Lecture Factory Planning SS 2014

Part 4: Work steps and Methods
- Value Stream Analysis

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<table>
<thead>
<tr>
<th>Vorlesung</th>
<th>Datum</th>
<th>Uhrzeit</th>
<th>Raum</th>
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<td>MD 162</td>
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<td>08. Juli</td>
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Task for the 28.05.2013

- **Objective:**
  - Checklist with a minimum of 50 questions regarding to goal-setting and basic data obtainment.

- **Task:**
  - Formulate 10 questions for the objectives design on meta plan cards
    - Questions for the strategic goals
    - Questions for the basics of the project
    - Questions for the project management
Value Stream Analysis
Principles of Lean Production

1. Define the desired customer benefit
2. Identify the value stream for any product, discover waste
3. Care for a constant material flow
4. Implement everywhere there a PULL-control, where currently no constant flow exists.
5. Strive for perfection, so that production steps, time and information are reduced.

source: Womack, Jones
Value Stream Analysis

Value stream: all operations (value creation and not value added), those are necessary, to bring a finished product from the raw material up to the customers hands.

- The value stream analysis directs the look onto the essential – the service creation of the considered enterprise
- The value stream includes the value-adding core operations of a enterprise
- The focus is on lead times, throughput and the link of material- and information flow
- The basic concept consist to take in the customers view. Within a enterprise are presenting „intern customers“ the following operations in value stream.
- A value stream provides– especially in connection with a gross layout – quickly the necessary overview of a enterprise.
- The analysis of the quantify model (lead times, throughput, stocks) allows a quick potential assessment
Process and Value Stream Improvement

Flow-Kaizen

Value stream

process-Kaizen process-Kaizen process-Kaizen

process

stamp

welding

assembly cell

Raw material

Finished goods
Value Stream Levels

- **Process level**
  - One plant („gate to gate“)

- **Several plants within the enterprise**

- **Over several plants (Supply Chain)**

**Start here!**
Starting point of the value stream analysis is the choice of a representative product line.

Choose product line

Plotting of current status

Plotting of nominal cond.

Project realisation

---

Define your product line through common process steps

<table>
<thead>
<tr>
<th>Products</th>
<th>„Assembly“ – steps and machines</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Point welding</td>
</tr>
<tr>
<td>pitman arm left</td>
<td>X</td>
</tr>
<tr>
<td>pitman arm right</td>
<td>X</td>
</tr>
<tr>
<td>dashboard mount. support</td>
<td></td>
</tr>
<tr>
<td>seat- track</td>
<td>X</td>
</tr>
<tr>
<td>bumper support</td>
<td>X</td>
</tr>
</tbody>
</table>

Source: Rother
Afterwards it's time to plot the current status.

Understanding of the present plants functionality:

- Material a. information streams
- Use symbols while plotting
- Beginning from “door to door”
- Go along the flow yourself and draw with a pencil by hand.
- **No standard times!**
- Foundation for the next steps
- Analysis a similar value stream for new products

1. Choose product line
2. Plotting of current status
3. Plotting of nominal cond.
4. Project realisation
Basic Concept: Customers point a view!

Start with the dispatch and approach upstream!

(and not as usual along the material flow, starting with the delivery)

• The customers point of view defines the requirements towards the production

• The respective follow-up processes are customers for the preliminary delivery processes.

• The value stream branches out upstream, because a product has normally parts of several source processes: explicit starting point.

• The simplified understanding is based on result or purpose of a process, so that you can ask easier for the “how”.

Lecture Factory Planning SommerSemester 2013
What differentiates the value stream analysis from other methods

- Change of perspective onto waste
- Focus on lead time
- Focus on the linkage of processes
- Material and information flow
- Easy display on one side
- Refinement of the vision through iteration cycles
Display with standardised plotting symbols

customer or supplier (extern)

truck delivery

Tu & Th

stock (amount a. time value note)

stamps

2 shifts
Cycle time
setup time
Term (%)

assembly

material “Push” (advanced)

2 shifts
Cycle time
setup time
Term (%)

PPS

Productio

shedul.

PPS

plant Köln

plant Köln

4x/day

Data box

process box

information flow

electronic information flow

Term (%) Term (%)

customer or supplier (extern)

process box

stock (amount a. time value note)

truck delivery

Tu & Th

stamps

2 shifts
Cycle time
setup time
Term (%)

assembly

material “Push” (advanced)

2 shifts
Cycle time
setup time
Term (%)

source: Rother
Data to be collected

Cycle time of process
Setup time of machines
Machine reliability
Lot size / container size for finished parts
Buffer between and in the single production steps
Number of employees
Number of product varieties
Available working hours/shift work
Scrap installment/ rework installment
Lead time and processing time
Definition of time indicators

Value creation time:
Time for activities which changes the product as a customer requests it

Cycle time (ZZ):
Displays the required time between the completion of two parts

Processing time:
States the time which is necessary to create a product (value creating + handling + process time + ...)

Value creation time:
Time for activities which changes the product as a customer requests it

Set-up time (RZ):
Time, while one resource is not available for the value creation.
Approach

1) Assess customer information
2) Fast passage to identification of sequence for processes
3) Fill in of Data boxes and stock triangle
4) Plotting of delivery
5) How do the processes know what they have to produce? (draw information flow)
6) Where will material be advanced? (“Push”)
7) Calculate lead time
The Stanz AG produces different components for the car assembly. This case study concerns a product line - (an of steel made dashboard structure in two versions, each one production for left-hand steered and right-hand steered models of the same car). Those components will be delivered to the assembly plant cologne (the customer).
Case study: Stanz AG

Customer requirements:

- 18,400 pieces per month
  - 12,000 monthly „left“
  - 6,400 monthly „right“
- The customers plant drives daily two shifts
- Dispatch container appx. 20 columns. The customer order per container (several container per order).
- The assembly plant receives one delivery by truck daily.

Working hours:

- 20 days per month
- Two shifts daily in all production departments
- 8 hours per shift; if necessary overtime
- Two 10- minutes breaks per shift. During the break is the manual process stopped.
- Unpaid lunch break
Case study: Stanz AG

Production processes:

- Processes necessary for the product line are: stamping of metal parts, welding and assembly. Afterwards the finished components will be set at the dock and will be dispatch to the auto assembly plant daily.
- The set-up time from the left to the right columns is 1 hour in the stamp and 10 minutes for a span tool change in the welding shop.
- The Ruhr AG supplies the Stanz AG with steel coils every Tuesday and Thursday.
Case study: Stanz AG

1) **Stamp** (produces parts for many Stanz AG products)
   - Cycle time: 1 Sec. (60 pie./min.)
   - Set-up time: 1 hour
   - Automatic 200-ton press with coil feeding
   - Machine reliability: 85%
   - Inventory levels today:
     - 5 days un-stamped coils
     - 4,600 finished stamp parts „left“
     - 2,400 finished stamp parts „right“

2) **Point welding station** (for this product line)
   - Manual process with one employee
   - Cycle time: 39 Sek.
   - Set-up time: 10 min (change of clamping device)
   - Machine reliability: 85%
   - Inventory levels today:
     - 5 days un-stamped coils
     - 4,600 finished stamp parts „left“
     - 2,400 finished stamp parts „right“

3) **Point welding station II** (for this product line)
   - Manual process with one employee
   - Cycle time: 46 Sek.
   - Set-up time: 10 min (change of clamping device)
   - Machine reliability: 80%
   - Inventory levels today:
     - 1,600 pieces „left“
     - 850 pieces „right“

4) **Assembly I** (for this product line)
   - Manual process with one employee
   - Cycle time: 62 Sek.
   - Set-up time: none
   - Machine reliability: 100%
   - Inventory levels today:
     - 1,200 pieces „left“
     - 640 pieces „right“

5) **Assembly station II** (for this product line)
   - Manual process with one employee
   - Cycle time: 40 sec.
   - Set-up time: none
   - Machine reliability: 100%
   - Components in stock today:
     - 2,700 pieces „left“
     - 1,440 pieces „right“

6) **Dispatch**
   - Disposition out of the finished goods inventory and supply for dispatch by truck.
Case study: Stanz AG

Production scheduling at STANZ AG:

- Gets an 90/60/30 days notification of the customer and enters it into the PPS - System
- Forwards a six-week-plan over the PPS to the Ruhr AG.
- Secures the coil steel through weekly fax order to the Ruhr AG.
- Gets an daily binding order from the plant in cologne.
- Creates weekly PPS instruction for the departments, based on customer orders, cycle stock, finished goods stock and the expected loss of production (committee, production stop)
- Passes the weekly process plan to the punching shop, welding shop and assembly.
- Forwards a daily delivery plan to the dispatch department.
Current-Status Stanz AG

Ruhr AG

Produktionsplanung

Köln

Custom. info

Di. und Do.

5 Stahl-Coils pro Tag

5 Tage

7,6 Tage

1,8 Tage

2,7 Tage

2 Tage

4,5 Tage

1 Sec

39 Sec

46 Sec

62 Sec

40 Sec

188 Sekunden

Lead time

23,6 Tage

Tägl. Stückzahl: 920

Weekly plan

Täglich

2400 „R“

600 „R“

850 „R“

640 „R“

1440 „R“

2700 „L“

1600 „L“

1100 „L“

4600 „L“

ZZ=1 Sek.

ZZ=39 Sek.

ZZ=46 Sek.

ZZ=62 Sek.

ZZ=40 Sek.

RZ=1 Std.

RZ=10 Min.

RZ=10 Min.

RZ=0

RZ=0

MZ=85%

MZ=100%

MZ=80%

MZ=100%

MZ=100%

2 Schichten

2 Schichten

2 Schichten

2 Schichten

2 Schichten

27.600 Sek.

27.600 Sek.

27.600 Sek.

27.600 Sek.

27.600 Sek.

verfügbar

verfügbar

verfügbar

verfügbar

verfügbar

EPEI=2 Wochen
Based on the defined optimization potential is to plot the nominal condition

Product line choose

plotting of Current status

plotting of Nominal condi.

Conversion project

Draft of a stream:
- The performance of an value stream mapping
- Always keep the nominal condition plotting on hand
- 70 % and constant refine (pencil!)
- Material and information streams
- Foundation of your work plan
  - like the layout of a house
Basics of nominal plotting

- Start at present plotting
- 1. Review is based on the existing step and machine (we can relocate furnishing, combine them, erase RD, place small sources etc)

But there is a problem!
The nominal plotting status strives on to the ideal status

- Current status
- 2 – 3 alternatives
- Nominal condition

Ideal status
Focus is on lead times

- Every process is only allowed to produce what the next process steps requires (type and time wise)
- Direct (control, manage, regulate) all efforts in the plant with the objective to shorten the lead times constantly.

Value creating time: minutes
Time in plant: weeks

„All we are trying to do is shorten the time line...“
Taiichi Ohno
Toyota Production Chief after WWII
Waste

production elements which do not create any value

Waste costs time and money

Key points of „waste“:

- Waste is more a symptom than an cause of the problem.
- Waste shows problems inside the value stream
- We have to find the causes of waste and have to get rid of them.
7 types of waste

Handling
Over dimensioned machines, wrong or missing tech. Equipment, set-up time, buffer cleaning

Inventory
High cycle inventories as well as bloated material and finished goods inventory

Over production
Unnecessary production

Movement
Unnecessary transportation of sourcing materials, tools or information

Scrap
Flow interruption through mistakes and time/effort/space for analysis and removal

Transport
Movement of materials between process steps towards and away from warehousing space

Waiting Time
Material waits for handling or human/machine waits for material, tool etc.
The objective of the Value Stream Mapping is performance improvement.
6 guidelines to improve the value stream

1) Customer cycle time
2) Constant flow
3) FiFo-systems
4) Supermarket-Pull-Systems
5) Customer discoupling point
6) Stroke bound removal
Guideline 1: customer cycle time

- The customer cycle time is an on the sales rate basing production rate for the assembly.
- The customer cycle time supports the synchronization of assembly rhythm and sale rhythm.

\[
\text{customer cycle time} = \frac{\text{available operating time per shift}}{\text{customer requirement per shift}}
\]

Customer cycle time = \(\frac{27,600 \text{ sec.}}{460 \text{ pieces}} = 60 \text{ sec.}\)
The customer cycle time is an excellent instrument to interpret the available capacity suitable to customer requirements.

Practice example:
Production of feather sets for vehicle clutches
Guideline 2: constant flow

a) Lot and batch processing

b) Constant flow
Guideline 3: FiFo-Systems

- Coupling of several processes in a continuous production line
- Subsequent process sends an release signal to the previous process, when a piece is finished
- The FiFo-lane has a maximum stock level
Guideline 4: Supermarket-Pull-systems

1. Customer process takes the necessary parts out of the supermarket on time.
2. Deliver processes are in charge to refill the taken products.
Balance of daily fluctuations

Dimensioning of supermarket: replenishment lead time + demand fluctuations of customer + safety stock

pacemaker

finished goods supermarket

customer
Comparison of guideline 2 - 4

Guideline 2: Constant flow

Plan

| A | B | C | D |

Guideline 3: FiFo - Systems

Plan

| A | FIFO | B | FIFO | C | FIFO | D |

Guideline 4: Supermarket – Pull Systems

Plan

| A | C | B | C | C | D |
Guideline 5: customer decoupling point (pacemaker process)

Try to integrate the order only at one point!

Use always work flow, otherwise Supermarket-Pull or FIFO
Small lot production and balancing at pacemaker process

bad:

Assembly plan
Monday....... 400 A
Tuesday ...... 100 A, 300 B
Wednesday. 200 B, 200 C
Thursday .... 400 C
Friday ........ 200 C, 200 A

(result)

better:

Monday:
140 A 100 B 160 C

Every part every day

much better

50 B 70 A 80 C 50 B 70 A 80 C

Every piece to each delivery ("Window")

Important: short/ frequent set up times at the pacemaker process!
Frequent Change Over (Set-Up)

Before:

<table>
<thead>
<tr>
<th>product A</th>
<th>change over</th>
</tr>
</thead>
<tbody>
<tr>
<td>product B</td>
<td>change over</td>
</tr>
<tr>
<td>product A</td>
<td>change over</td>
</tr>
<tr>
<td>product B</td>
<td>change over</td>
</tr>
</tbody>
</table>

Set up time reduced:

<table>
<thead>
<tr>
<th>product A</th>
<th>change over</th>
</tr>
</thead>
<tbody>
<tr>
<td>product B</td>
<td>change over</td>
</tr>
<tr>
<td>product A</td>
<td>change over</td>
</tr>
<tr>
<td>product B</td>
<td>change over</td>
</tr>
</tbody>
</table>

8 hrs.
EPEI: Every Part – Every Interval

autom. 200 tonnage press with coil feeding

ZZ = 1 Sec.
RZ = 1 hr.
MZ = 85%

5 products, a 14,400 piece
2 shifts/day = 14 hrs. (= 50,400 sec.)

Process time = Number Prod. x amount x ZZ

Process time = 5 x 14,400 piec. x 1sec = 72000 sec.
RZ total = 18,000 sec.
Run. time + RZ = 90,000 sec.
90,000 / 14h = 1,8 => EPEI

EPEI = 1,8 days

If all products have to be produced, it is only possible to tie up product A again after 1,8 days.
Guideline 6: Takt engaging withdrawal at pacemaker process

- How much work will be released at the pacemaker process?
- What is your management time frame? (How often do you see divergence between performance and customer requirements?)
- Do you offer „customer cycle time sense“?

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>Coverage</th>
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<tbody>
<tr>
<td>1 week</td>
<td></td>
</tr>
<tr>
<td>1 day</td>
<td></td>
</tr>
<tr>
<td>1 shift</td>
<td></td>
</tr>
<tr>
<td>1 hour</td>
<td></td>
</tr>
<tr>
<td>1 takt</td>
<td></td>
</tr>
<tr>
<td>1 pitch</td>
<td></td>
</tr>
</tbody>
</table>

Time interval with the x-amount of customer cycle time
Question to improve the current status

1. What does the customer cycle time mean for the product line?
2. Do you produce customer anonymous (in a supermarket) or customer related?
3. Where can you insert a constant flow?
4. Where do you have to insert Supermarket-Pull-Systems?
5. At which place during the manufacturing chain do you inject orders?
6. How are you going to balance the production mix at the pacemaker process?
7. At which „Pitch“ do you set the pacemaker process?

Supporting improvements:
- Which process improvements are necessary (e.g. operational reliability, change over, training, etc.)
Questions regarding Value Stream Analysis

- Please, display the standardized plotting symbols of value stream mapping.

- Which data is necessary for the analysis of the value stream and for the calculation of the characteristics (data).

- Please, define the different time modules and give an example.

- Please, calculate the lead time with the following parameters: Customer cycle time of 75 seconds respectively delivery quantity of 1.500 piece a day and cycle stock of 11.250 piece.

- Please, sketch the structure of a value stream and name the single structures.
Question value stream analysis

- Please, define the seven types of waste.
- Please, name the 6 guidelines for the improvement of value stream and explain one guideline in detail.
Display with standardised plotting symbols

Customer or comp. supplier (extern)

Truck delivery

Tu & Th

Stock (amount a. time value note)

Productio n shedul.

PPC

Electronic informations flow

Informations flow

Process box

Data box

Plant Köln

4x/day

source: Rother
Data to be collected

Cycle time of process
Setup time of machines
Machine reliability
Lot size / container size for finished parts
Buffer between and in the single production steps
Number of employees
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