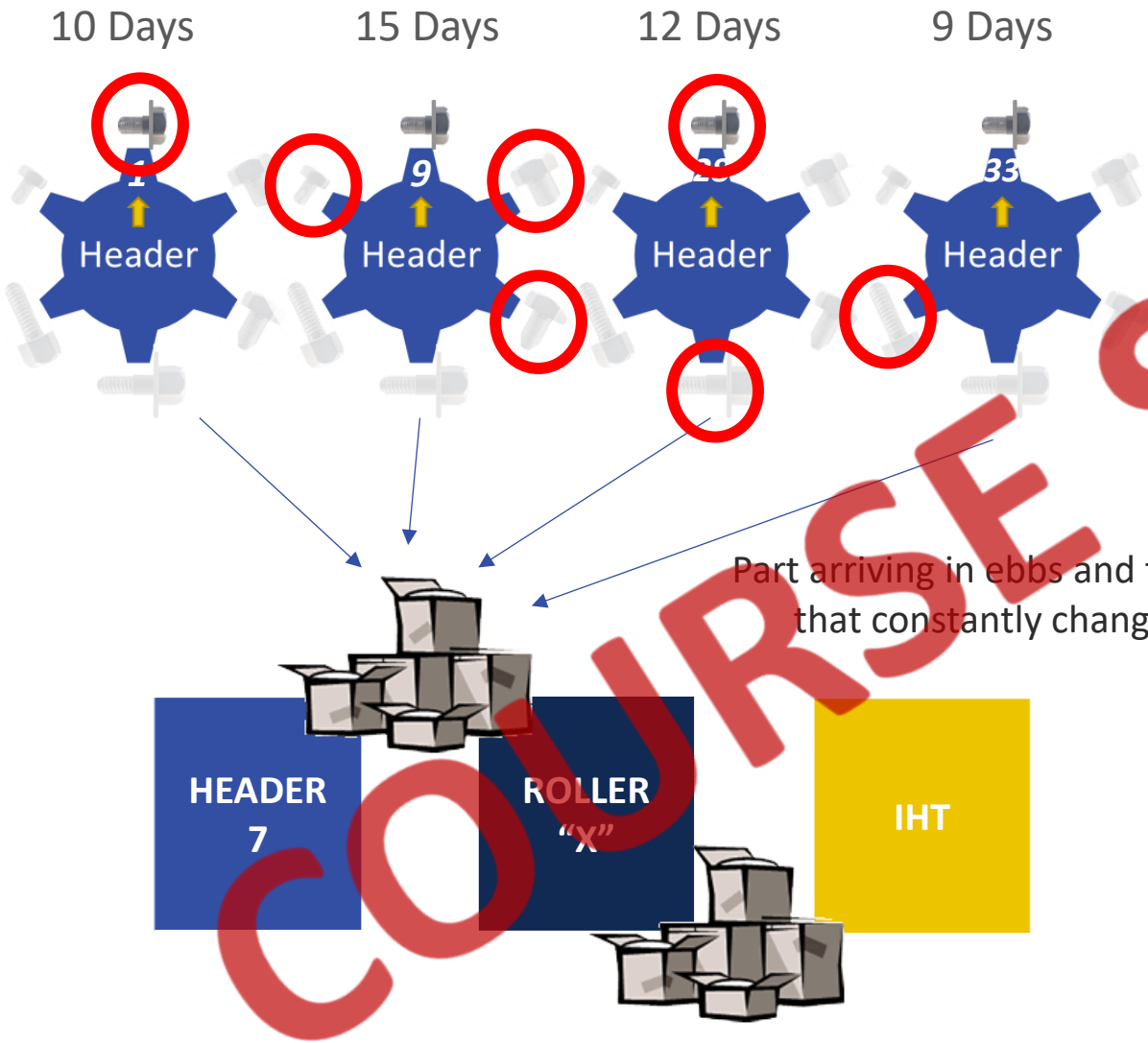
…which means that **lead times for parts will fluctuate**… our VS becomes **unpredictable**

- Could be a loading / routing issue…
- Could be a capacity issue…
- Could be a timing issue…
- Could be a staffing issue…
- Could be a staging / queue management issue…
- Could be a true **balance** issue…

*Whatever the case, **WIP adds to our Value Stream's Lead Time…** which **adds inventory…** which **puts cash in jail***

COURSE SAMPLE

VALUE STREAM BALANCE AND FLOW



Part arriving in ebbs and flows that constantly change

Multiple Headers with **varying intervals** all feeding the same Roller

Flow is *not being considered* in the **"Load Strategy"** for Rollers

Forcing a **second point of scheduling** at the Rollers

Not ***designing*** the Value Stream for ***flow***…

COURSE SAMPLE

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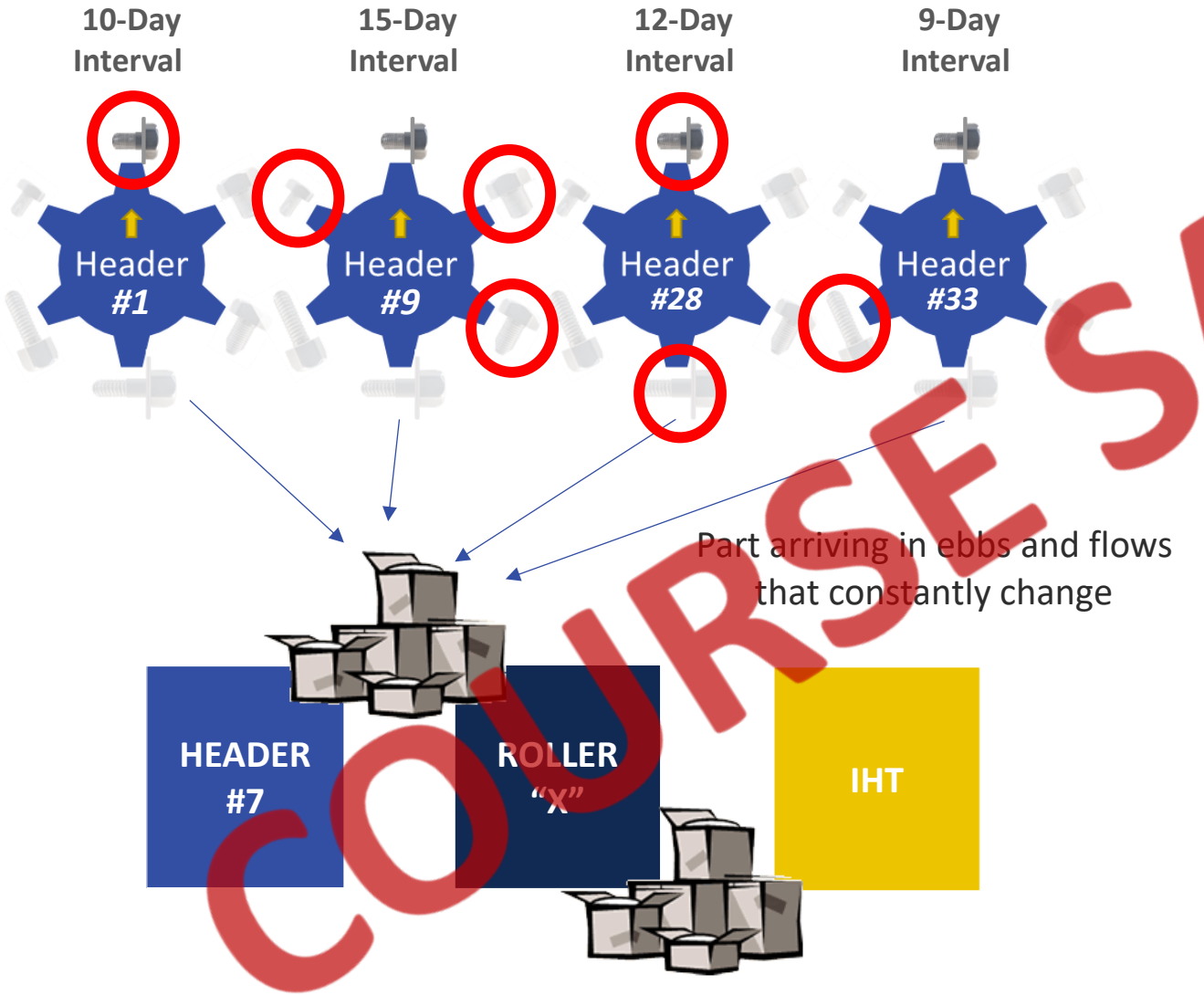
VALUE STREAM BALANCE AND FLOW



We need to **Balance the arriving work-load** from Headers with **the "Right" capacity** in a Roller or a **"bank of Rollers"**

We need to consider **Flow** from the headers in the **"Load Strategy"** for Rollers

We need to analyze **each "High-Volume" Value Stream Independently** so that flow between headers and rollers within each value stream is not **interrupted by "Low-Volume" parts**

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VALUE STREAM BALANCE AND FLOW

High-Volume Business

We want this to run like a balanced

"mixed model" production line that *"flows"*

with a

single point of scheduling via the Header's planned Cycle/Interval

Low-Volume Business

We want this to run like a traditional

"job shop" or a *"factory-within-a-factory"*

with

multiple points of scheduling after Heading via MRP

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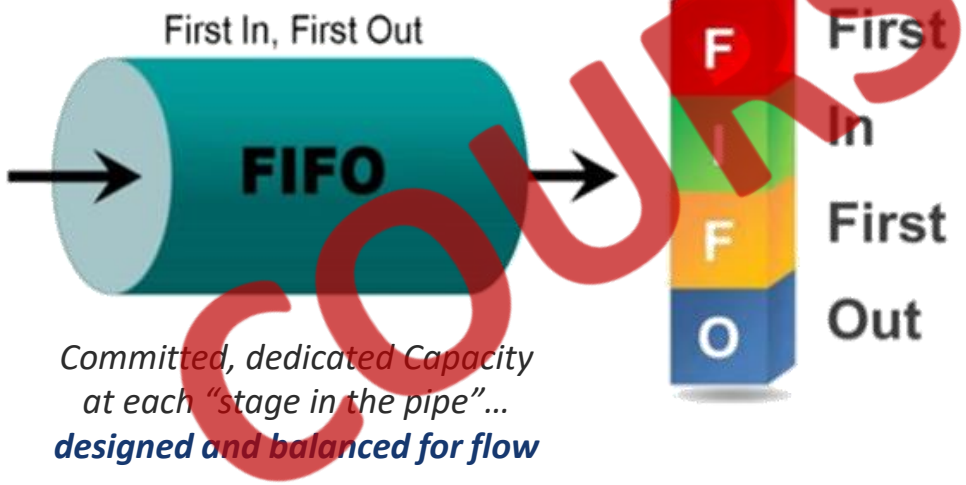
VALUE STREAM BALANCE AND FLOW

Same Value Stream… **same assets**	Same Value Stream… **not the same assets??**	Same Value Stream… **same assets ??**	Same Value Stream… **same Vendors ??**	Same Value Stream… **not the same assets**
HEAD	ROLL	IHT	OPS	INSPECT

Core Business

Flow = *little to no WIP, little to no Queue…*

Achieved through dedicated, balanced assets



Committed, dedicated Capacity at each "stage in the pipe"…
designed and balanced for flow

Job Shop = *WIP and Queuing Common*

Managed through shared assets

Factory-Within-a-Factory

MRP set priorities - WIP arranged into an MRP scheduled
Single Queue – Multi Server Model when possible

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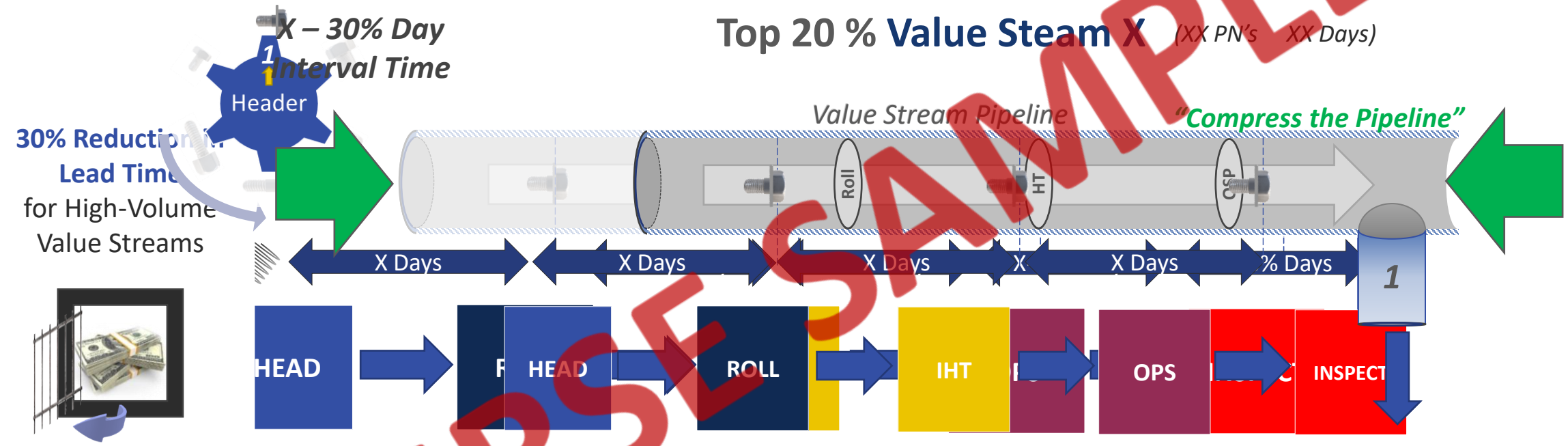
VALUE STREAM BALANCE AND FLOW



- **Use EPEI and the Optimizer tool as a Single Point of Scheduling** for each of the four High-Volume Business Value Streams
- Achieve the aggregate Header EPEI cycle (sequence & times) every interval – **perform to or beat the Optimizer plan standards**
- **Balance the processes in the Value Stream** to minimize any WIP & Queuing & **achieve flow**
- Stabilize the performance of the pipeline to **achieve or beat standard lead times – make the pipeline predictable**
- Over time, reduce lead times for top 20% parts by 30% or more = reduce inventories = **get cash out of jail**

COURSE SAMPLE

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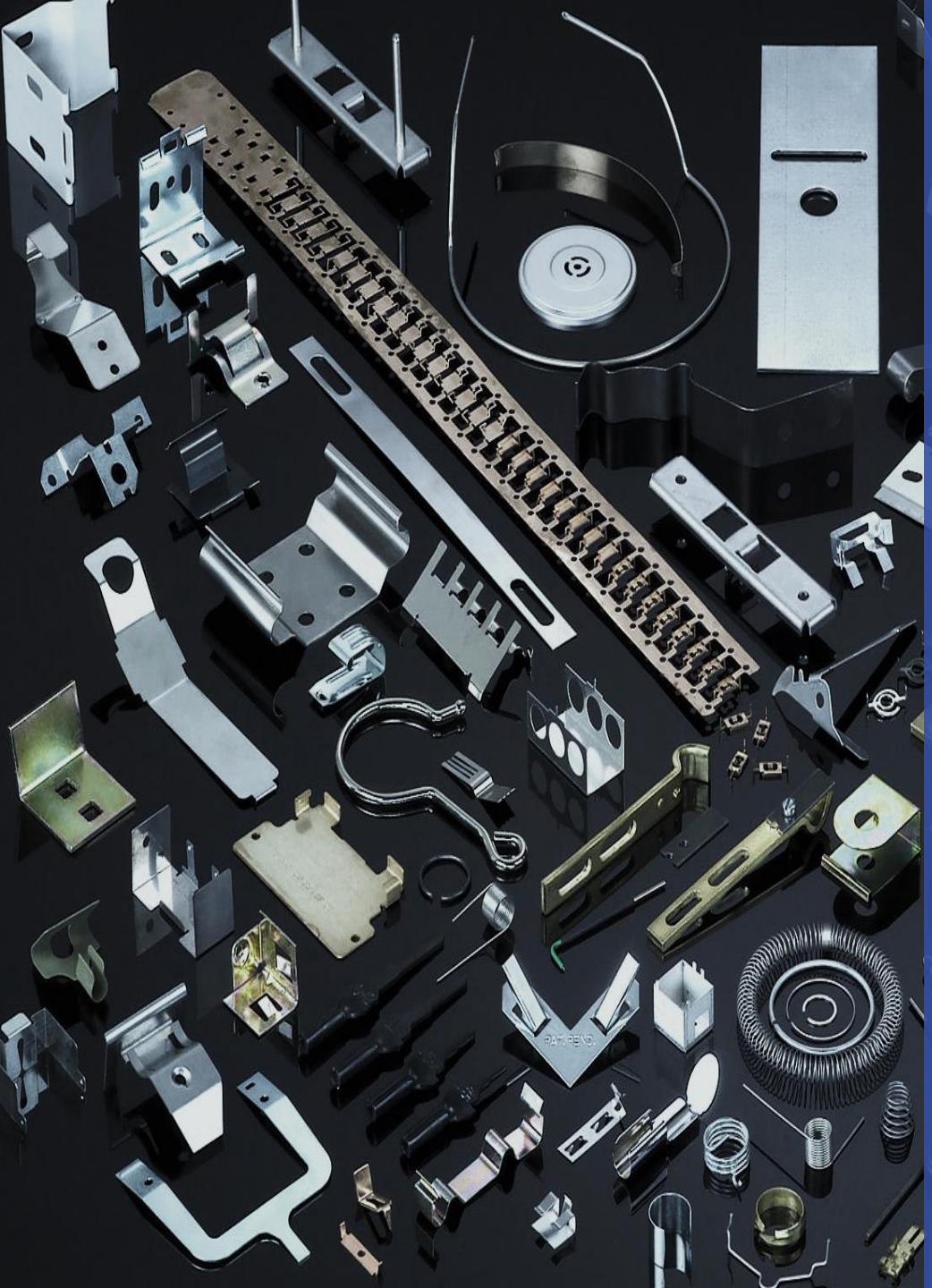


TOPIC #8

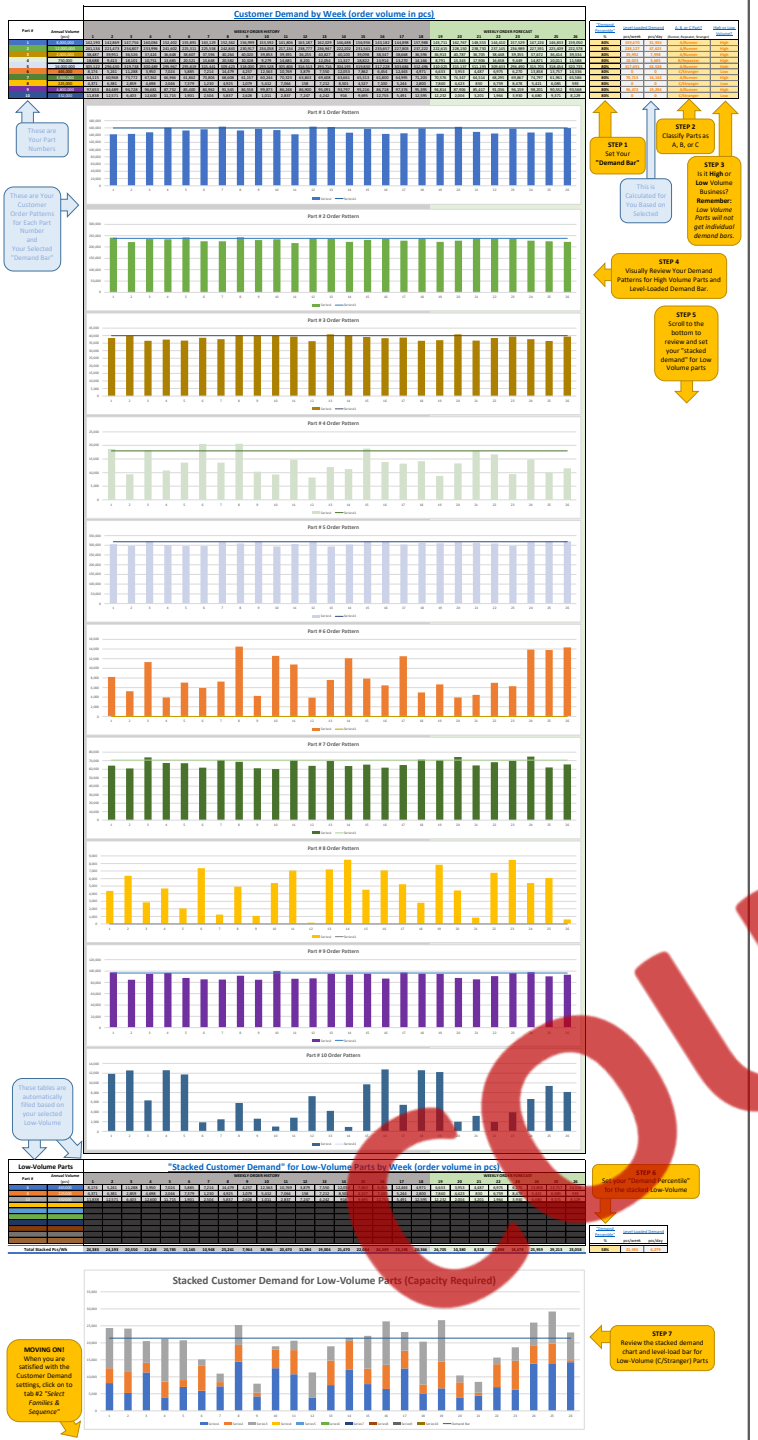
EXERCISE

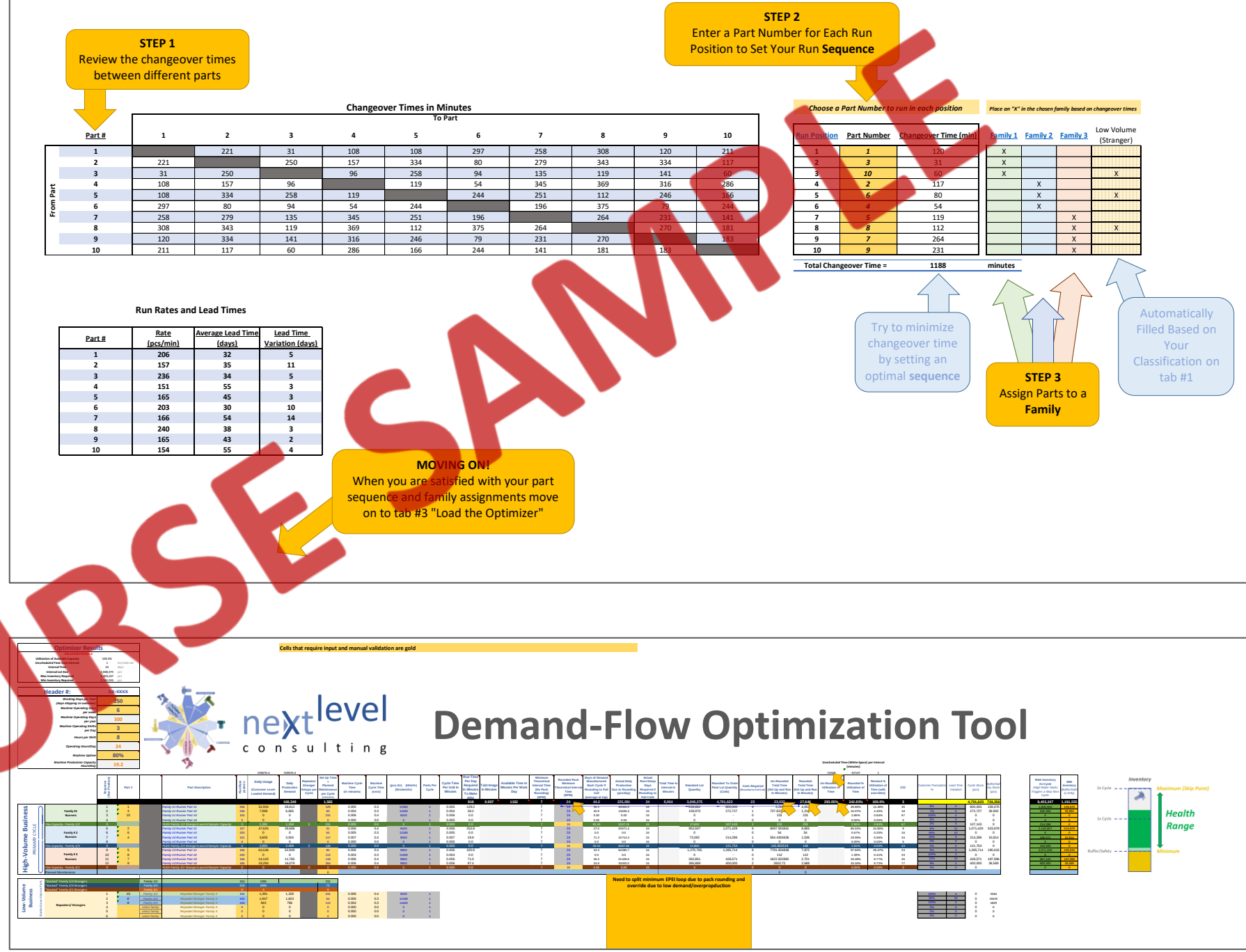
Bringing it all together…

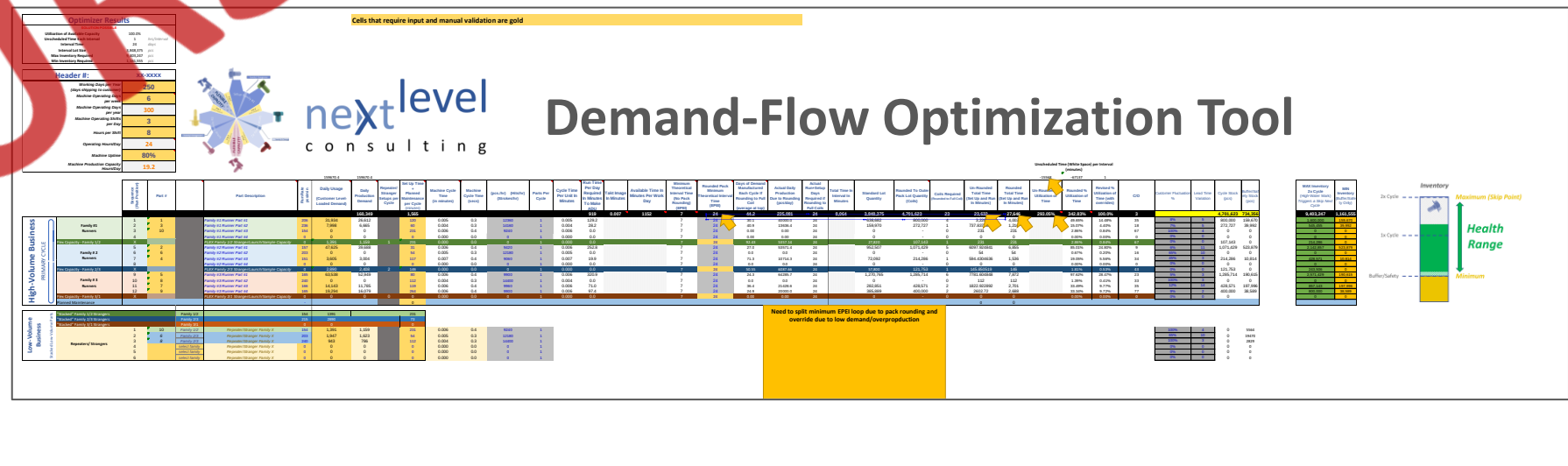
nextlevel

TRAINING

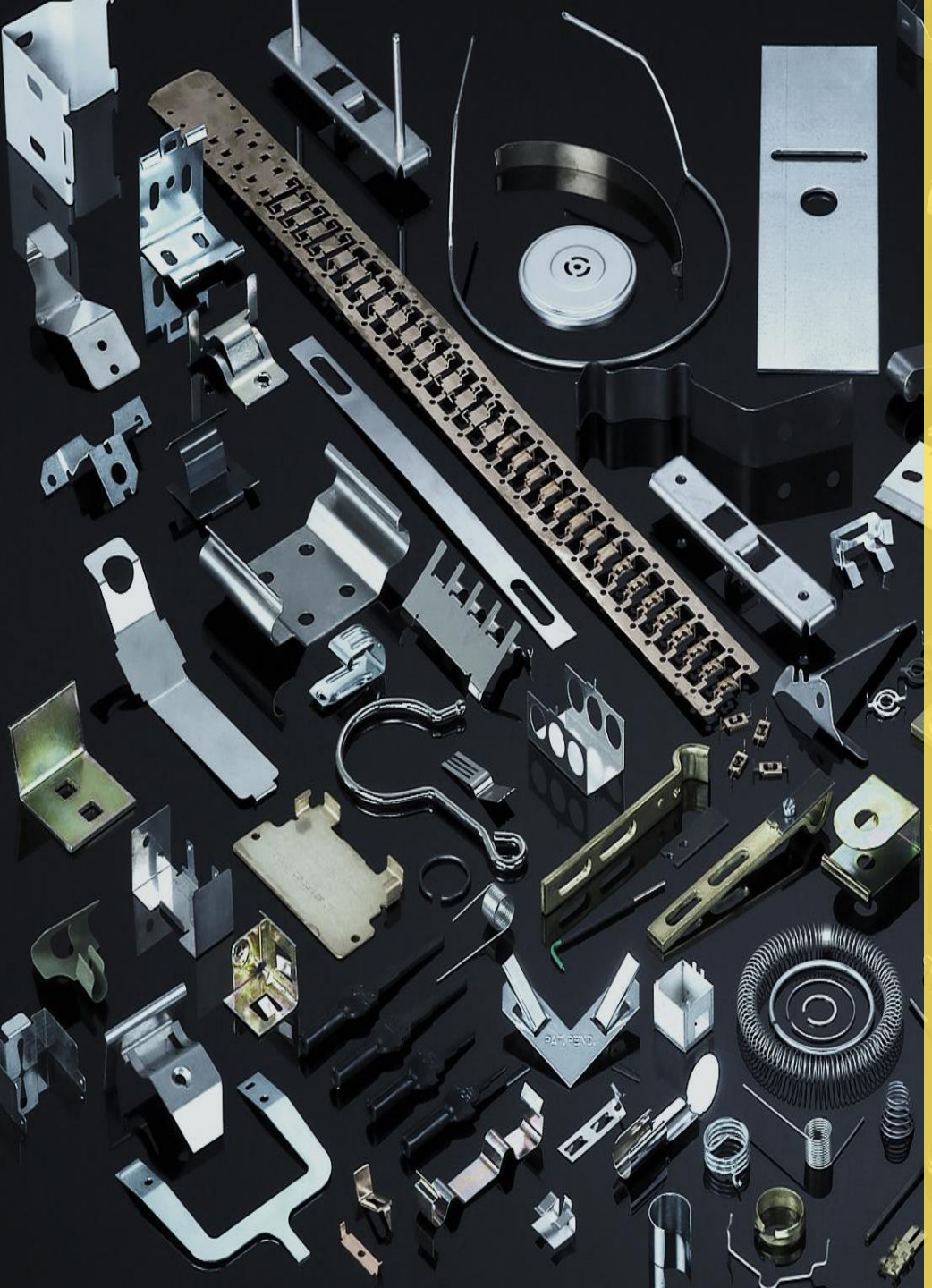
Forward. Upward.







COURSE SAMPLE



OPTIONAL CUSTOMIZED MODULE

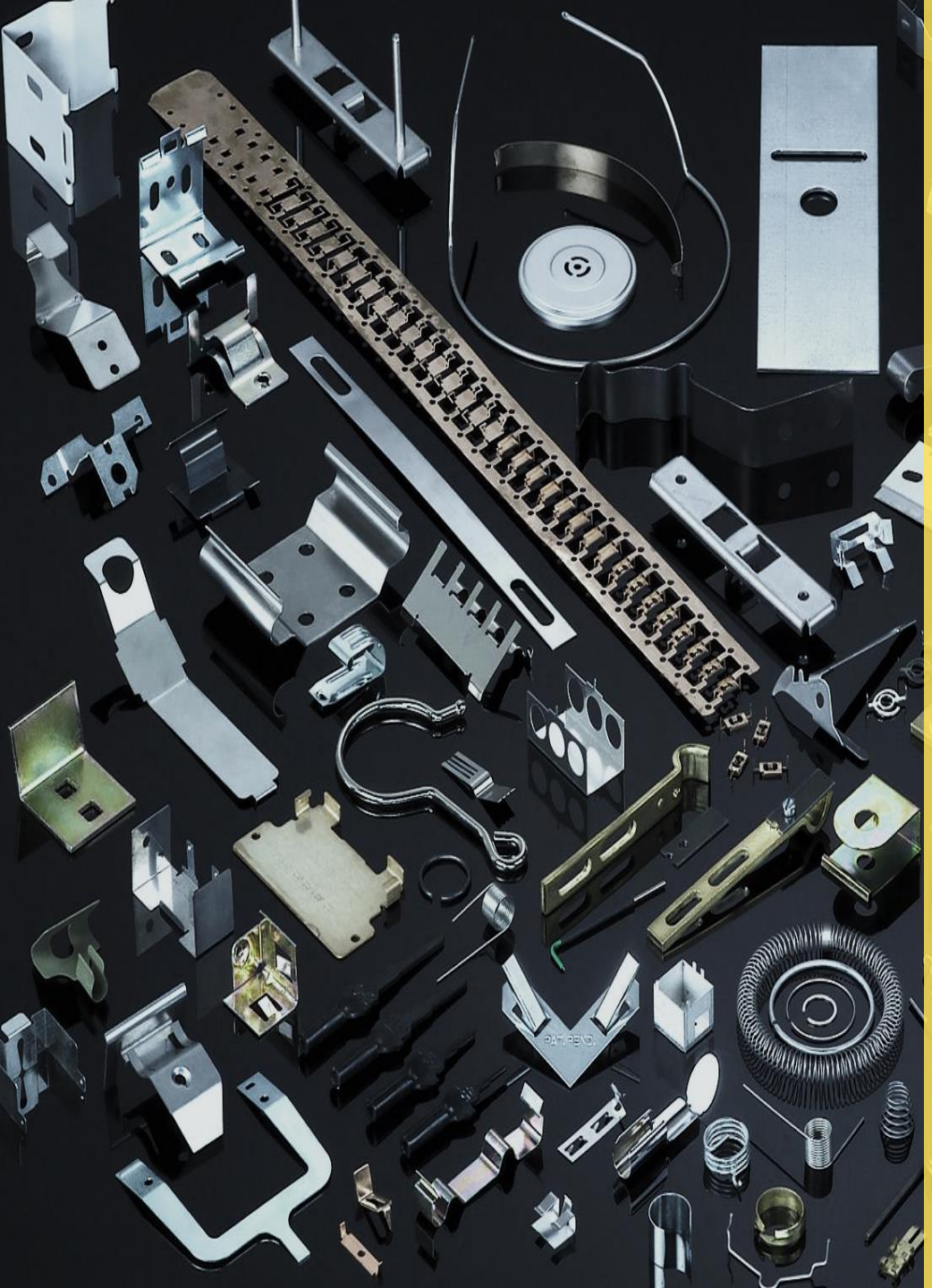
(TOPIC #6)

Breaking the Planned Cycle & Recovery

nextlevel

TRAINING

Forward. Upward.



OPTIONAL CUSTOMIZED MODULE

(TOPIC #7)

Self-Directed Work Teams

for

Cycle Improvement

nextlevel

TRAINING

Forward. Upward.