

HERBIE – AN INTRODUCTION TO WIP LIMITS

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Game: MotorCityGame.com

KANBAN

Method formally devised by Taiichi Ohno

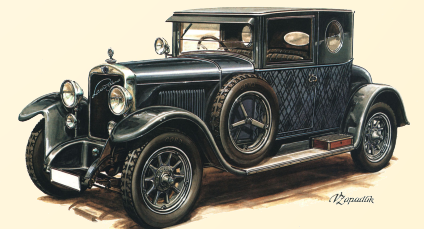
1. Visualize Your Work

- Make ALL work visible
- Make Policies explicit
- Identify Workflows

2. Limit Work in Progress

3. Improve Flow

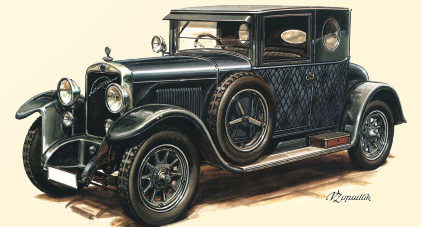
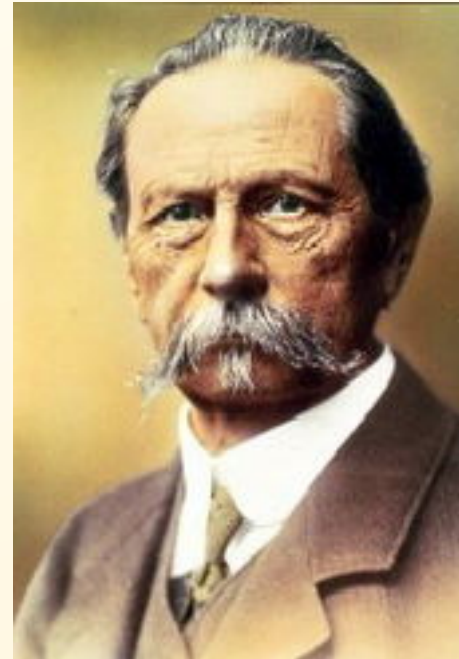
- Inspect and Adapt



MOTOR MANUFACTURING

Motor Car invented by...

- Karl Benz in 1886



ASSEMBLY LINE

Assembly line invented by...

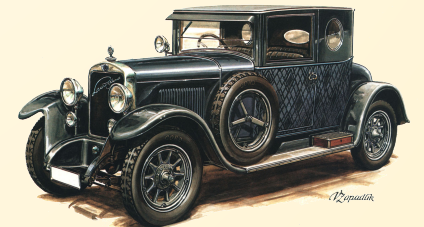
- Marc Isambard Brunel (1803)

Motor Car Assembly line by...

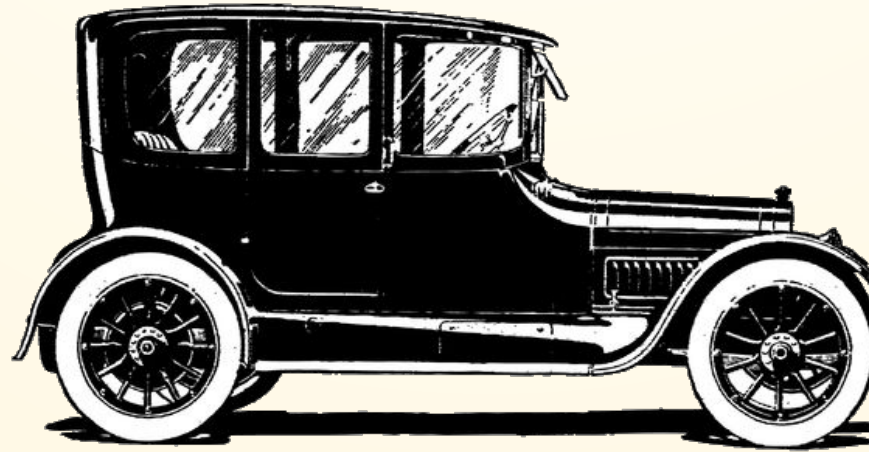
- Ransom E. Olds

What about Henry Ford?

- He invented the Moving Assembly Line

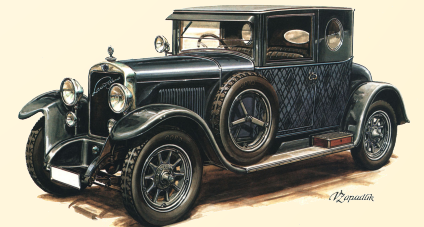


WHY WAS THE MODEL T ONLY AVAILABLE IN BLACK?



Model T came off the line every 3 minutes, taking just 93 minutes to build one.

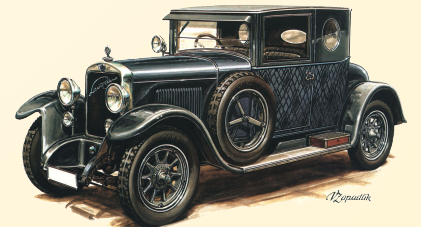
Only the black paint would dry fast enough until a new paint was developed 12 years later in 1926



WHY DOES THAT MATTER?

An assembly line/replaceable parts is the first time people were not working towards a specific and visible end product.

Prior to that over production or under production was not an issue in the same way.



TERMS

MOTOR CITY

A KANBAN GAME

AVAILABLE PRODUCTION POINTS

Order Number

Invoice Date

Completion Date

MP

SELECTED	MANUFACTURE <small>WIP Limit</small>	ASSEMBLY <small>WIP Limit</small>	QUALITY <small>WIP Limit</small>	PAINT <div>Cycle 1 Cycle 2</div>	DONE
<div></div>				<div><div></div><div></div></div> <div></div> <div></div> <div></div>	<div></div>

WORK IN PROGRESS

4373

14th North Blvd.
and Townsend Blvd.
Croydon

Received with Order # 4373

the sum of £ 9.99

TO
LTD.

It is our desire to execute all orders, and carry out all work entrusted to us, to the entire satisfaction of our customers. Should occasion for any complaint arise, kindly communicate at the earliest opportunity with the Managing Director.

IN PROGRESS

CONWIP Limit

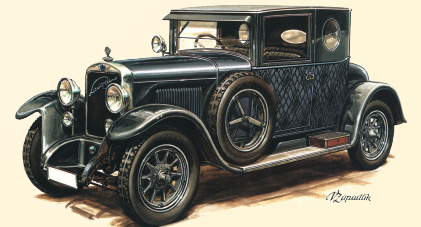
YORKESOFT

Replica

WORK IN PROGRESS LIMITS

Why might we use WiP Limits?

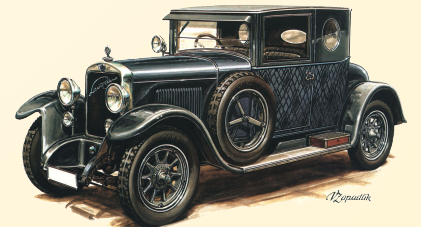
1. Help Identify bottlenecks
2. Improve cycle time
3. Reduce Inventory Costs
4. Ability to respond to change more quickly
5. Encourage T-shaped people
6. Lack of explicit policy creates confusion
7. Increase Throughput



WORK IN PROGRESS LIMITS

Why might WiP Limits be undesirable?

1. Too tight – can starve your flow and reduce throughput
2. Too loose and you don't see the problems
3. Not always easy to understand or apply
4. Encourages T-shaped people*



MORE TERMS

MOTOR CITY
A YORKE SOFTWARE GAME

AVAILABLE PRODUCTION POINTS

Order Number _____
Invoice Date _____
Completion Date _____

SELECTED

MANUFACTURE
WIP Limit _____

ASSEMBLY
WIP Limit _____

QUALITY
WIP Limit _____

PAINT
Cycle 1 Cycle 2

DONE

Cycle Time

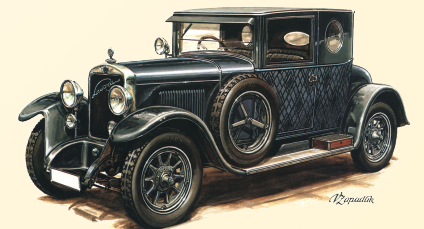
Wait Time

Lead/Delivery Time

It is our desire to execute all orders, and carry out all work entrusted to us, under entire satisfaction of our customers. Should occasion for any complaint arise, kindly communicate at the earliest opportunity with the Managing Director.

TO LTD.
YORK

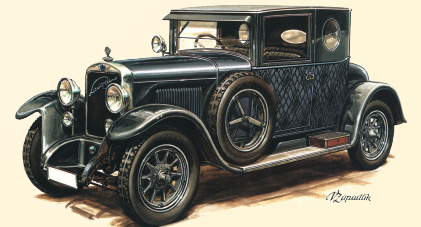
YORKESoftware.com



FORECASTING – LITTLE'S LAW

- A Customer has asked when his car will be complete, he is not asking to expedite merely to forecast.
- Little's Law – Mathematical theory on queues
- Average Cycle time = Average WiP/Average Throughput

BORING!

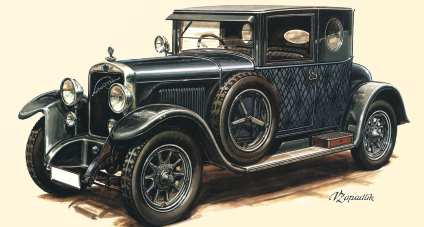


LITTLE'S LAW – IN STARBUCKS



Minutes until I get coffee = $\frac{\text{Number of people in line}}{\text{people served per minute}}$

$$\frac{11 \text{ in line}}{1 \text{ per minute}} = 11 \text{ minutes to get coffee}$$



LITTLE'S LAW – IN STARBUCKS

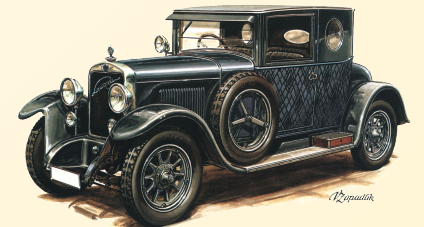


- Minutes until I get coffee = $\frac{\text{Number of people in line}}{\text{people served per minute}}$

How do I get served more quickly?

Option 1 – Reduce the number of people in the queue

Option 2 – Increase the number of people served each minute



HOW MIGHT YOU LIMIT WORK IN PROGRESS?

What can we learn from the past?

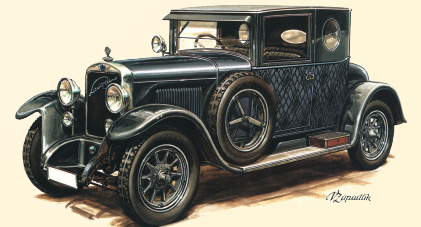
- Henry Ford, observed excess WiP and reduced space
- Taiichi Ohno, used cards to limit items worked on
- Eli Goldratt, observed that WiP is constrained only by your bottleneck
- Balance production line, all workstations to have same average throughput/cycle time.*



WIP LIMITS IN KANBAN

There are 4 broad types of WiP Limits that I have observed in Kanban.

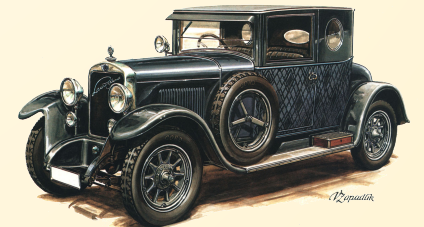
1. Column WiP Limits (Henry Ford)
2. ConWiP Limits (Taiichi Ohno)
3. DBR - Drum, Buffer, Rope (Eli Goldratt)
4. Balanced Production to Maximize Efficiency (USA Motor Industry) *



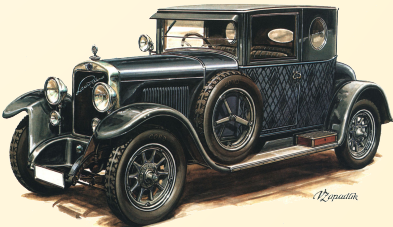
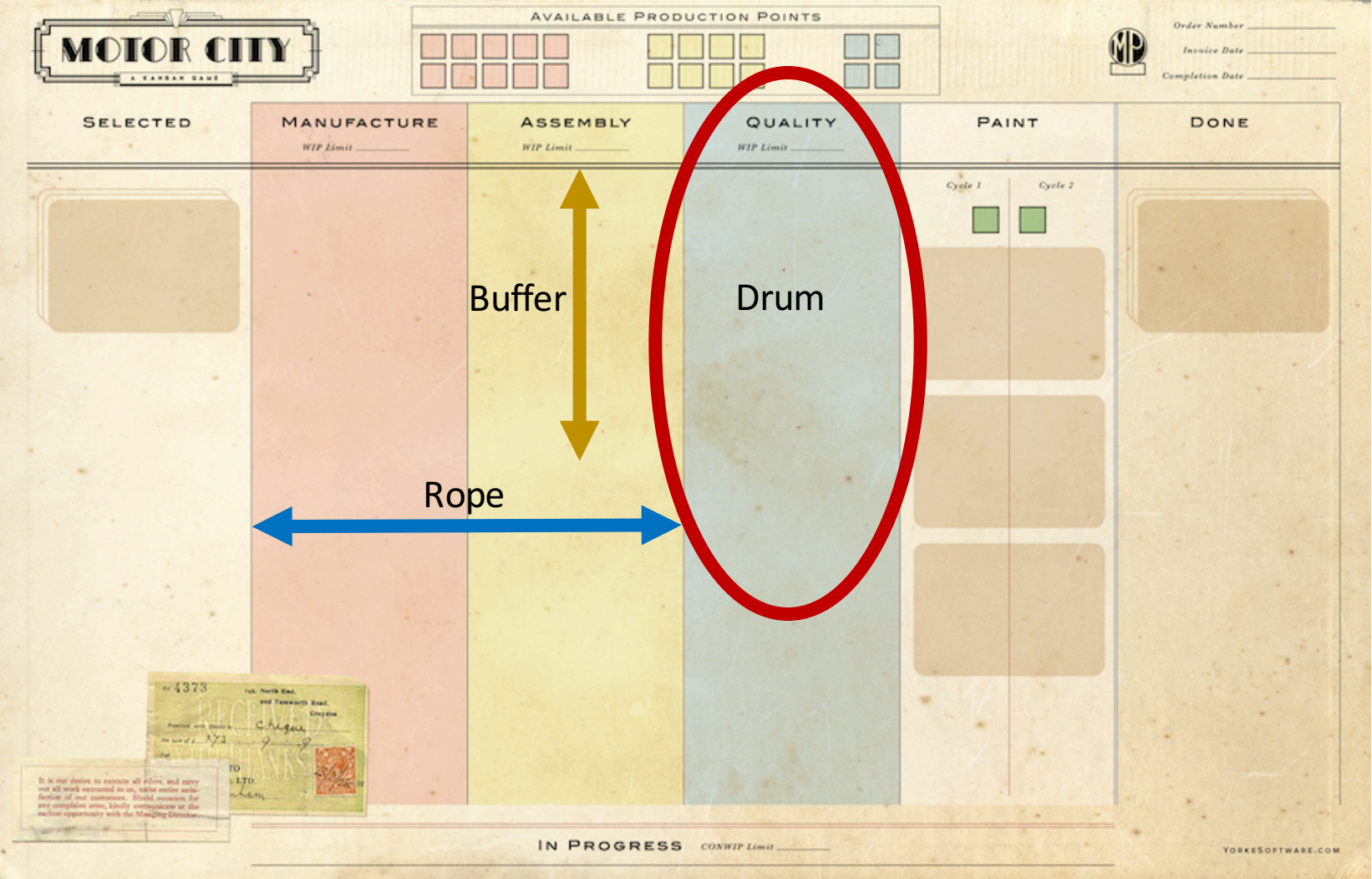
WIP LIMITS

The image shows a Motor City Kanban board, a tool used for managing production flow. The board is divided into several columns representing different stages of production: **SELECTED**, **MANUFACTURE**, **ASSEMBLY**, **QUALITY**, **PAINT**, and **DONE**. Each of these columns has a **WIP Limit** (Work In Progress Limit) indicated by a line. These limits are highlighted with blue circles. Above the columns is a section for **AVAILABLE PRODUCTION POINTS**, which consists of a grid of colored squares (red, yellow, and blue). To the right of the board, there are fields for **Order Number**, **Invoice Date**, and **Completion Date**. The **PAINT** column is further divided into **Cycle 1** and **Cycle 2**, each with a green square icon. At the bottom of the board, there is an **IN PROGRESS** section with a **CONWIP Limit** (Continuous Work In Progress Limit), also highlighted with a blue circle. In the bottom left corner, there is a small card with the number 4373 and some handwritten notes. The bottom right corner of the board has the text **YORKESoftware.COM**.

If a Wip limit exists it cannot be exceeded at any point in the turn.



DRUM-BUFFER-ROPE - HERBIE



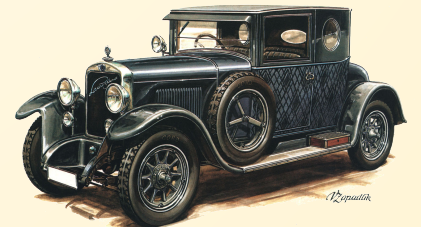
THE MYTHICAL BALANCED SYSTEM

In a balanced system the desire is to attempt to have all workstation's average production to be equal.

Mathematically this gives the superficial impression that you can maximize utilization without hurting throughput.

However it ignores reality,

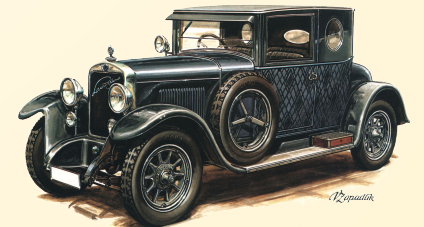
- All workstations have statistical variations
- Work (especially in software) is not consistent
- The focus is on utilization rather than throughput.



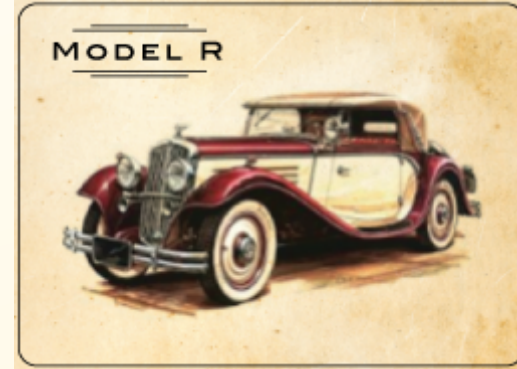
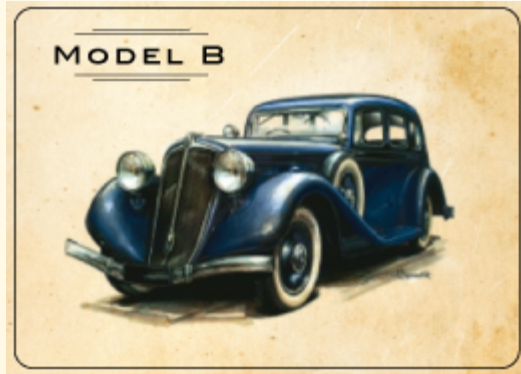
MOTOR CITY EXPERIMENT



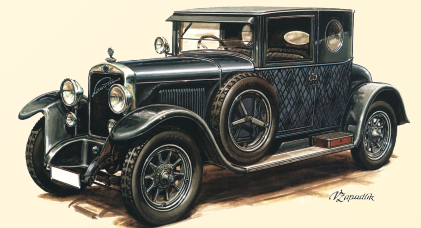
- Teams will run for 8 iterations(hours)
(dice rolled by facilitator)
 - Compare throughput – How many completed cars
 - Teams will review progress, What would you change?
 - Can you see a bottleneck?



MOTOR CITY EXPERIMENT

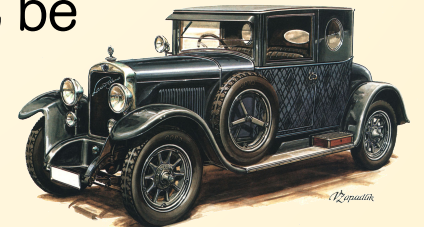


- How many cars are still in flight?
- In manufacturing the blocks represent effort and materials, in software it is the same, code is our inventory and it costs real money.
- Our client/Employer pays for our time and so their expense reflects work in progress AND completed items
- Whose cost is highest?



DO WIP LIMITS HELP US?

- What are the consequences of too tight or too loose limits
- Why should WiP limits be explicit?
- Which WiP limit style is best?
 - In the game, when used correctly Throughput should be the same, only amount of WiP is impacted.
 - Understanding your workflow and your limitations is key. E.g. Only have a designer 1 day a week then ensure there is a buffer of work for them.
 - If Devs regularly get ahead of testing or deployment, then limit Dev column to encourage leaving comfort zone.
 - Simple is usually easier – system wide limit focuses on flow, but be aware of buffering work for constraints



SUMMARY

Why might we use WiP Limits?

1. Help Identify bottlenecks
2. Improve cycle time
3. Reduce Inventory Costs
4. Ability to respond to change more quickly
5. Encourage T-shaped people
6. Lack of explicit policy creates confusion

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