OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

MB ILM

FAKULTÄT FÜR MASCHINENBAU
INSTITUT FÜR
LOGISTIK UND MATERIALFLUSSTECHNIK

Supply Networks

Toyota Motor Manufacturing, U.S.A., Inc.

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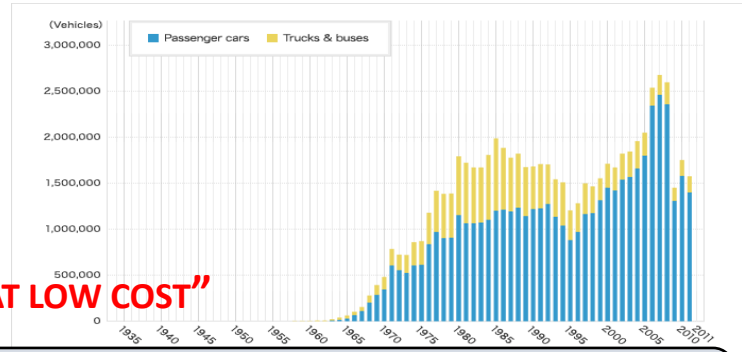
Team 3

WS 23/24

Background

In the early 1980s, Japanese auto makers considered building cars in North America for 2 reasons.

- The high trade barriers and tariffs imposed on the imported cars made them more expensive.
- Rapidly rising value of yen improved the economic feasibility of the such investment.



UNCERTAINITY - CARS PRODUCED OUTSIDE JAPAN COULD LIVE UP TO THE REPUTATION? – "HIGH QUALITY AT LOW COST"

1988 – Toyota Motor Manufacturing, U.S.A.(TMM) started production on 1,300 acre site in Georgetown, near Lexington.

TOYOTA CAMRY SEDAN

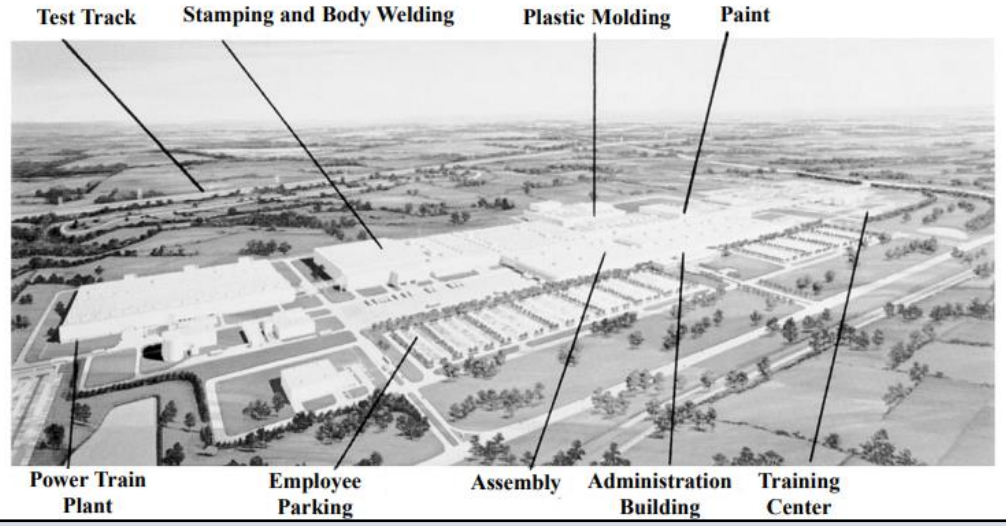
1992 – TMM was expected to supply 240,000 all-new Camrys, because the sale was up by around 20% since the model change in 1991.

TOYOTA CAMRY WAGON

1992 – For the first time TMM started producing wagon versions of the new Camry exclusively with Toyota's worldwide plant network.

The new Camry priced at $18,500 joined the ranks of midsize family sedans which were 1/3rd the total American car market and returned average 17% pretax profit margin on the price.

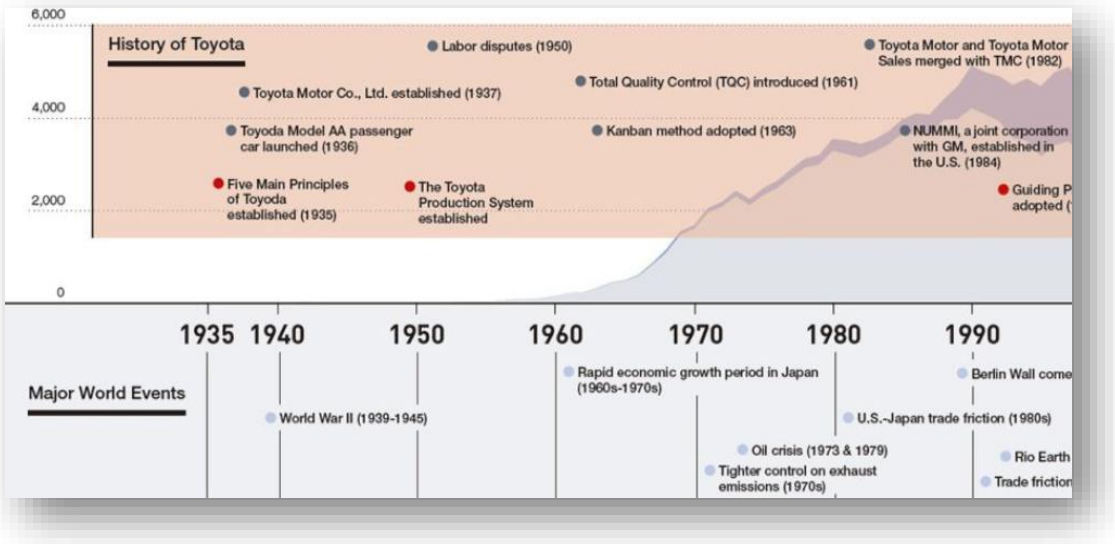
1985 – Toyota Motor Corporation(TMC) unveiled its plan to open $800 million greenfield plant in Kentucky.



Plant's Annual capacity – 200,000 Camry sedans – to replace the bulk of Japanese imports of the same model.

Toyota Production System

MOTTO - “Better cars for more people”



Difficulties After Second World War:

- Most people in Japan could not afford a car even with the low price – Low Economy.
- Japan’s labor productivity was only 1/8th of that of the United States.

So, in total Toyota had to cut cost dramatically, but without the scale economies that American firms enjoyed.

SOLUTION??

Toyota Production System (TPS)

TPS aims at cost reduction by thoroughly eliminating waste.

The Toyota Production System (TPS) centers on the identification and elimination of seven types of waste, collectively termed "Muda." These encompass overproduction, excess inventory, unnecessary motion, waiting time, needless transportation, overprocessing, and defects.

But, Identifying waste in reality was, no simple matter.

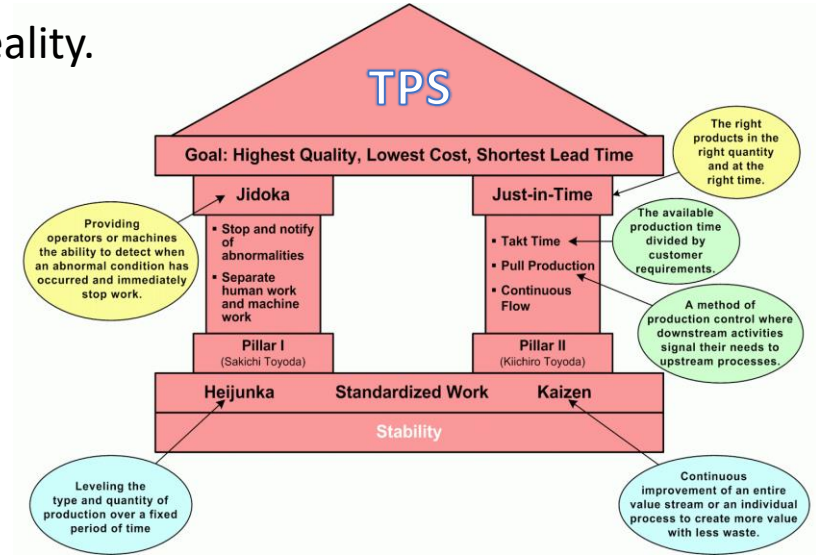
JIT & JIDOKA

TPS provide two guiding principles to facilitate the process of identifying waste in reality.

- **Just-In-Time(JIT) production :** Manufacture precisely what's necessary, in the exact amount, precisely when it is required
- **Jidoka principle :** Instantly reveal production issues and halt production upon their detection

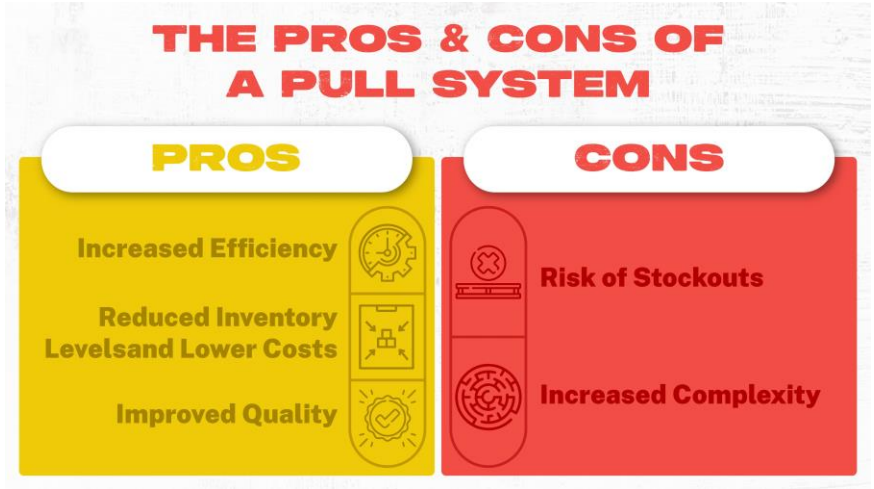
TPS defined "needs" and "value" from the viewpoint of the next station down the line, that is, the immediate customer

Let's consider a simplified example in a manufacturing setting: Imagine a car assembly line following the principles of the Toyota Production System (TPS).



SEQUENTIAL PULL SYSTEM

With TPS, the system is designed to respond to real-time demand. So, let's say the assembly line operates based on the number of cars actually being assembled downstream. As soon as a car on the assembly line needs a door, a signal is sent to the door manufacturing area to produce and supply only the necessary number of doors needed at that moment.



Tools Used:-Kanban, Heijunka, Andon Pull Systems, etc…

Human infrastructure

Toyota's Corporate Slogan " **Good thinking, Good Products**" depended on human Infrastructure.
Plants applying Jidoka and JIT were at high risk of shutdowns and would be paralyzed without people capable of solving exposed problems promptly.
Therefore Toyota recognized the importance of cultivating culture of "Good Thinking". This was achieved through coaching by senior management and internal training programs.

"Five Whys"

Problem: Welding robot breakdown!

WHY Fuse melted due to overloading

WHY Bearing lubrication was inadequate

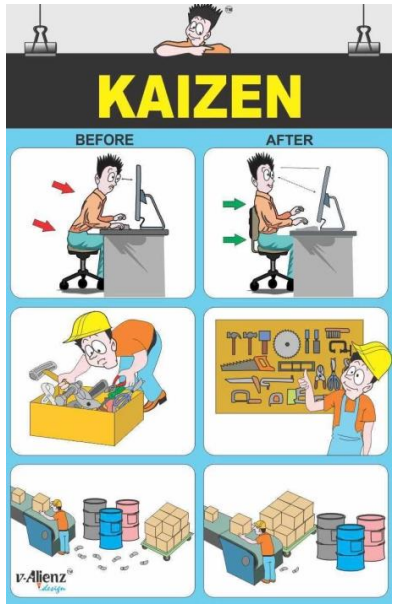
WHY Oil pump did not draw enough oil

WHY Metal shavings were sucked into the pump

WHY There was no filter on pump intake

Install Oil Filter

Kaizen



Kaizen was later indispensable in pursuing TPS goals continuously and indefinitely

Transplanting TPS: TMC's Vision & TMM Development

In 1987

TMM Georgetown started with the assignment of the **Camry from Tsutsumi**. The production line was meticulously replicated with **a deliberate slow ramp-up**.

Training trip to Tsutsumi in 1987

Saw top managers immerse themselves in a month-long experience. Personalized, one-on-one training fostered a deep understanding of **Toyota Production System (TPS) principles**.

Fujio Cho's vision

For TMM emphasized safety, quality, and productivity, aspiring to **make TMM a truly American company** contributing to the community.

1992

Georgetown experienced remarkable growth with over 4,000 employees, a $150 million payroll, and ongoing construction to double TMM's capacity.

1992 Toyota Camry

TPS Impact in Georgetown

- Georgetown's power train plant fuels the assembly line, mastering various operations from stamping to assembly.
- Engines and axles flow seamlessly from the power train plant to assembly, showcasing a synchronized production process.
- TPS, ingrained in daily practices, is the cornerstone of efficient management, ensuring continuous improvement.
- **Mike DaPrile's insight:** TPS shines a light on problems for swift resolution, making everyone at Georgetown perpetual learners.
- Georgetown's success lies in the commitment to TPS—**a journey of shared learning.**

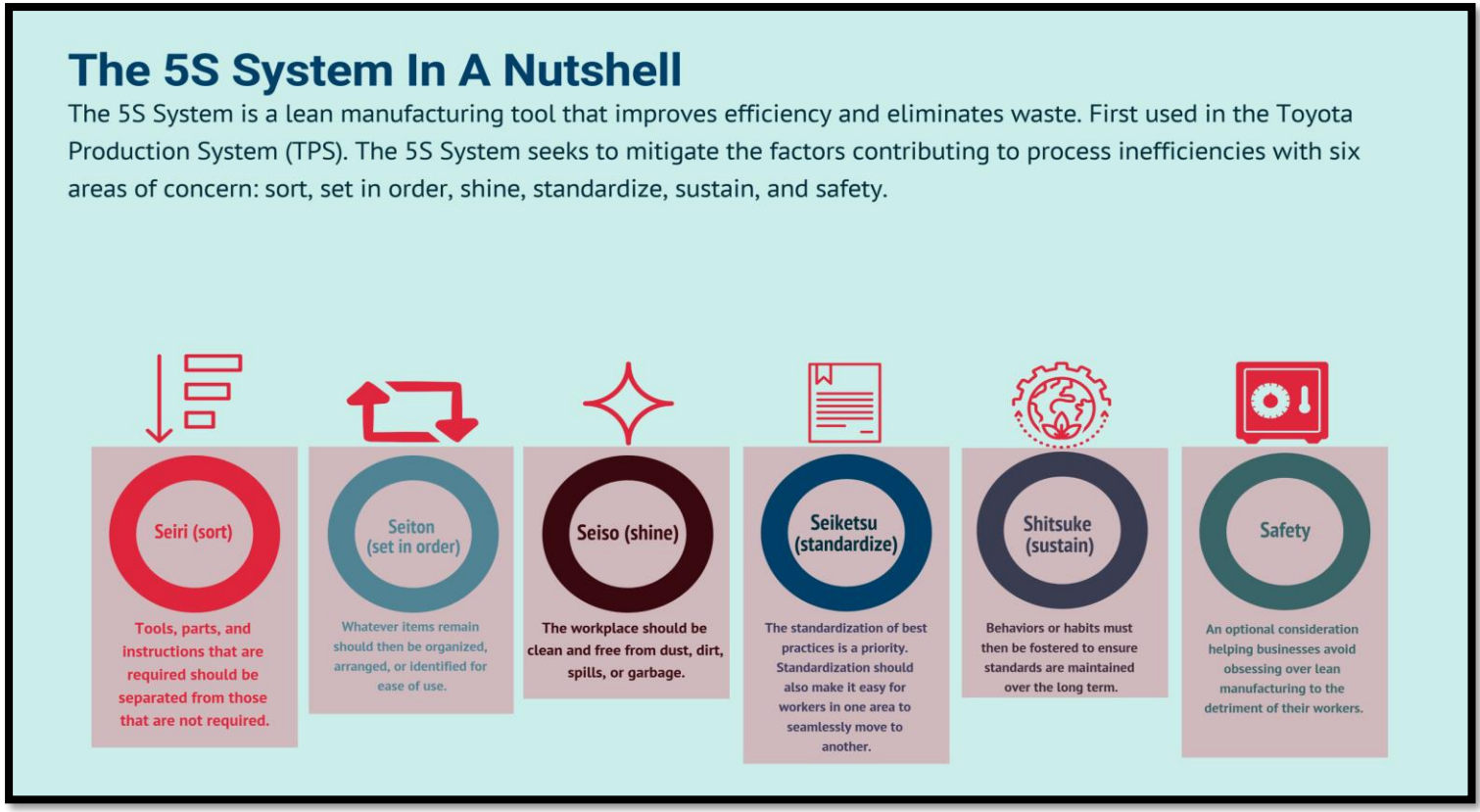
Toyota Georgetown Production plant

Efficiency in Assembly: TMM Overview

Assembly Line Overview:
353 stations, five-mile conveyor line with distinct segments.
Line cycle time: 57 seconds, optimized from the startup's 60 seconds.
769 team members in two shifts, supervised by Doug Friesen.

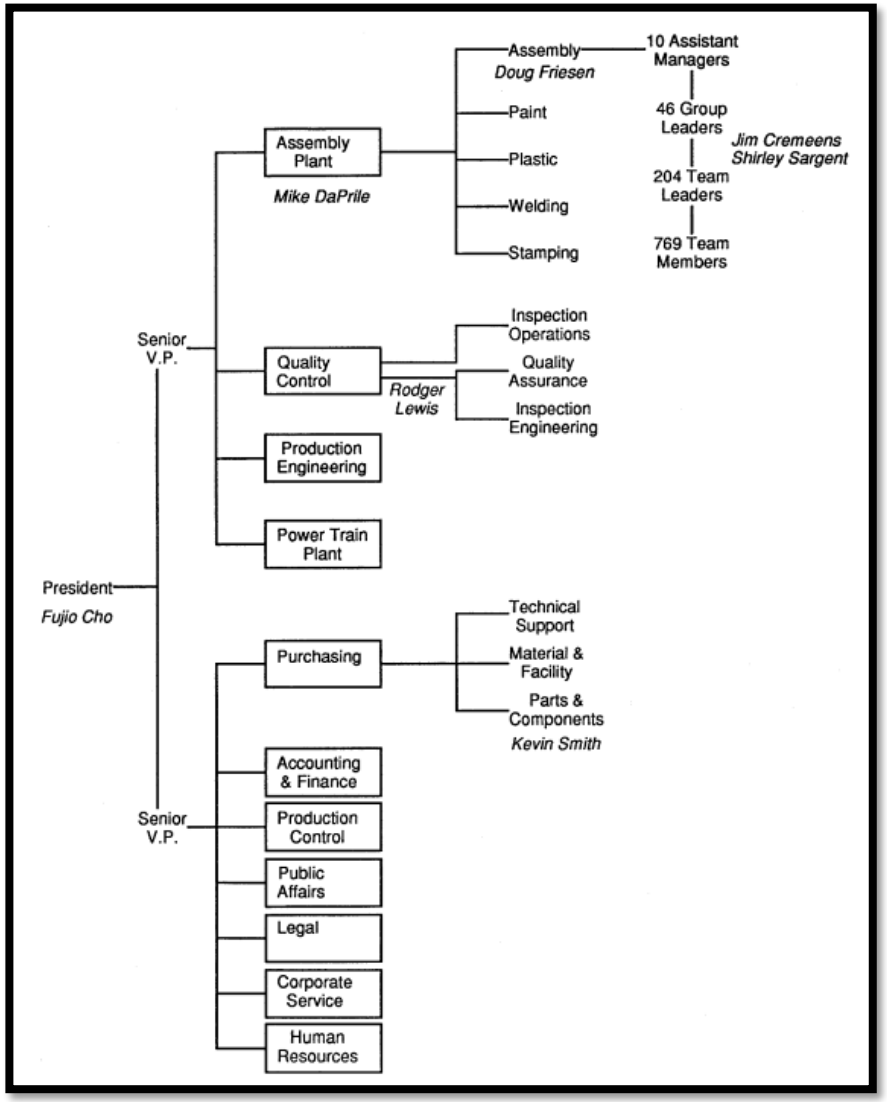
Operational Details:
•Line cycle time: **57 seconds** (down from 60 at startup).
•Team structure**: Four members and one team leader** per team.
•Doug Friesen's management team: 10 assistant managers and 46 group leaders for two shifts.

Work Environment and Tools:
•**Jidoka and kaizen** tools at every station.
•Standardized work charts at each station.
•Colored tape marking areas and **promoting "5S" principles.**

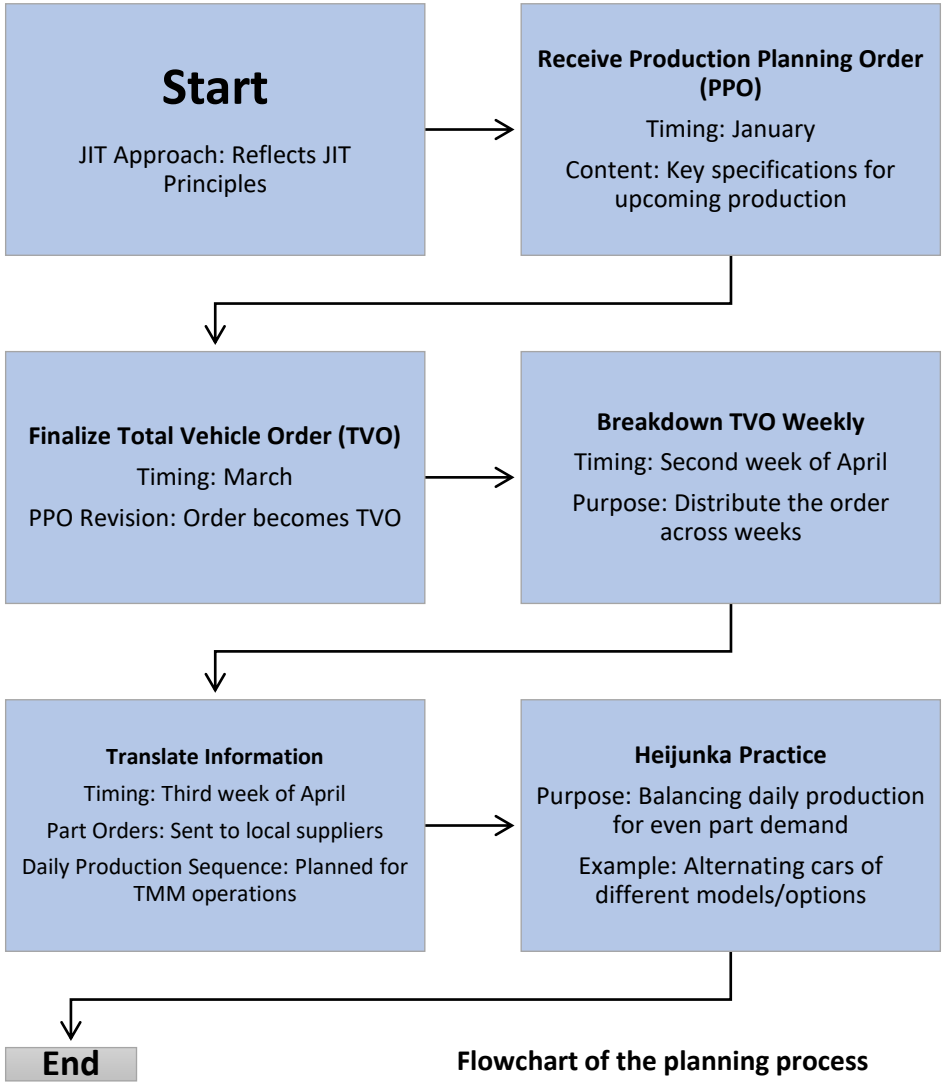


Production Control (PC) Department Overview"

TMM Schematic Organization Chart



JIT Planning Practices



Flowchart of the planning process

- **JIT Approach:** Reflects Just-in-Time (JIT) principles.
- **Production Planning Order (PPO):** Received in January, finalized as Total Vehicle Order (TVO) in March.

Heijunka Practice: Balancing daily production sequence for even part demand and reduced supplier workload

- **Demand Smoothing:** Heijunka evens out part demand, relieving suppliers and facilitating JIT.
- **Variety in Production:** Cars of different models, colors, and options made alternately.
- **Synchronization**: Aligning assembly line with the ultimate sales of cars.

Heijunka????

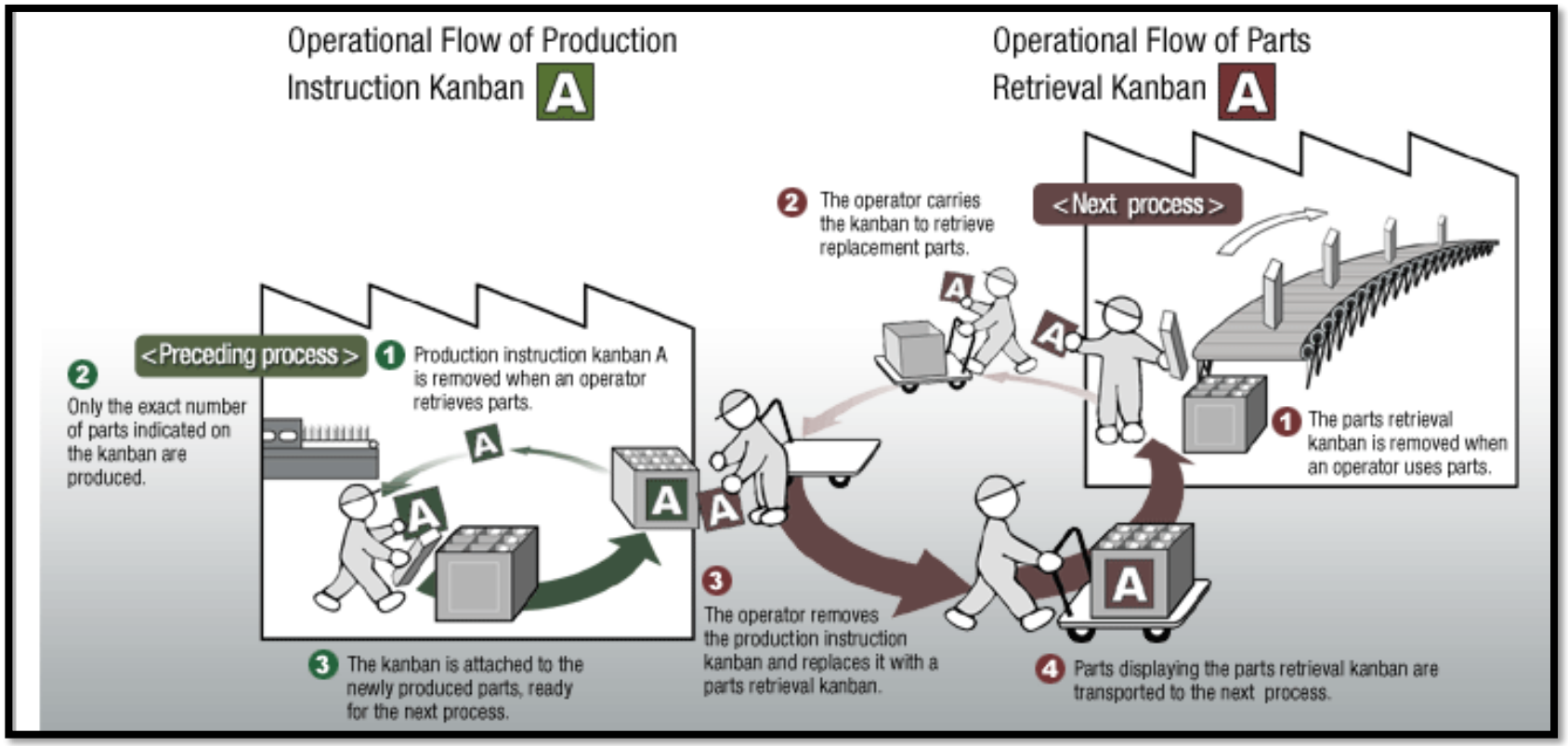
This is Toyota's terminology describing the idea of distributing volume and different specifications evenly over the span of production such as a day, a week, and a month. Under this practice, the plant's output should correspond to the diverse mix of model variations that the dealers sell every hour.

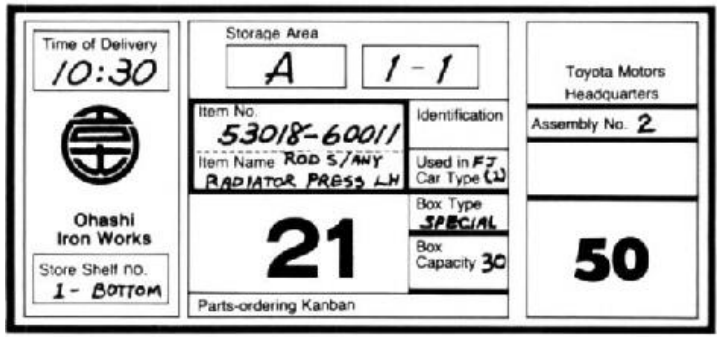
Heijunka Board

Kanban System for Efficient Production

- **Kanban Cards:** Used to trigger part production, shared with suppliers.
- **Container System:** Each part container has a kanban card, signaling parts needed.
- **Circulation Control:** Assembly leaders adjust kanban circulation to avoid shortages or overflows.

- **Monitoring and Continuous Improvement**
- **PC Department Role**: Monitors kanban circulation for inventory control.
- **Feedback Loop:** Information feeds back to improve inventory control and part ordering.
- **Continuous Improvement:** Emphasizing the iterative nature of JIT implementation.





Kanban????
Kanban means "signboard" in Japanese. The one used for a part supplied by an outside supplier indicates the name of the supplier, the receiving area at Toyota, the use-point inside the Toyota plant, the part number, the part name, and the quantity for one container. A bar code is used to issue an invoice based on actual part usage.

Quality Control

HIGH QUALITY AT LOW COST

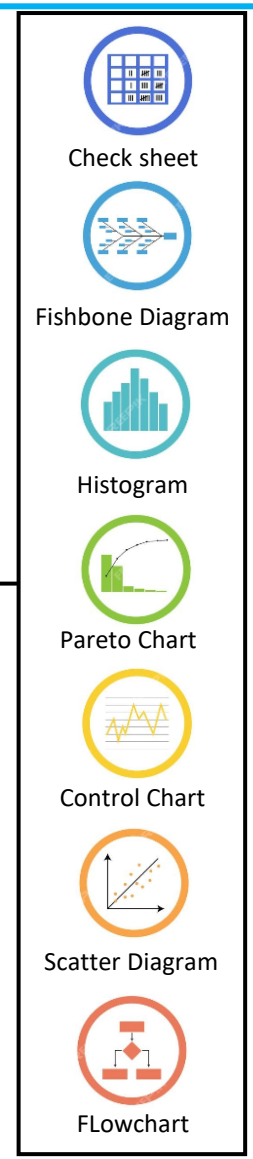
- A mandatory routine of inspecting the vehicles against the set quality standards.
- QC Engineers assisted assembly leaders in resolving assembly and part quality issues

Functions

- Provide immediate feedback to operations by inspecting assembly quality.
- Sending back the problematic cars to the clinic area.
- Shutting down the assembly line under “Code1” status to discuss the counter measures.

- Preventing problems from happening at the first place.
- Collaboration with the design team.
- Setting achievable goals for the suppliers.

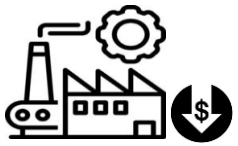
7 QC TOOLS



Purchasing

Kevin Smith's Previous Role: Low price-focused negotiations through supplier competition.(Buyer)

Emphasis on low overall costs, not just low prices. Consistent Low Prices Require Low Manufacturing Costs.



Challenge: Estimating Supplier's Manufacturing Cost Without cost Data.

TMM's Approach: Successfully convinced suppliers to share cost information.

Kevin's Transformation Learned to estimate manufacturing costs at TMM.

Discussions: Improving manufacturing processes and collaboration with kaizen experts.

Holistic approach of procurement at TMM.

The Seat

- Camry seat consists several pieces : front left and right assemblies, the rear seat bench and backrests and the rear side bolsters.

Challenges

1. **Risk of damage** – Delicate and large part
2. **QC** – To perform crash test to meet the set quality standards.
3. **Customer Satisfaction** – surface finishing
4. **Purchasing** – costing $740, fabric consuming the half of the amount.

Rear side Bolster

Front seat

Rear seat

Manufacturing and Installation

- **Kentucky Framed Seats (KFS)** - Sole seat supplier
- **Sequential pull system** - Every 57 seconds, a matching seat emerges beside the final assembly line as a Camry passes through.

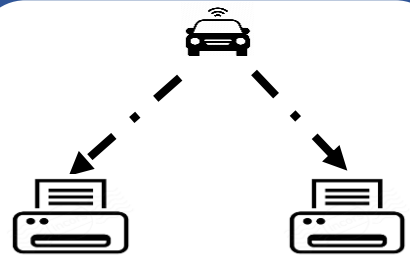
Example - Blue DX Sedan – blue fabric covering

Black XLE sedan – gray leather covering

TRIM LINE PROCESS

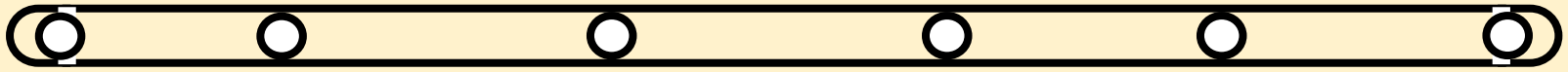
- As body shells exited the paint line, individual transmitters on each body send information to printers at both TMM and KFS.
- Bypassing the production plan
- **KFS Manifest** – Specifications of seat style and color.

TRANSMITTER

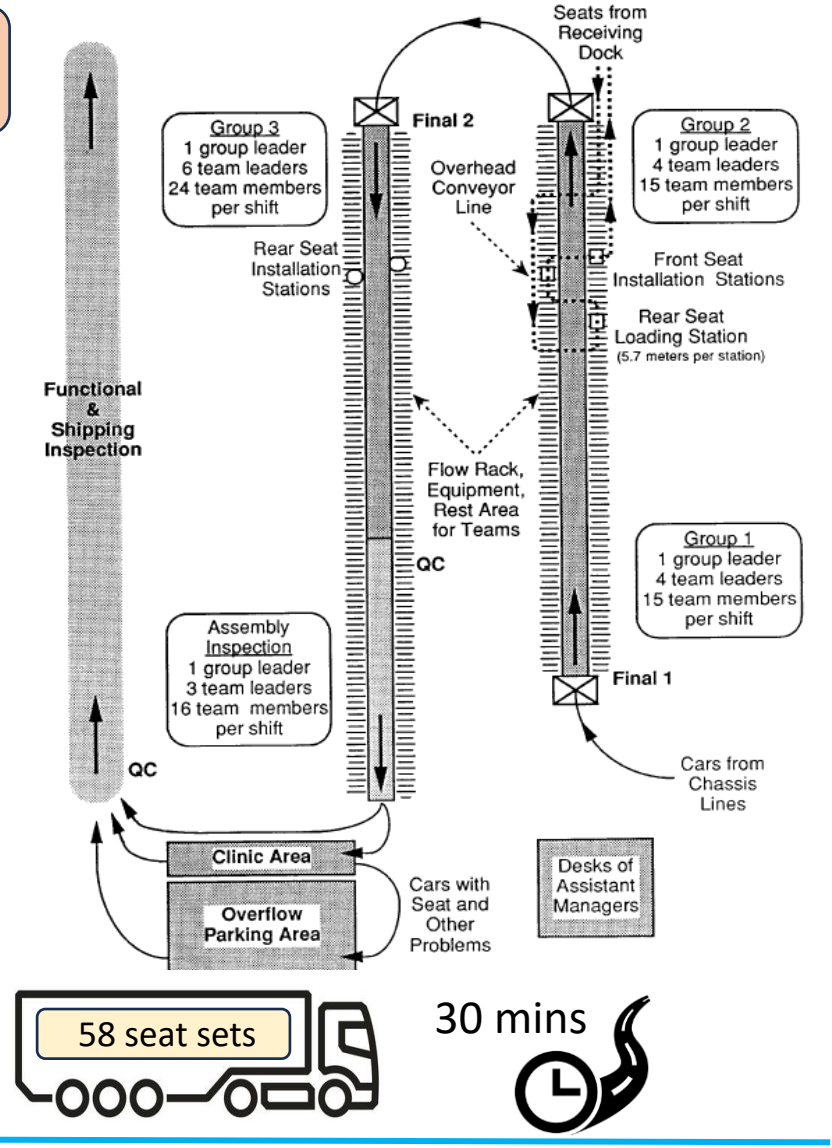


KFS Factory

Seat assembly pieces travel through seat assembly lines → All the matching pieces merge at the end of KFS line and strapped together. → 100% inspected and loaded into the trailer.



TMM Assembly lines



The Supplier

1986

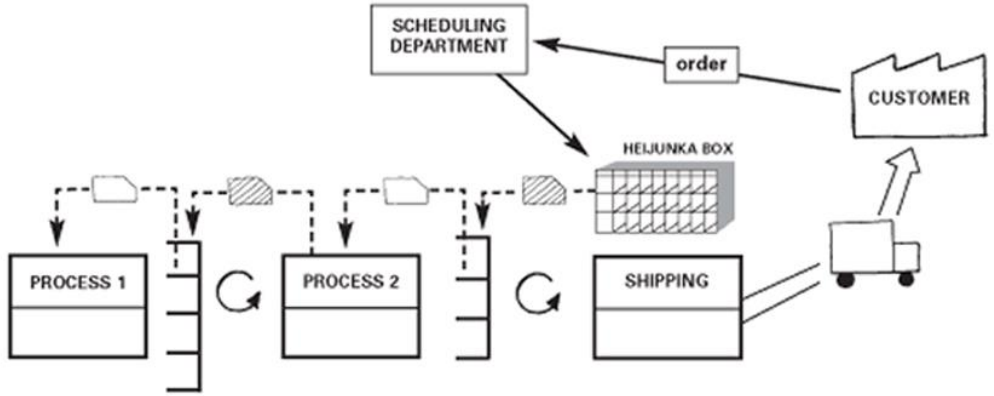
- KFS was a rare exception to Toyota's multiple supplier policy. It marked a new ideology of integrating fully assembled seat sets.
- TMM and KFS were situated in close proximity, leading to the success of sequential pull system.

1987

- TPS spread to KFS lines. They functioned like an extenstion of TMM.

1991

- Model change led to new challenges. Sequential pull system implemented till the last of the old model was produced.
- Left KFS with only 10 weeks to build up capacity for new model.



Signs of problems

- Inclusion of wagon models added 10 styles for export to Europe and 18 styles to Japan and the Middle East.

Product proliferation in 1992 led to more issues. New Camry offered 3 seat colours in 5 different styles.

- Large number of off-line operations required.

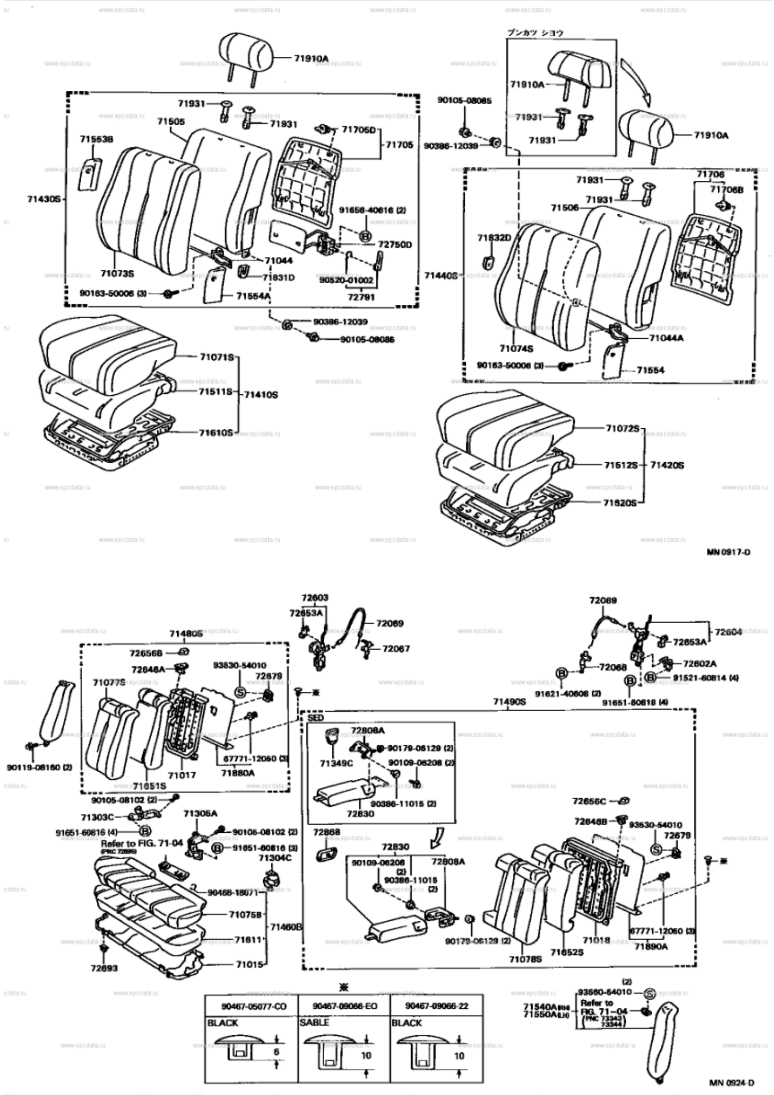
Run ratio down from 95% to 85%, causing shortfall of 45 cars per shift.

The process was continued even though it deviated from *jidoka* principle.

- Possibility to assemble car without seat assemblies.
- Final QC group knew of the problem.
- Line stoppage was too expensive.

Seats were one of the main points of concern. Defective seats installed and assembly continued.

- Car tagged to alert QC of the problem.



The Meeting

- On May 1st, 1991 a meeting was held with all managers, group leader of clinic area, PC and QC managers from TMM and KFS.
- DaPrile proposed to walked through overflow parking area to see the problem. He noted that 18 vehicles with seat problems were present.
- Some cars dated back to April 27, whereas cars were supposed to leave with retrofit seats within same or following shift.
- This occurred as KFS sent wrong seat assemblies which did not match any cars.

- Friesen looked for possible problems between Final 1 and 2.
  - Front seat assembly some times lead to cross-threading incidents, could be fixed in 30 seconds.
  - Group leader of Final 2, Shirley Sargent mentioned breaking of a hook during rear side bolster installation.
- Rear seat bolster hook concerns:
  - Tooling for modified hook would cost KFS 50,000$.
  - Tsutsumi used identical hook with no reported problems.
  - Hook breakage occurences reduced from 7 per shift at new model introduction to 1 per shift by April.

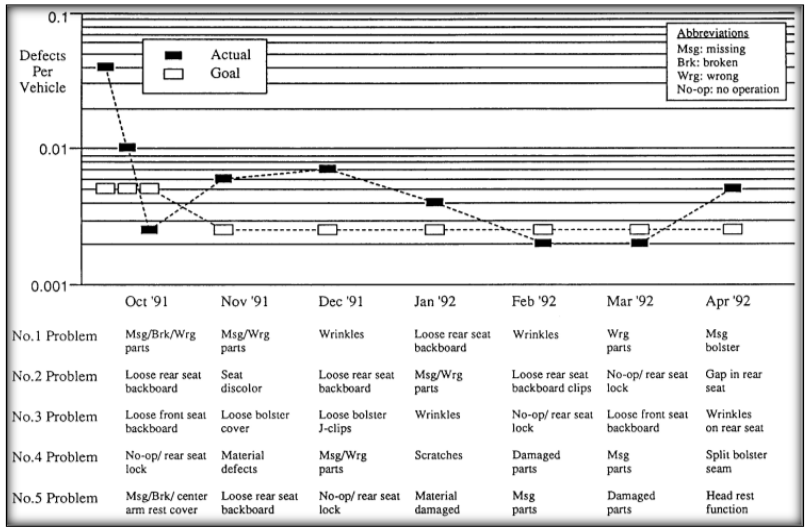
The Hook

Action plan

Area of focus

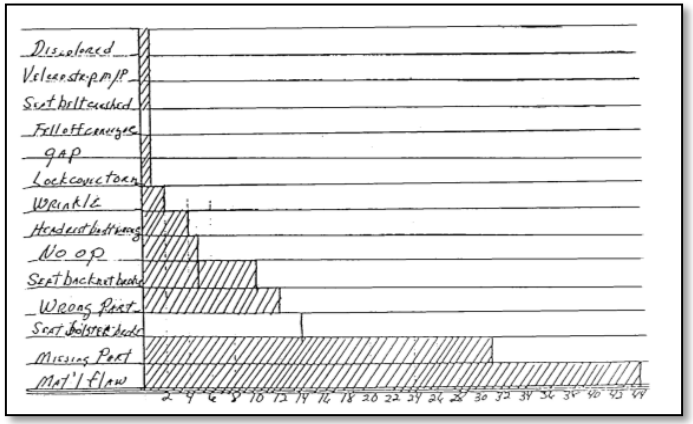
- Figure out why KFS is sending MISMACTHING seats when previously they were always able to send the right ones.

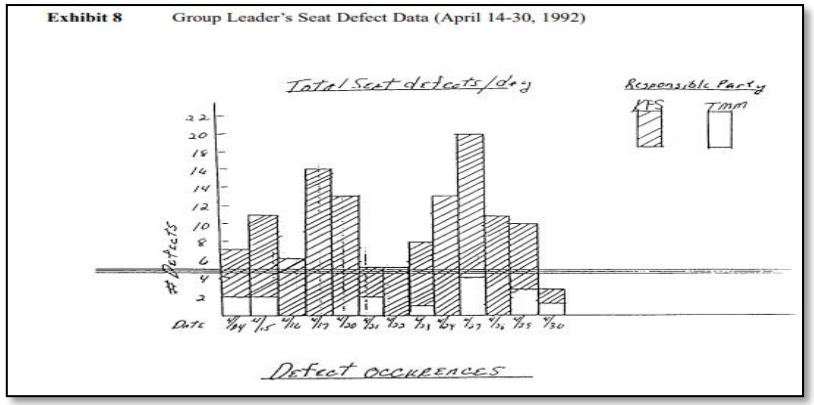
In March, KFS noticed an increase in seat faults, which were especially noticeable after new Camry Wagons were introduced. By April, the European wagon models had ten variations ,Middle Eastern and Japan wagon models had eighteen more seat configurations. **Why did KFS have these problems?**



Seat Quality Review Report

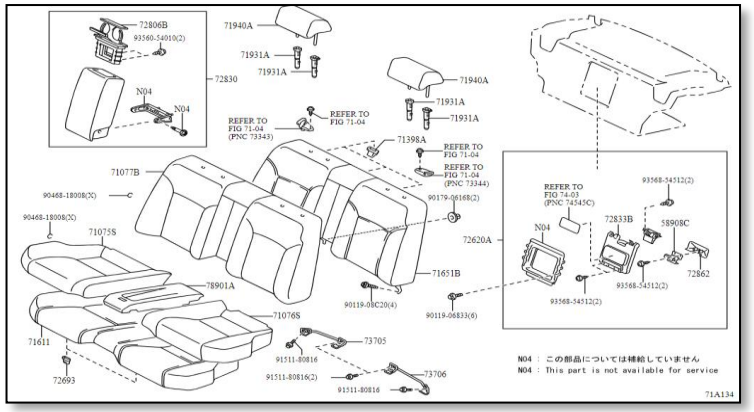
- The major contributor to the seat problem is material flaw. Analyse why KFS is suddenly dropping the quality of products shipped.
  Audit their inspection methodology.





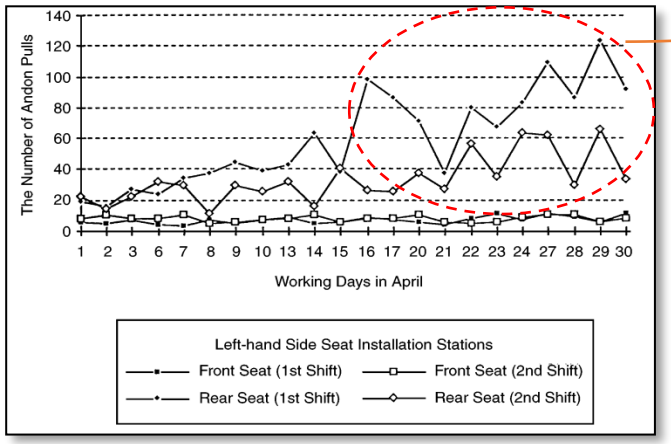
Action plan

- Analyse why the seat bolster hook problem only occurred at Georgetown and not in Tsutsumi.



Same **engineering designs** were shared between Tsutsumi plant and the Georgetown Plant. Then why does the problem arise in Georgetown only?

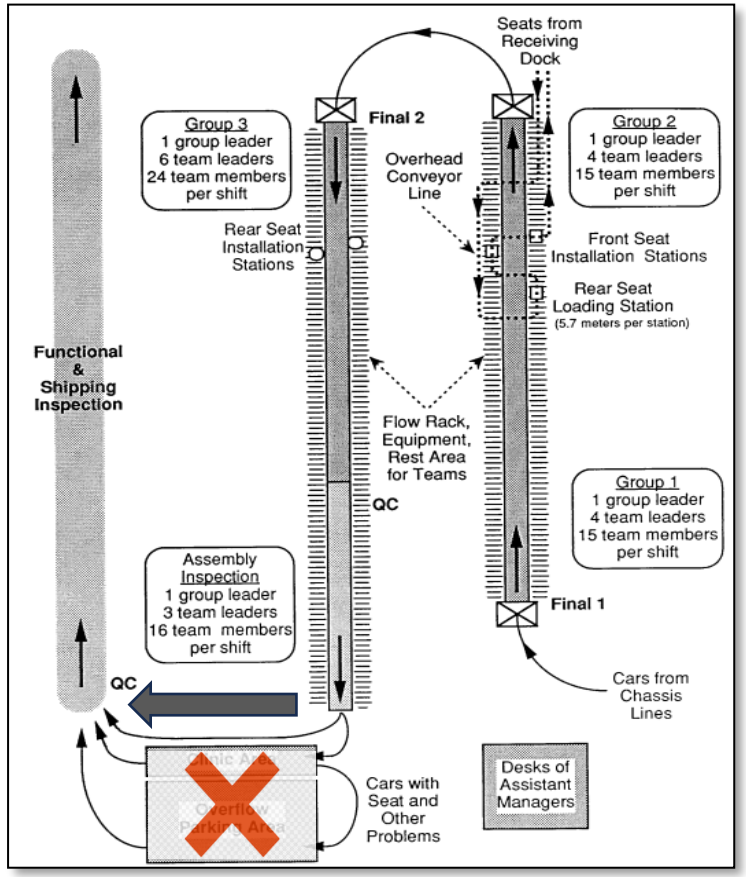
- Why are andon pulls at the rear seat installation much higher in the first shift than the second shift?



Rear Seat installations has more issues!!
WHY??

Action plan

- Eliminate off-line processes.



- Conduct a proper root cause analysis using 5 why method. Lets go see it!!

Problem: Why is the Run ratio decreasing?

WHY — Too many cars need off-line operations

WHY — Car Seats were not being installed properly

WHY — Material Flaws, Parts missing, Wrong Parts

WHY — ???

WHY — ???

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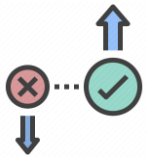
Recommendations

Short term options

Call for assistance from Tsutsumi plant – better understanding of TPS.

Do not implement change of material of bolster hook.



Breakage of hooks and wrong threading incidents can lead to more andon pulls. Train the group members to better install the seats.

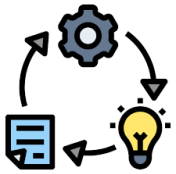
Problems identified at TMM should be implemented as QC parameters in KFS' final inspection.

Assign QC members from TMM to KFS.

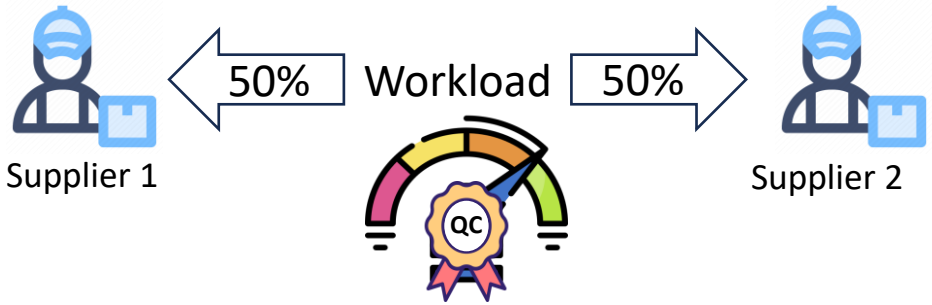
Recommendations

Long term options

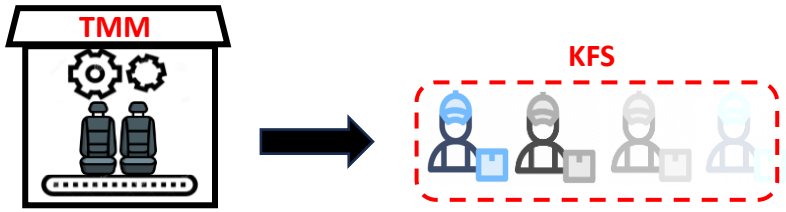
Revisit the TPS ideologies being employed at KFS. Implement a more robust system emulating TMM.



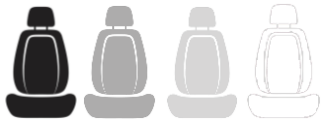
Have more than one supplier for seats. This reduces demand expected from individual supplier and allows focus on quality.



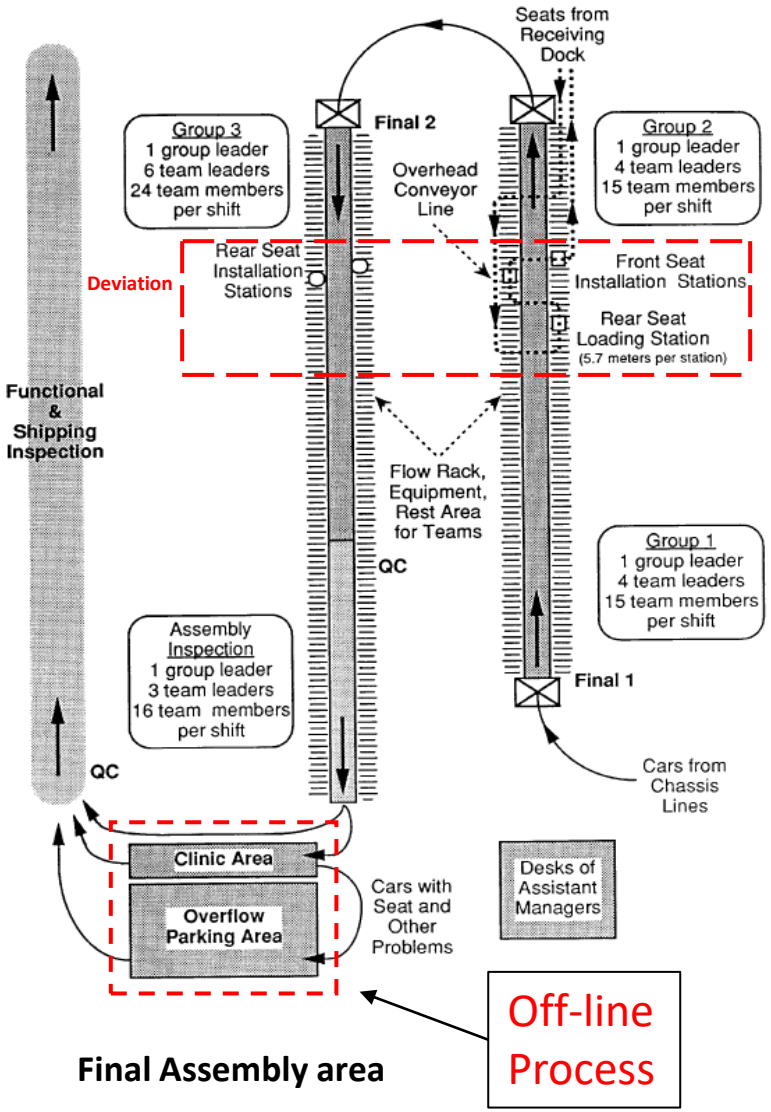
TMM setup a in house seat production unit and slowly phase out the supplier.



Try to reduce seat variations in future models.



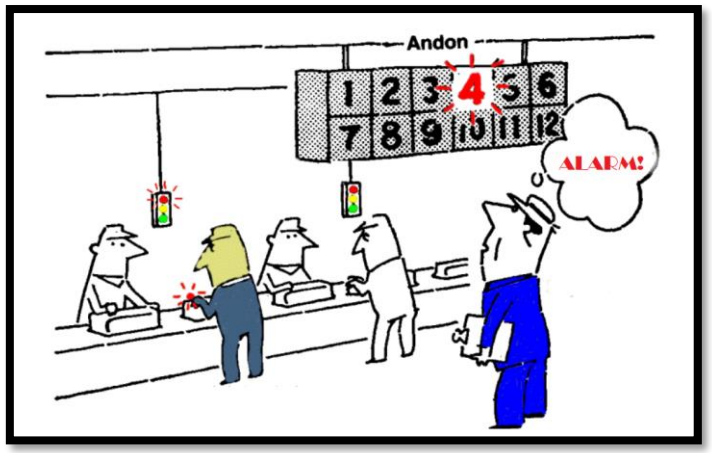
Deviations of Toyota Production System Principles

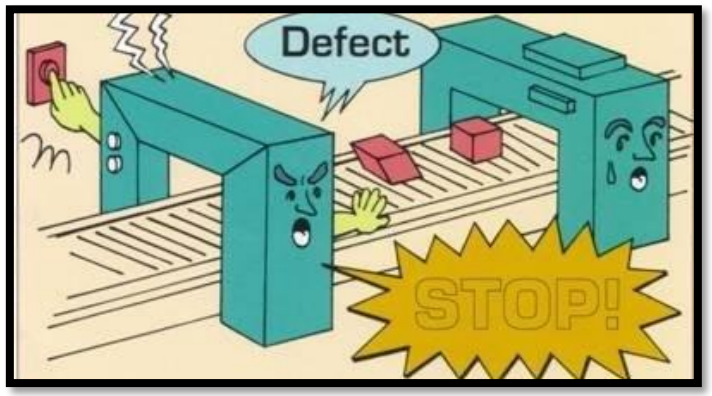


Deficiency in Jidoka Implementation

Issue: Current handling of defective seats off-line indicates a gap in implementing Jidoka

Impact: Potentially compromises quality control and contradicts the essence of Jidoka methodology.



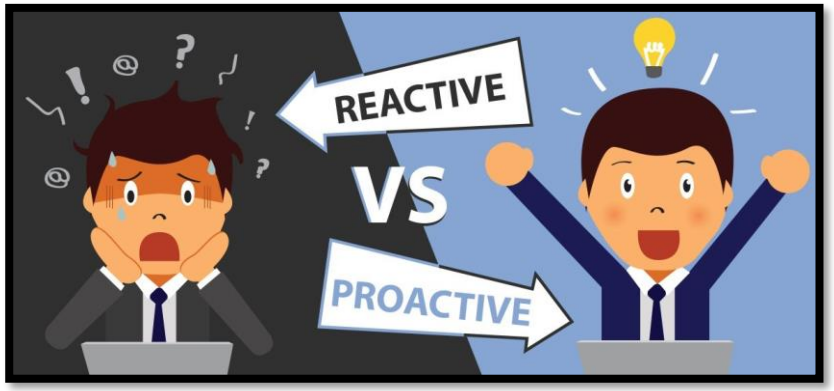


Deviations of Toyota Production System Principles

Stagnation in Kaizen Implementation

Kaizen is not being implemented as there seems to be a stagnation in the production system and no continuous improvement can be seen.

Impact: Hampers the ability to optimize processes, enhance efficiency, and adapt to changing needs.



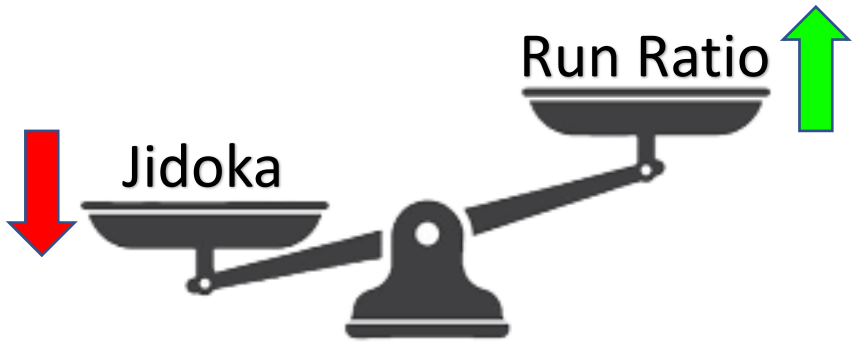
Heijunka Gap in Final Quality Check

Heijunka is being followed at the production and assembly line but is not being implemented in the final quality check as defective seats are being handled in a separate clinic area and more resources are being spent on one particular car.

Impact: Inconsistency in handling defects adds complexity, deviating from the principles of Heijunka

Real Problem faced by Doug Friesen

- Prioritizing run ratio or jidoka was the biggest issue.
- Choosing to solve one results in the other problem magnifying.
- Jidoka is a core principle of TPS, run ratio translates to efficiency.

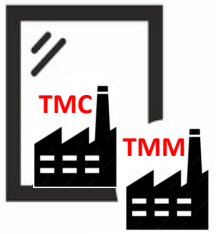


Overtime costs

Team Members	769
Hourly Wage	17 $/hr
Premium	50%
Overtime Wage	25.5 $/hr
Cycle time for one car	57 s
Number of cars to be produced	45
Total overtime	2565 s
	42.75 min
Overtime Cost for 1 member	18.16 $
Overtime cost for 769 members	13,971.76 $/shift
	6,985,884.38 $/annum

Real Problem faced by Doug Friesen

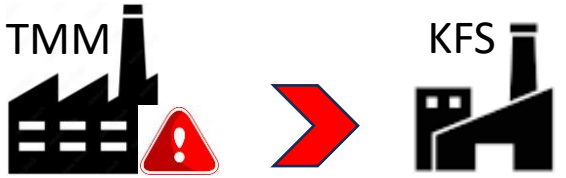
- TPS at TMM was mirrored from Tsutsumi plant. Even though TMM were able to implement it successfully under normal circumstances, they are unable to when complex problems started appearing.



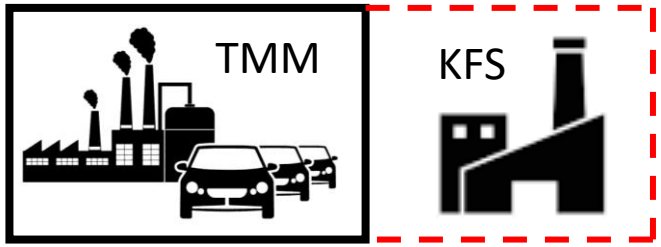
Normal

Complex

- KFS is the only supplier for seats. Also this was the first time Toyota were receiving assembled seats from a supplier. When a problem popped up, it meant that they were completely reliant on KFS to be able to fix it.



- TMM did not analyze issues at KFS like they were an extension of their production system. Instead they only focused on probable internal issues.



THANK YOU

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