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Problems to solve

AGENDA

Facilities planning process

how to situate the topics covered in this part of the course in a broader context?

Problem environment

setting the scene even better by exploring some typical decision problems – "complexity" !

Tools

what (and in how far) tools can help us here? considering some typical tools for (re)design, general management and justification

Stuff-to-think- about

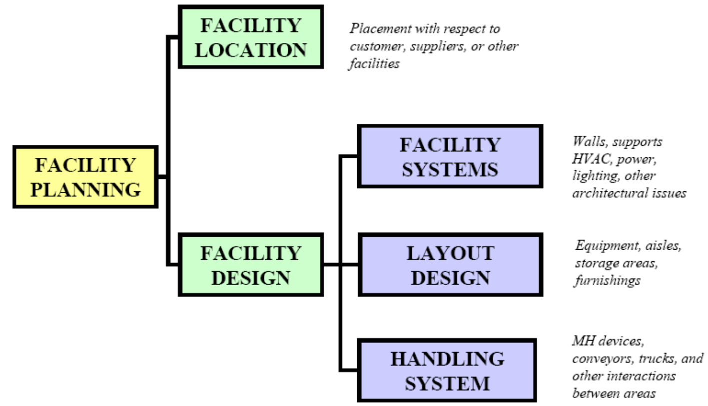
what about the tools ? what about technology ? what about the data needed ? generic approach ! – critical approach

Justification

Importance ! Steps Tips

Facilities planning process

What is it about?



Facilities planning

- covers: facility → department → work cell; unit → work stations; workstations → machines
  - e.g. brewery → packaging → cans; bottles, ... → control station → palletizer

- is a <u>complex and broad subject</u> that cuts across several physical disciplines: civil, electrical, mechanical and industrial engineers, architects, urban planners, real estate brokers, managers, consultants, contractors, ..

determines how the "arrangement in space" of an organization's tangible fixed assets best <u>support</u> achieving the organization's objective.

Characteristics of design process

1. No definitive problem formulation
2. No exhaustive list of permissible operations
3. No stopping rule
4. No *single* criterion for correctness
5. Many alternative solutions
6. Every wicked problem is symptomatic of another wicked problem
7. No immediate or ultimate test of a solution
8. Every wicked problem is a one-shot operation
9. Every wicked problem is essentially unique
10. We are morally responsible for our actions

Garcia-Diaz&MacGregor Smith, 2008

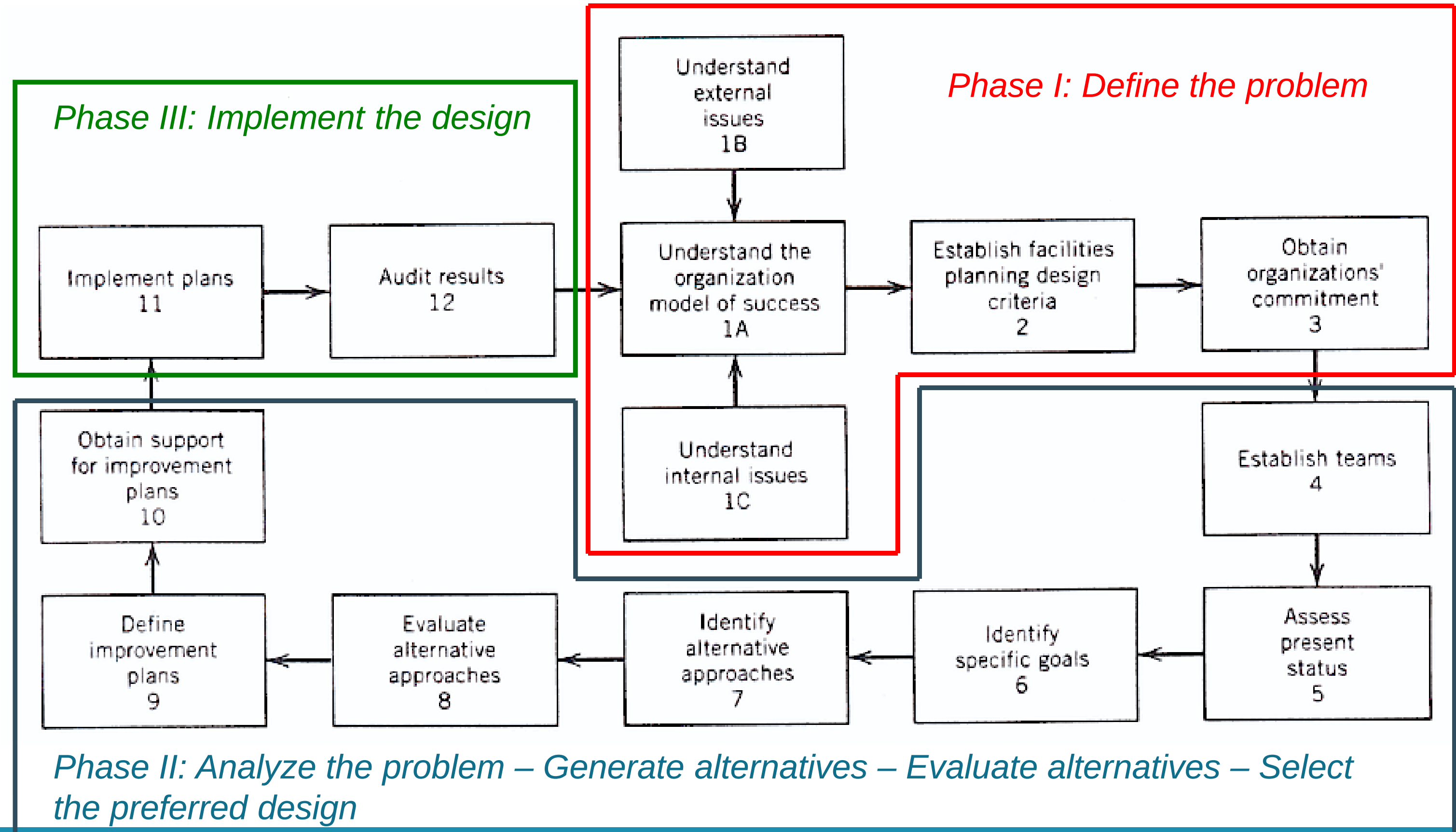
Complex!!

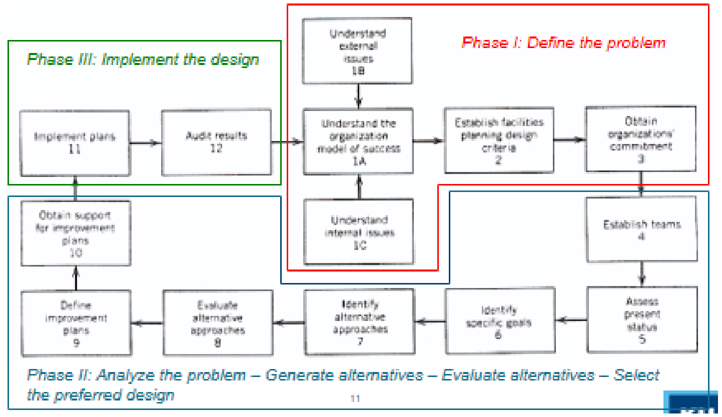
Many degrees of freedom

Many objectives

Many interactions

Phases


Phase I: Define the problem
Phase III: Implement the design
Phase II: Analyze the problem – Generate alternatives – Evaluate alternatives – Select the preferred design
Understand external issues 1B
Understand the organization model of success 1A
Understand internal issues 1C
Establish facilities planning design criteria 2
Obtain organizations' commitment 3
Establish teams 4
Assess present status 5
Identify specific goals 6
Identify alternative approaches 7
Evaluate alternative approaches 8
Define improvement plans 9
Obtain support for improvement plans 10
Implement plans 11
Audit results 12



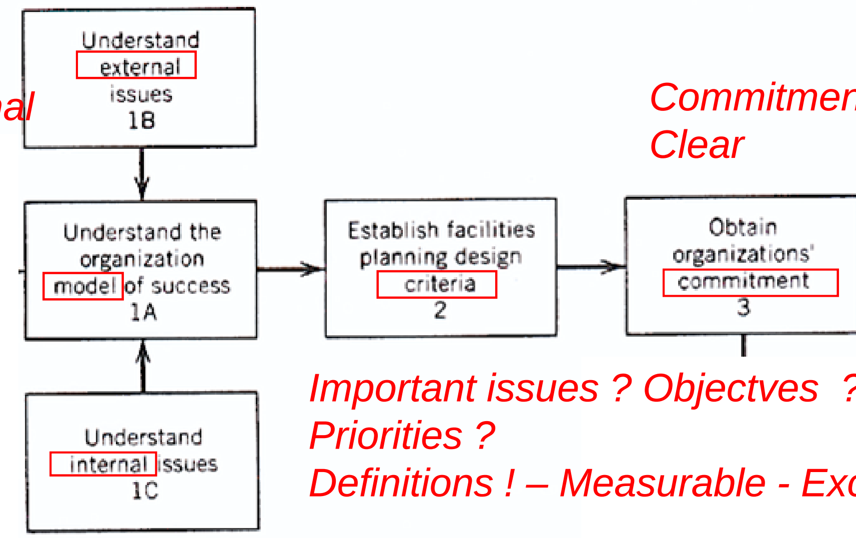
What would these phases look like for the following project: Building a Belgian distribution centre for consumer goods.

Phase I: Define the problem

Business environment
Context
Technology
(Fairs, professional journals, web, ….

Business model
Strategic choices
Scope

Resources
Constraints
(Im)possibilties
Trends



Commitment in line with
Clear

Important issues ? Objectves ?
Priorities ?
Definitions ! – Measurable - Exclusive - Exhaustive

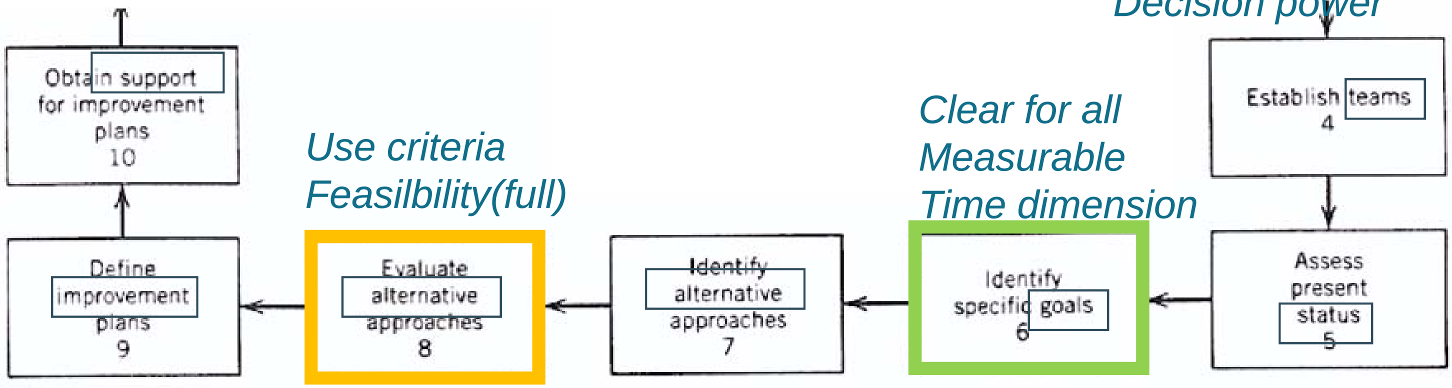
Phase II: Analyze the problem – Generate alternatives – Evaluate alternatives – Select the preferred design

Justification, Visualisation process steps
Mgmt & other levels

Multidisciplinary
Representative
Decision power

Clear for all
Measurable
Time dimension

Use criteria
Feasilbility(full)



Select "best" alternative
Start project planning & budgeting

"All" alternatieven
Systems, procedures, equipment, methods
Ask stakeholders for input

AS IS – future
Qualitative
Quantitative

Typical objectives

1. **Support** the organization’s **vision** through improved material handling, material control and good housekeeping
2. Effectively **utilize** people, equipment, space and energy – easy to manage
3. Minimize capital **investment**
   - Convertible investments ? Easy and flexible to adapt to future requirements ?
4. Be **adaptable,** promote ease of **maintenance**
5. Provide for employee **safety** and job **satisfaction**

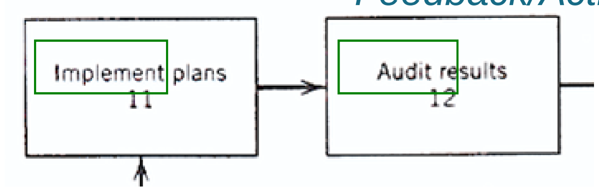
Some issues to consider *(cfr objectives)*

A. Total **distance** travelled
B. Manufacturing floor **visibility**
C. Overall **aesthetics** of the layout
D. **Space** requirements
E. **People** requirements
F. Impact on **WIP** levels
G. Ease of adding **future** business
H. Use of **current** MH equipment
I. **Investment** in new MH equipment
J. Human factor **risks**
K. Estimated **cost** of alternatives

Phase III: Implement the design

Do
(also tests, training, …)

Check
Document
Feedback/Action



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Problem environment

Problem types

- Design vs improvement
  - Building a new "plant"
    - Production site, bank, hospital, distribution center, ...
  - Improvement projects
    - Expansion, reorganization, outsourcing, automation, problem elimination, cost reduction, …

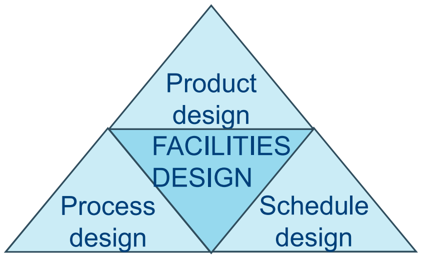
- "Hardware" and/or "Software"
  - Hardware: positioning installations, choosing racks, determining truck mix, …
  - Software: order pick algorithms, capacity planning, …

- Socio-technical characteristics of the system

Example 1

Imagine that you've won a industrial designers/inventors contest and that with the help of some professional engineers, marketeers and investors you are now ready to start your company. Your invention is a *widget**.

There are quite some decisions to take, let's consider some of the FP related ones …



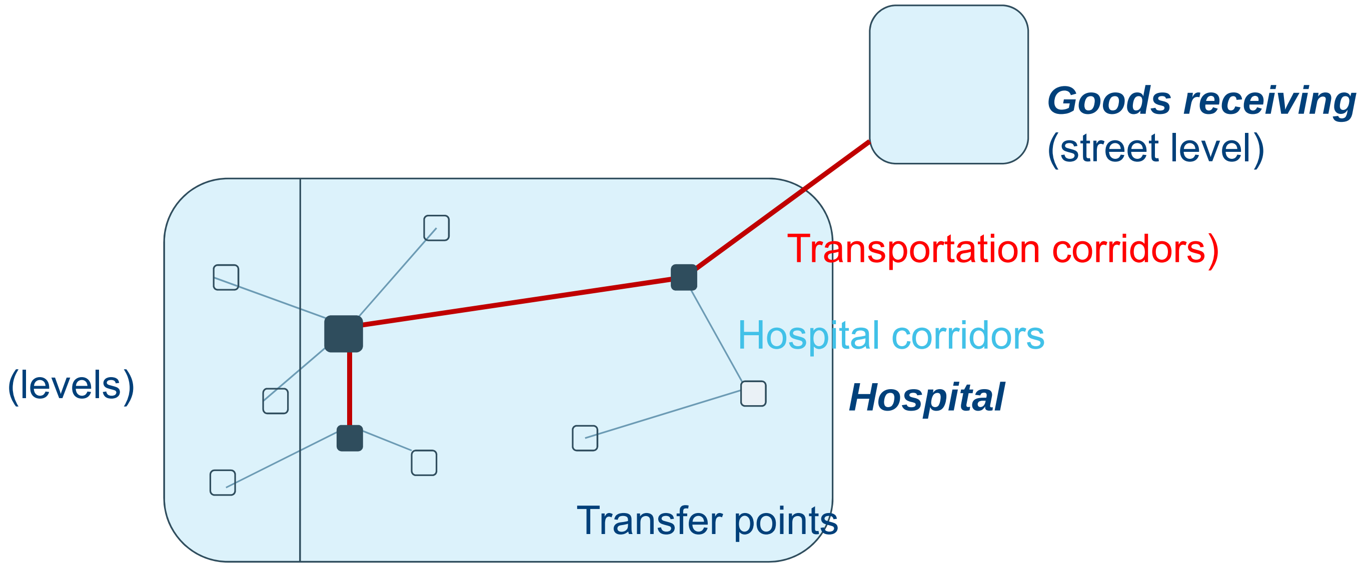
*widget = an unnamed article considered for purposes of hypothetical exam

Example 2

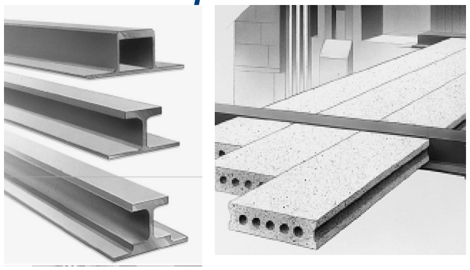
Project: Transportation of goods in a large hospital complex

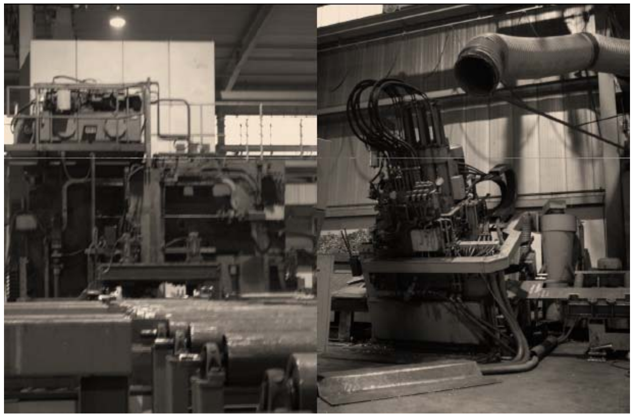
Scenarios: manual → partly automated → fully automated

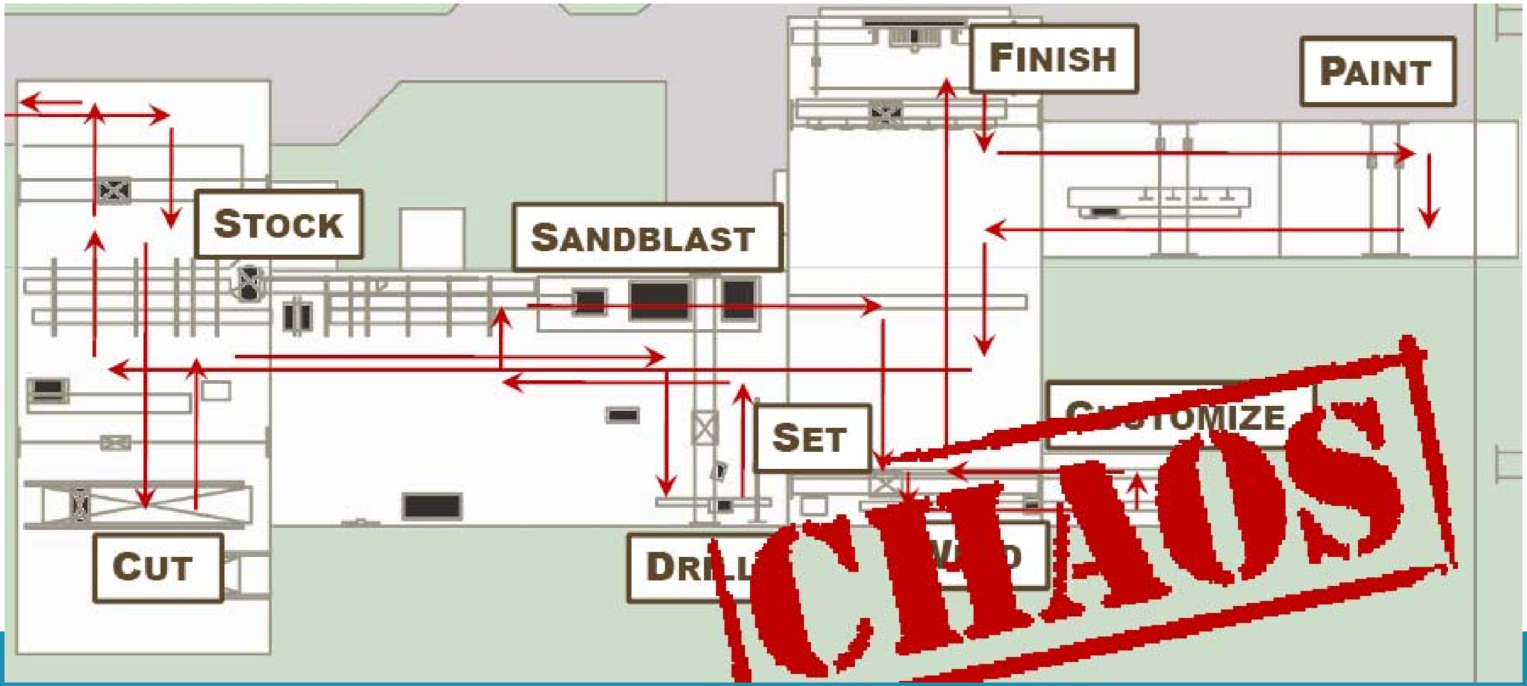
Which alternatives? How to decide?



Example 3



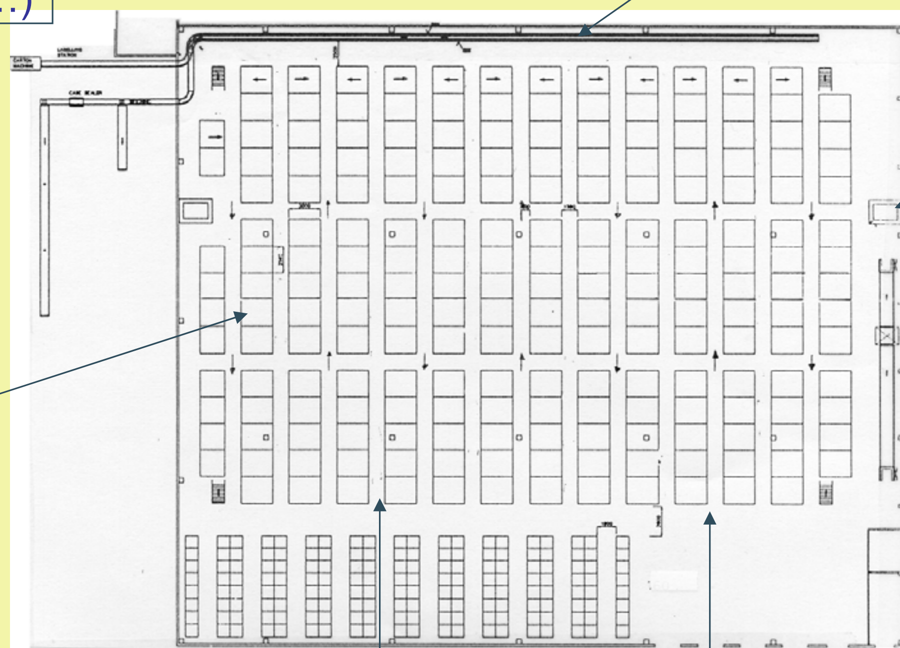




Example 4

Warehouse layout
(T shirts, jeans, …)

Conveyor belts



Elevator
to reserve
storage

Flow racks

Replenishment aisle

Aisle for manual order picking
(chart with computer on-board)

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Example 5

Company N produces electronic equipment for domestic use. The production engineers considers automating some of the production steps.   The CEO asks about the criteria for automation.

More specifically, what factors determine whether an industrial robot or a cobot is the best choice ?

Complexity (revisited) for example 3

1. No definitive problem formulation
2. No exhaustive list of permissible operations
3. No stopping rule
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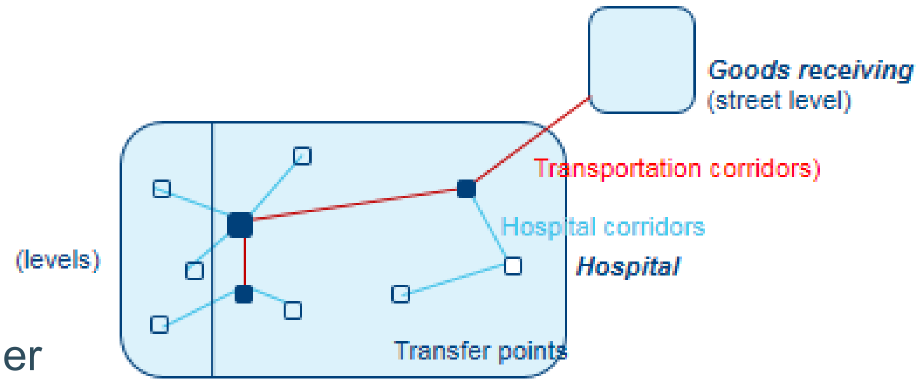


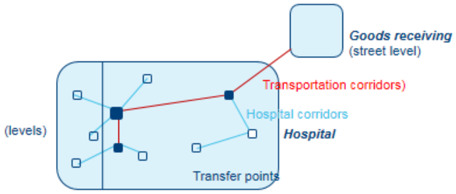
Based on Garcia-Diaz & MacGregor Smith,, 2008

Electrical tow truck

Fixed conveyor

Chain conveyor

Monorail



Tow AGV

Turtle AGV

Platform AGV

Forked AGV

Objectives & issues to consider (revisited)

Minimize material handling costs

Utilize space efficiently

Utilize labor efficiently

Eliminate bottlenecks

Facilitate communication and interaction between workers, between workers and their supervisors, or between workers and customers

Reduce manufacturing cycle time or customer service time

Many different , partly conflicting objectives

Eliminate waste or redundant movement

Facilitate the entry, exit, and placement of material, products, or people

Incorporate safety and security measures

Promote product and service quality

Encourage proper maintenance activities

Provide a visual control of operations or activities

Provide flexibility to adapt to changing conditions

Increase capacity

It is a constrained multi-objective optimization problem with many non-quantifiable costs and benefits.

There is **NO OPTIMAL SOLUTION!**

The best we can hope for is a "GOOD" solution.

Effective designs must consider all stakeholders

- Owners
- Customers
- Suppliers
- Employees
- Neighbors

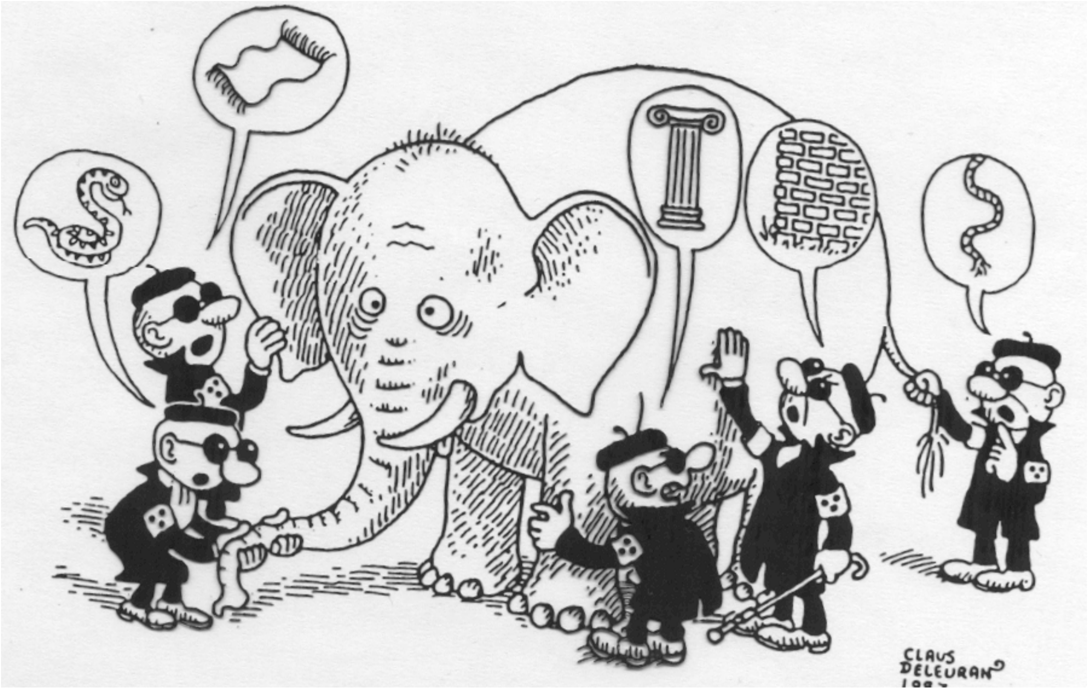
Image that a company is considering building a distribtuion center for drinks (beer, limonade, …) in the Celestijnenlaan.

Who would be the stakeholders to consider ? What are their priorities ?

Beware of Issues having a **long-range impact** on the strategic facilities plan

- Number, location, and sizes of warehouses and/or distribution centers
- Centralized vs decentralized storage of supplies, raw materials, work-in-process, and finished goods for single- and multi-building sites, as well as single- and multi-site companies
- Acquisition of existing facilities vs design of modern factories and distribution centers of the future
- Supply chain innovations/trends
- Flexibility required because of market and technological uncertainties
- Interface between storage and manufacturing
- Level of vertical integration, including “subcontract vs manufacture” decisions
- Control systems, including material control and equipment control, as well as level of distributed processing
- Automation opportunities
- Movement of material between buildings, between sites, both inbound and outbound
- Changes in customers’ and suppliers’ technology
- Changes in firm’s own manufacturing technology and material movement, protection and control technology
- Design-to-cost goals for facilities

Seeing the big picture



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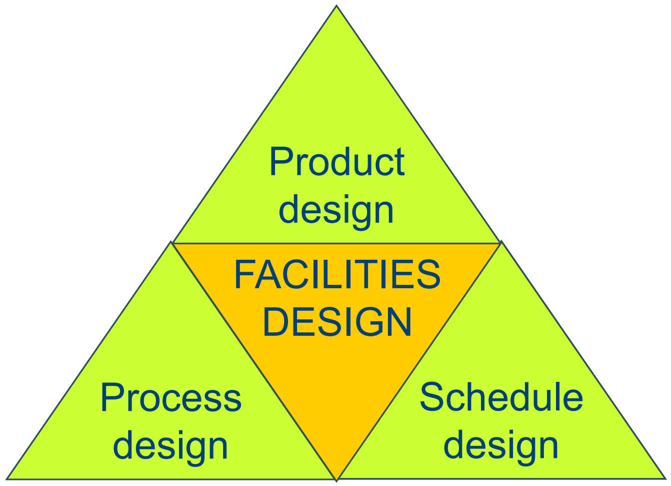
Tools for managing …

Typical for design

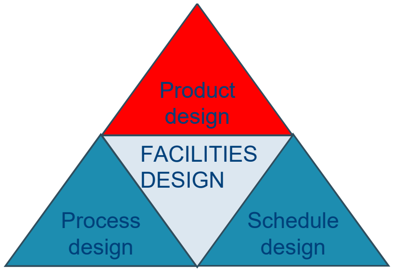
Facilities design elements

PP&S (product, process and schedule) design



Mutual support required !
Not “engineers only”, cfr concurrent or simultaneous engineering teams
Decisions cannot be done independently and sequentially.

a) PP&S: Product design

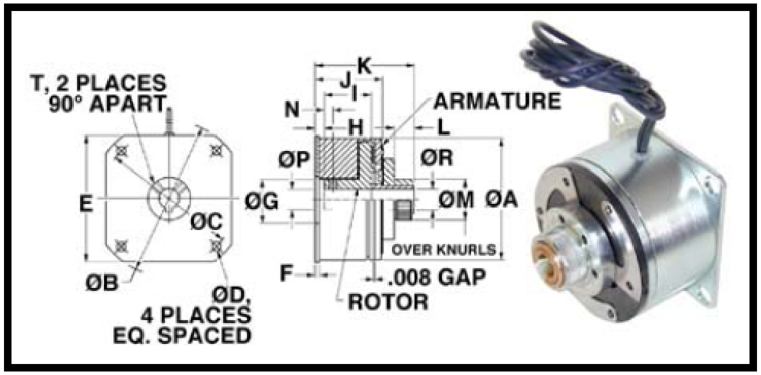


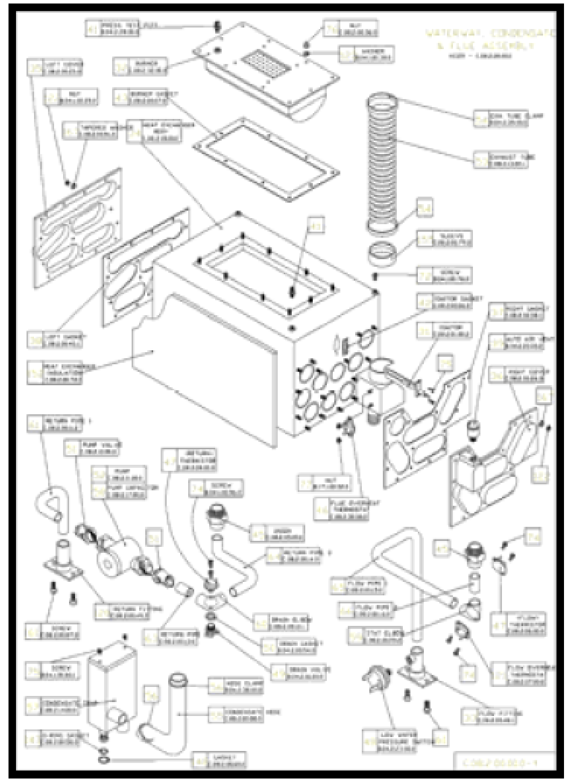
- Based on
  - Function
  - Aesthetics
  - Costs
  - Materials
  - Manufacturing Methods

Driven by market demand

- Key point
  - The product design MUST be finalized before designing the facility. Otherwise a flexible facility is needed.

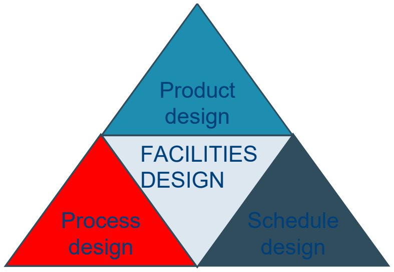
- Product/Part Drawings
  - 2-D, 3-D visualization



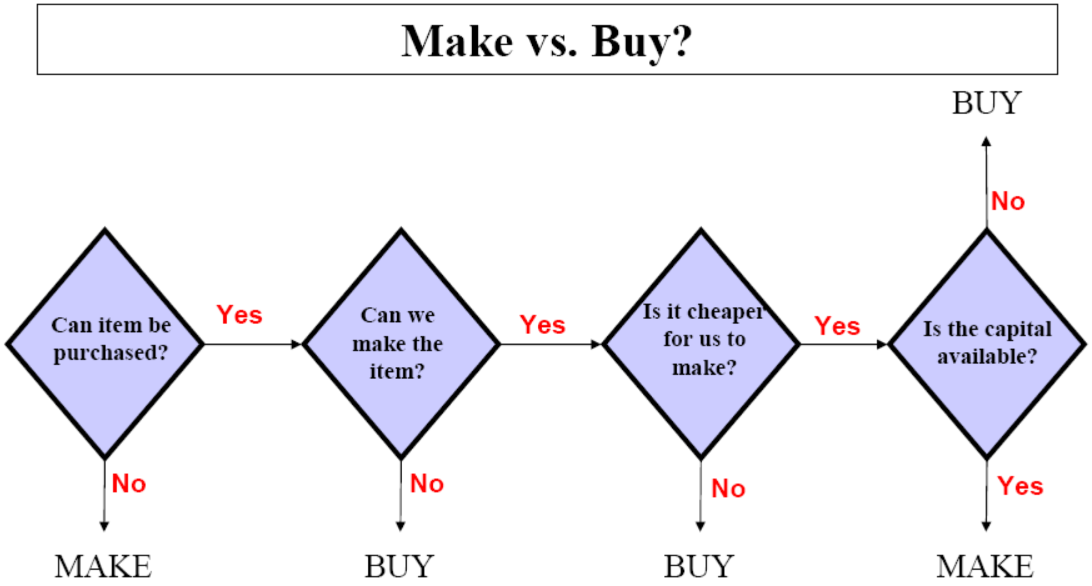


- Exploded Assembly Diagrams

b) PP&S: Process design



Decision charts



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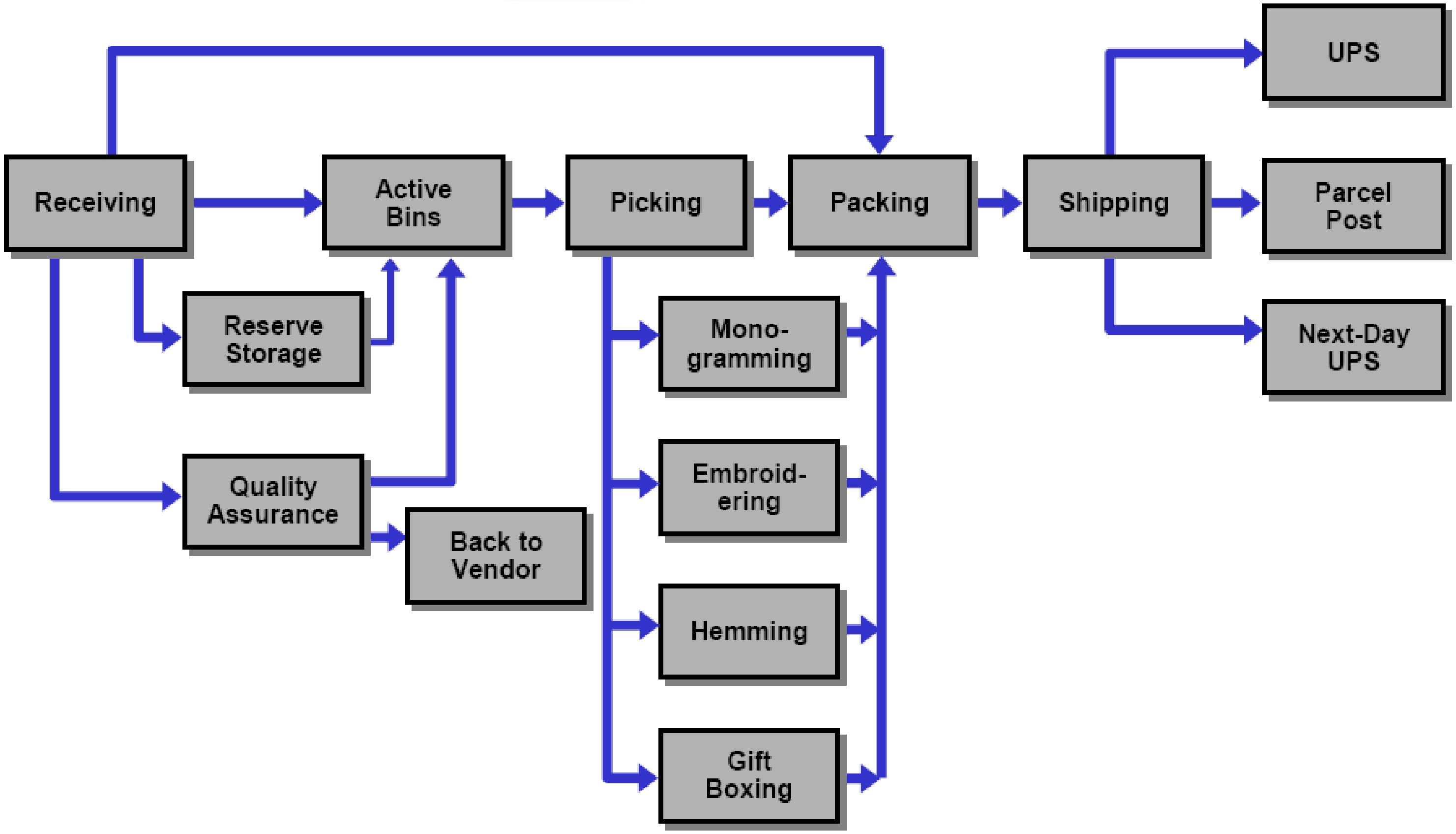
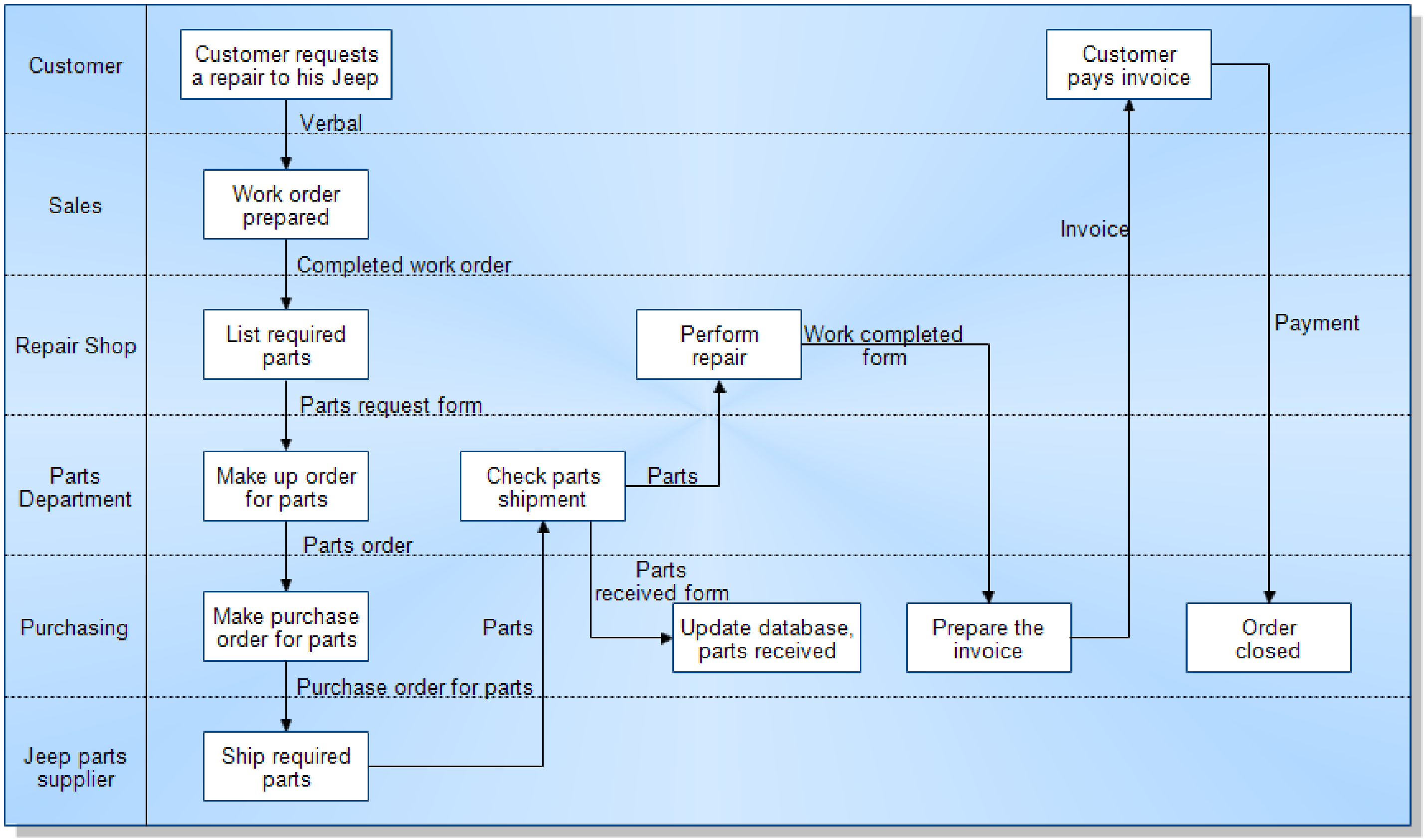
Process flow chart



Multi-actor/cross-functional process map (swimlane diagram)



PARTS LIST

Company: TW Inc. Prepared By: JSU
Product: Air Flow Regulator Date: 6/30/2003

Part No.	Name	Drwg. No.	Qty/unit	Material	Size	Make/Buy
1050	Pipe p					
2200	Bod					
3250	Seat R					
3251	O-Rir					
3252	Plung					
3253	Sprir					
3254	Plunger H					
3255	O-RIr					
4150	Plunger R					
4250	Lock N					

BILL OF MATERIALS

Company: TW Inc. Prepared By: JSU
Product: Air Flow Regulator Date: 6/30/2003

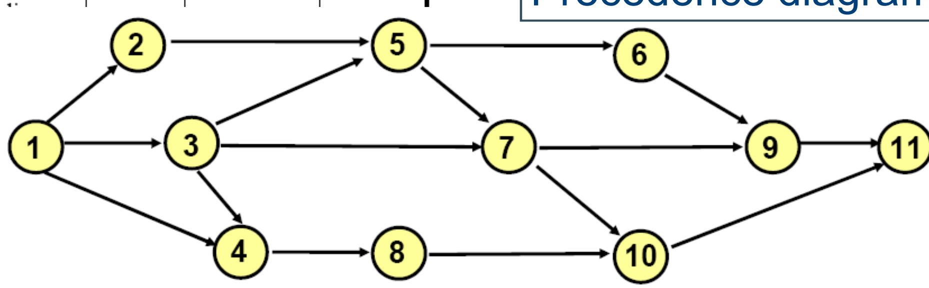
Level	Part No.	Name	Drwg. No.	Qty/unit	Make/Buy
0	0021	Air Flow Regulator	0999	1	Make
1	1050	Pipe plug	4006	1	Buy
1	6023	Main assembly	-	1	Make
2	4250	Lock Nut	4007	1	Buy
2	6022	Body Assembly	-	1	Make
3	2200	Body	1003	1	Make
3	6021	Plunger Assembly		1	Make
				1	Make
				1	Buy
				1	Make
				1	Buy
				1	Make
				1	Buy
				1	Make

Route Sheet

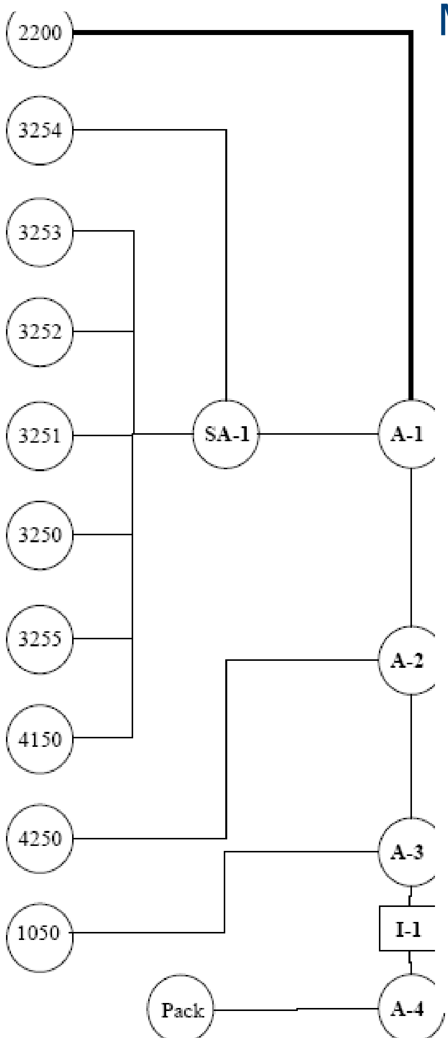
Company: ARC Inc. Part: Plunger Housing Prepared by: JSU
Produce: Air Flow Regulator Part No. 3254 Part No. 6/6/03

Oper. No.	Operation Description	Machine Type	Tooling	Setup (hr.)	Oper. Time (hr.)	Mtls. Parts
0104	Shape, drill, cut off	Auto sc. Machine	.5 in dia coller, cir. Form tool, .45" ... center drill	5	0.0057	Alum
0204	Machine Slot and thread	Chucker	0.045" slot saw, slot			
0304	Drill 8 holes	Auto dr. unit	0.078" diam twi			
0404	Debur and Blow out	Drill press	Deburring tool pilot			
SA 1	Enclose subassembly	Dennison hydraulic press	None	0.25	0.0100	

Precedence diagram



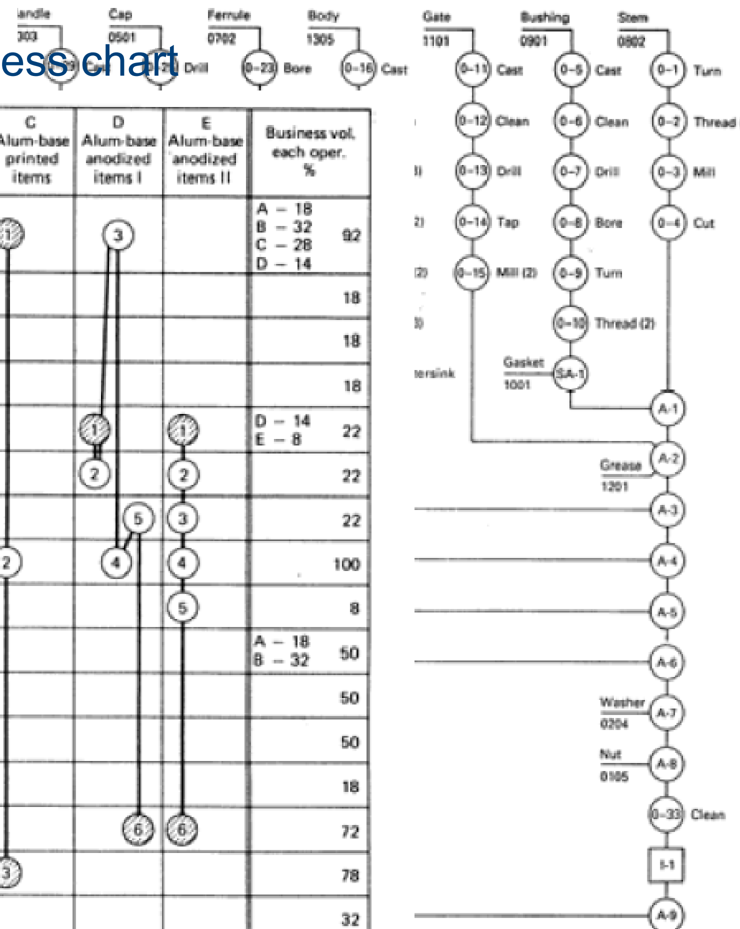
Assembly chart



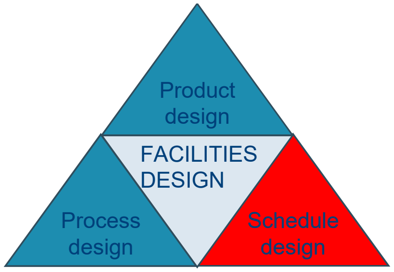
Multiproduct process chart

Operations	A Tin-base etched items	B Alum-base etched items	C Alum-base printed items	D Alum-base anodized items I	E Alum-base anodized items II	Business vol. each oper. %
1. Cut to size	1	1	1	3		A – 18 B – 32 C – 28 D – 14 92
2. Polish	2					18
3. Wash out	3					18
4. Nickel silver plate	4					18
5. Weld				1	1	D – 14 E – 8 22
6. Anodize				2	2	22
7. Colour				5	3	22
8. Print	5	2	2	4	4	100
9. Color etch					5	8
10. Dry spray	6	3				A – 18 B – 32 50
11. Retouch	7	4				50
12. Deep etch	8	5				50
13. Pickle	9					18
14. Rinse	10	7		6	6	72
15. Lacquer	11	8	3			78
16. Spray paint		6				32
17. Imbed colors (future consideration)	9 Alternate	7 Alternate				Future potential 50
Business vol. (%)	18	32	28	14	8	100

Operatons process chart



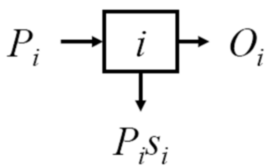
c) PP&S: Schedule design



- How much to produce? **(LOT SIZING)**
- When to produce it? **(PRODUCTION SCHEDULING)**
- How long will production continue? **(FORECASTS)**
- Impacts:
  - Machine selection
  - Number of machines/employees
  - Number of shifts
  - Space requirements
  - MH Equipment
  - Storage policies

Demand forecasts

Product or Service	Year 1	Year 2	Year 5	Year 10
A	5000	5000	8000	10000
B	8000	7500	3000	0
C	3500	3500	3500	4000
D	0	2000	3000	8000



P_i – Production input to operation i

s_i – Fraction of P_i lost (scrap)

O_i – output of process i

Production requirements, yields

$$O_i = P_i - P_i s_i$$
$$O_i = P_i(1 - s_i)$$

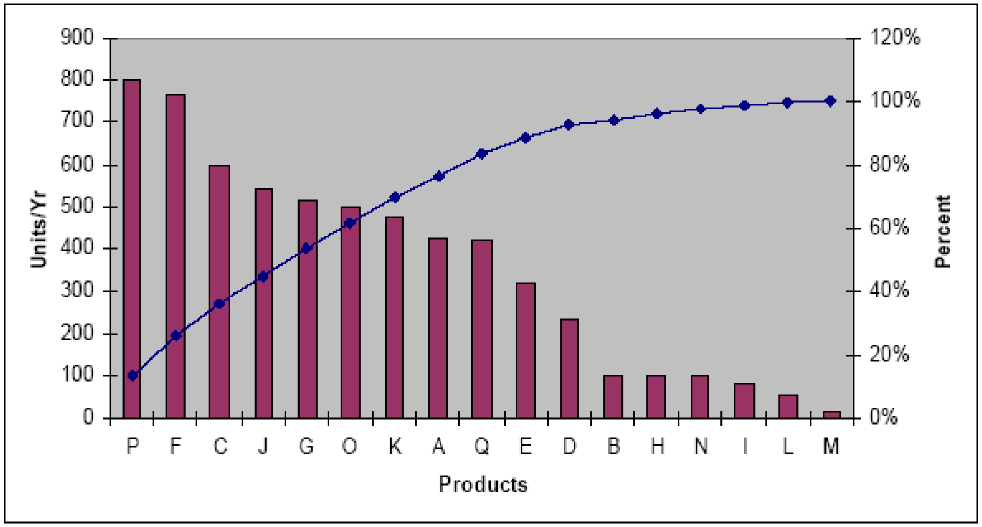
$$\longrightarrow \boxed{P_i = \frac{O_i}{(1 - s_i)}}$$

Equipment requirements

$$M_j = \sum_{i \in X_j} \frac{P_i T_i}{C_i E_i R_i} = \frac{\left(\frac{pc}{period}\right)\left(\frac{time}{pc}\right)}{\left(\frac{time}{period}\right)}$$

Product mix (volume variety chart)

Product	Units/year	Percent
P	800	13%
F	766	26%
C	600	36%
J	542	45%
G	513	53%
O	498	62%
K	475	69%
A	423	76%
Q	418	83%
E	322	89%
D	234	93%
B	100	94%
H	100	96%
N	100	98%
I	81	99%
L	52	100%
M	16	100%



Operator machine charts – Multiple activity chart

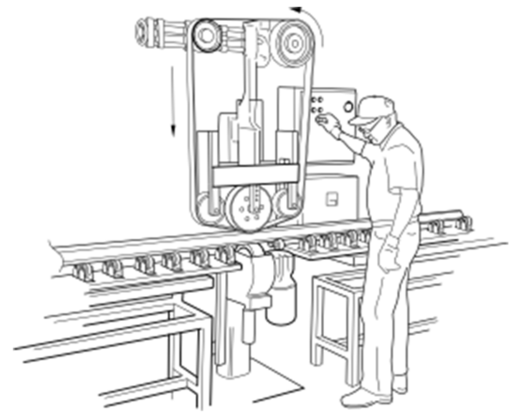
Operator Machine Charts

TWO MACHINES

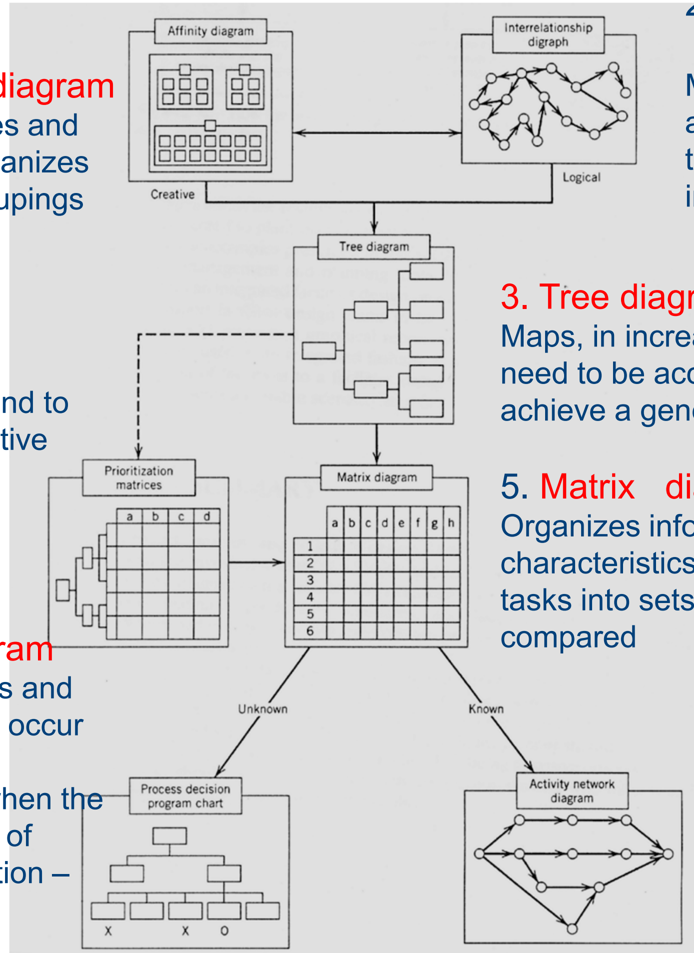
Time	Operator	M1	M2
0.5	U1	UNLOAD	RUN
1	U1	UNLOAD	RUN
1.5	L1	LOAD	RUN
2	L1	LOAD	RUN
2.5	I&P	RUN	RUN
3	T-2	RUN	RUN
3.5	U2	RUN	UNLOAD
4	U2	RUN	UNLOAD
4.5	L2	RUN	LOAD
5	L2	RUN	LOAD
5.5	I&P	RUN	RUN
6	T-1	RUN	RUN
6.5		RUN	RUN
7		RUN	RUN
7.5	IDLE	RUN	RUN
8		RUN	RUN
Cycle Time	8	min	
Oper. Idle	2	min	
Mach Idle	0	min	
Prod Rate	0.25	pc/min	

THREE MACHINES

Time	Operator	M1	M2	M2
0.5	U1	UNLOAD	RUN	RUN
1	U1	UNLOAD	RUN	RUN
1.5	L1	LOAD	RUN	RUN
2	L1	LOAD	RUN	RUN
2.5	I&P 1	RUN	IDLE	RUN
3	T-2	RUN	IDLE	RUN
3.5	U2	RUN	UNLOAD	RUN
4	U2	RUN	UNLOAD	RUN
4.5	L2	RUN	LOAD	RUN
5	L2	RUN	LOAD	RUN
5.5	I&P 2	RUN	RUN	IDLE
6	T-3	RUN	RUN	IDLE
6.5	U3	RUN	RUN	UNLOAD
7	U3	RUN	RUN	UNLOAD
7.5	L3	RUN	RUN	LOAD
8	L3	RUN	RUN	LOAD
8.5	I&P 3	IDLE	RUN	RUN
9	T-3	IDLE	RUN	RUN
Cycle Time	9	min		
Oper. Idle	0	min		
Mach Idle	1	min		
Prod Rate	0.333333	pc/min		



Example: Building a new manufacturing plant ...



1. Affinity diagram
Gathers issues and ideas and organizes them into groupings

2. Interrelationship digraph
Maps the logical links among related items, trying to identify which items impact others the most

3. Tree diagram
Maps, in increasing detail, the actions that need to be accomplished in order to achieve a general objective

4. Prioritization matrices
Helps to evaluate the different alternatives and to select the best alternative based on evaluation attributes defined in coordination with management

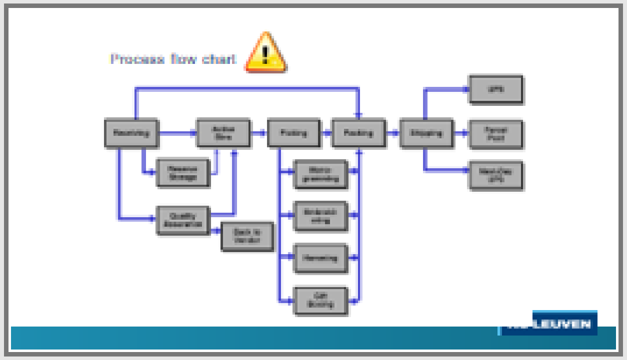
5. Matrix diagram
Organizes information such as characteristics, functions and tasks into sets of items to be compared

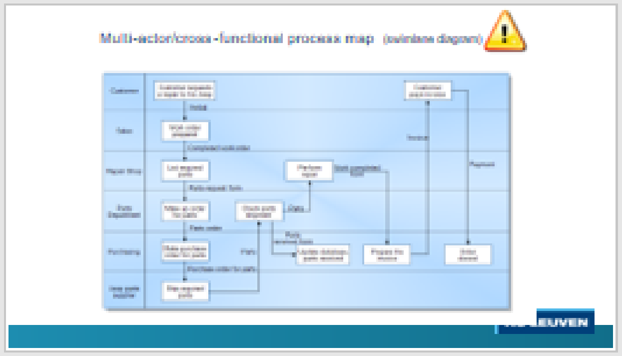
6. Contingency diagram
Maps conceivable events and contingencies that might occur during implementation. Particularly interesting when the project planned consists of unfamiliar tasks (prevention – reduction)

7. Activity network diagram
Used to develop a work schedule for the facilities design effort. Examples: Gantt chart, CPM (critical path method), PERT (program evaluation and review technique)

Typical for (re)design

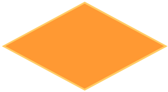
Tool: Flow chart





Start, stop

Choice, decision

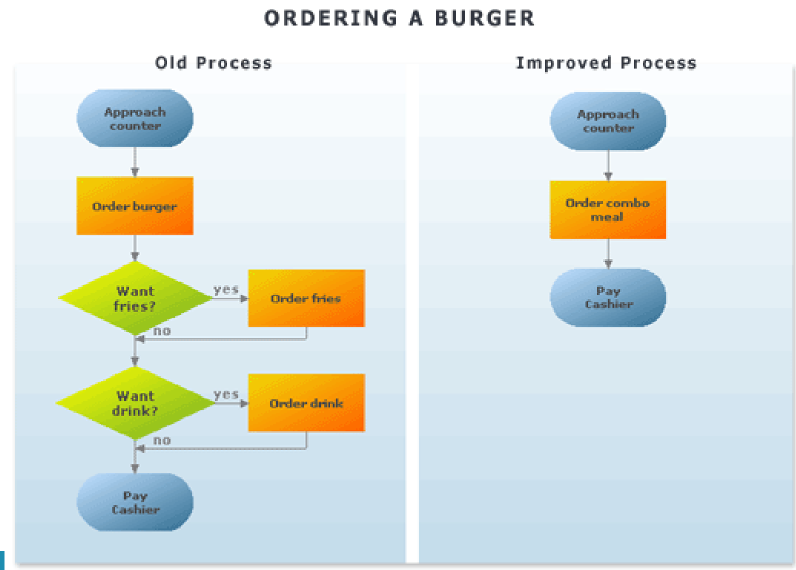


Action, process, inspection

Storage

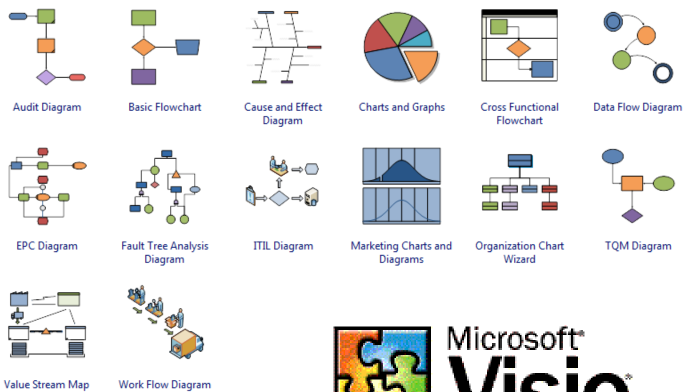
Temporary storage

Transportation, movement

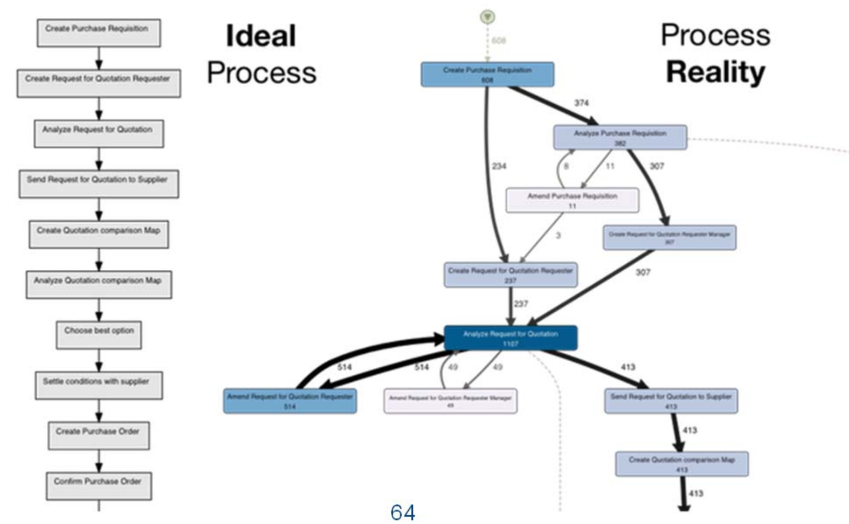


“process mapping”

“manual mapping”



Microsoft Visio



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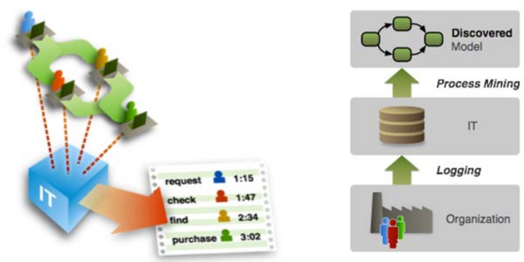
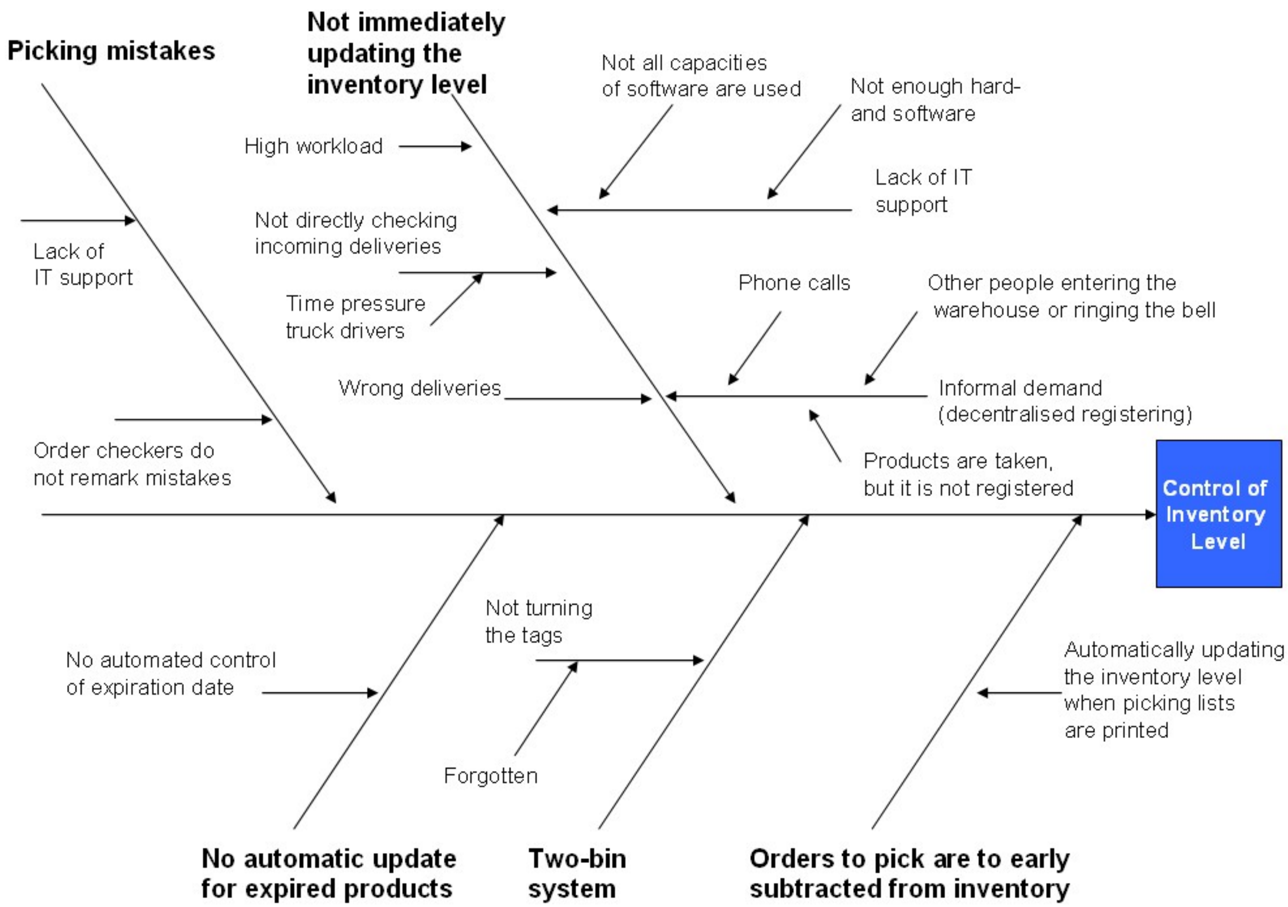
SmartDraw Communicate Visually



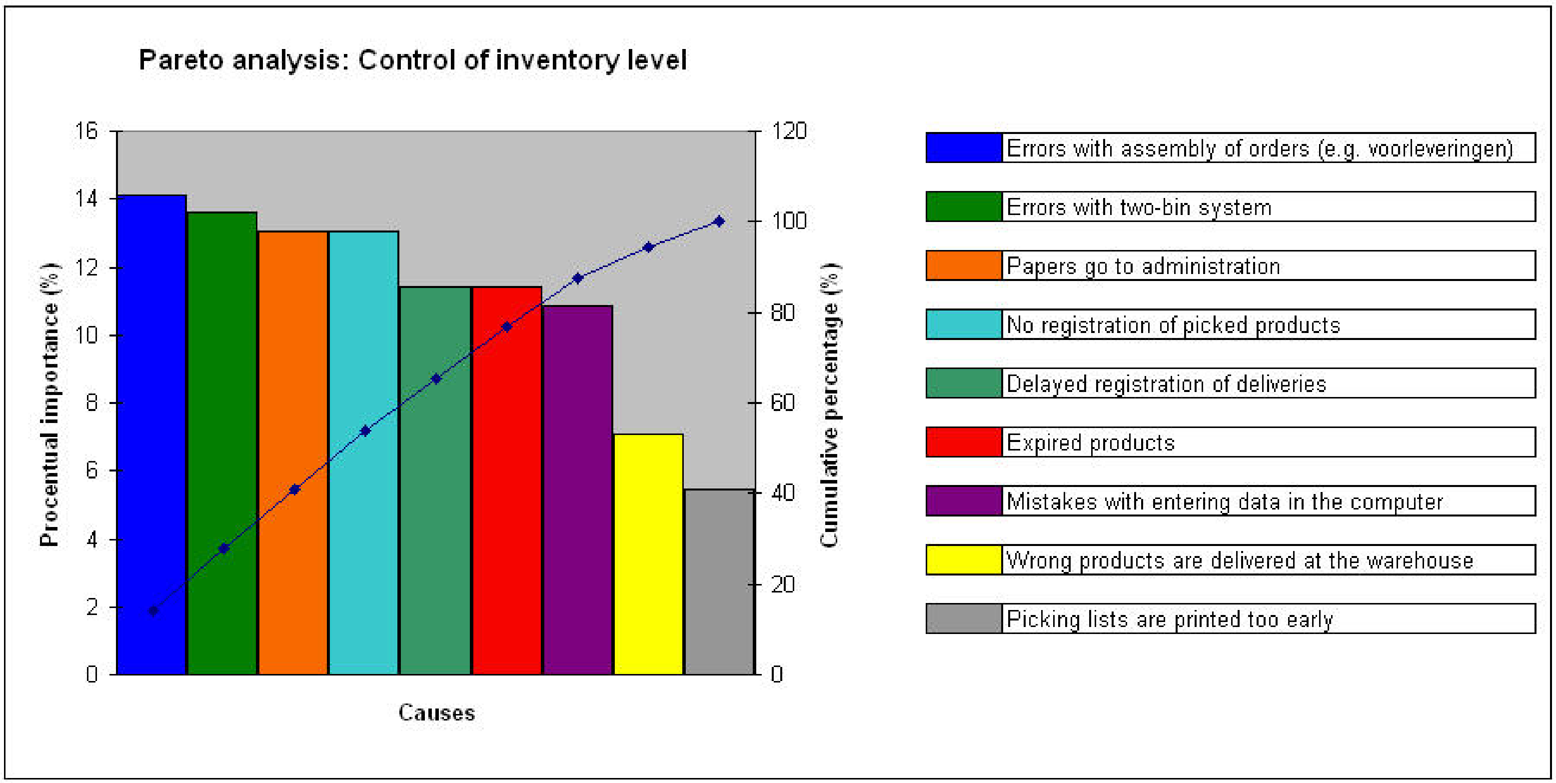
(a) IT-supported Processes record in detail which activities were executed when and by whom.

(b) Process Mining extracts the 'As-is' process from these data.

Tool: Ishikawa- or fishbone diagram



Tool: Pareto analysis



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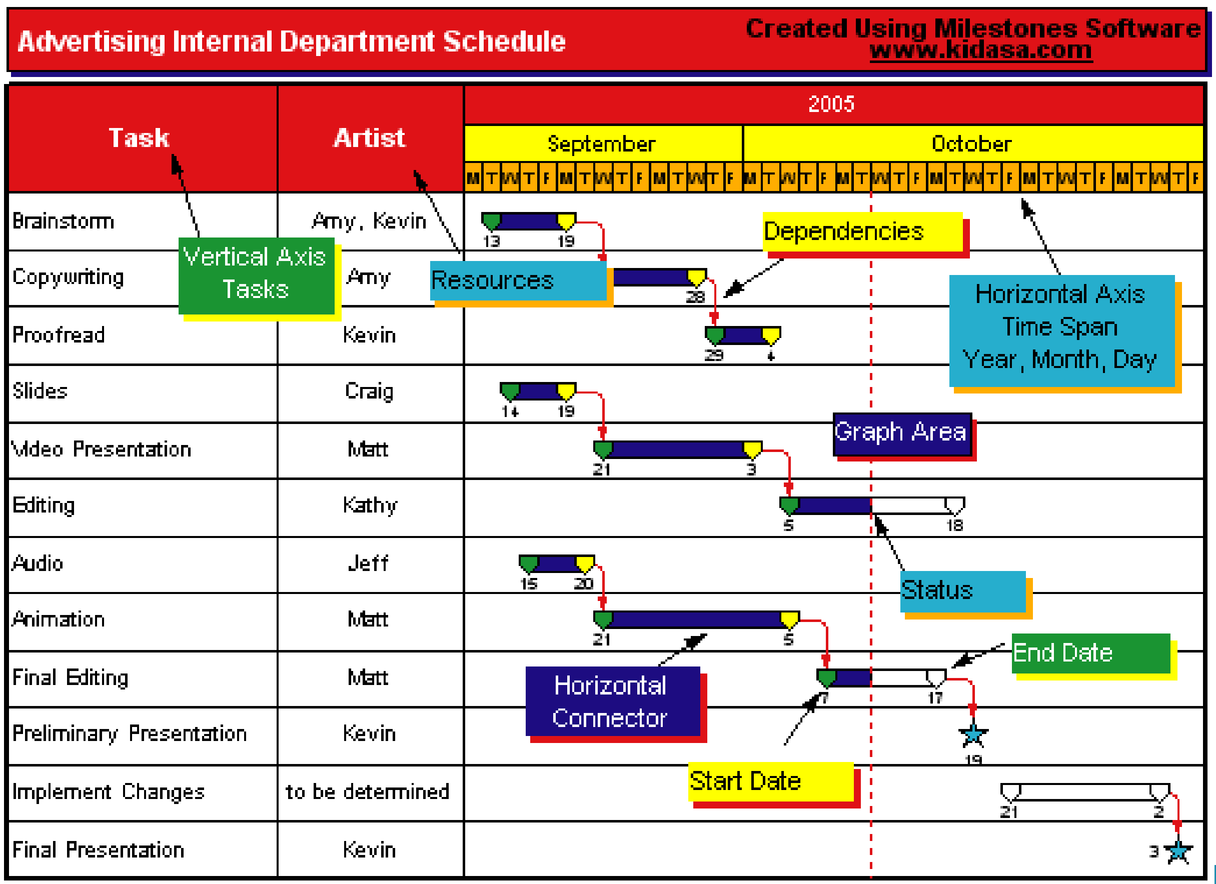
Tool: Gantt chart



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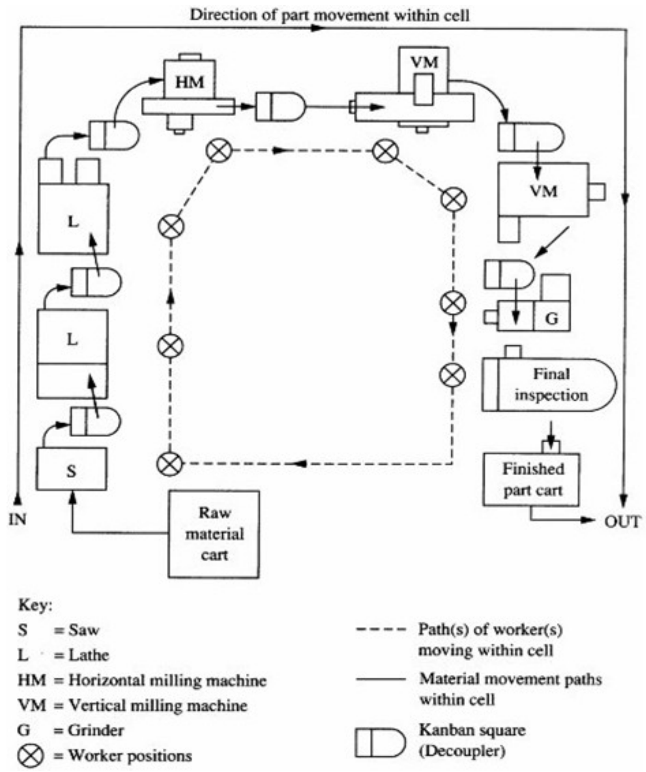
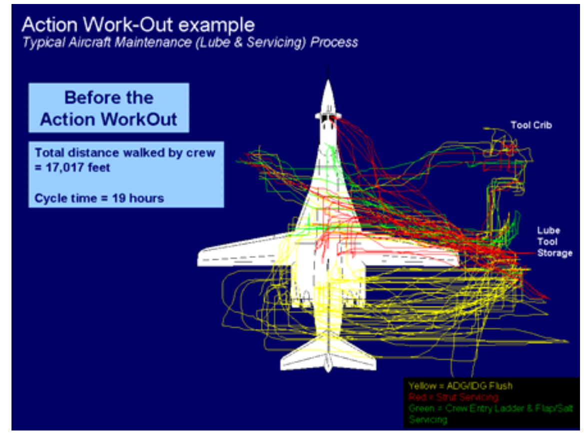
Tool: Process flow chart

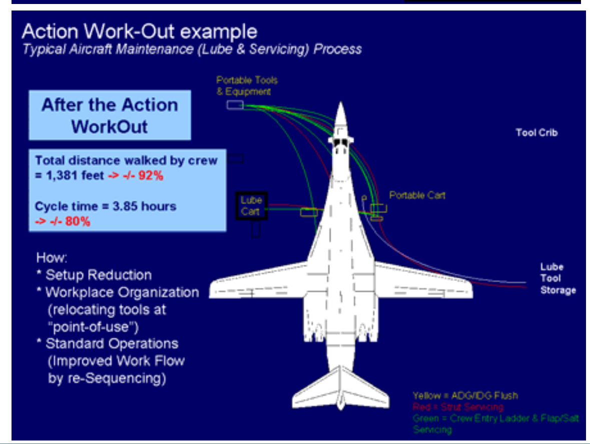
Date: 9-30-02 Analyst: TLR						Location: Graves Mountain Process: Apple Sauce		
Step	Operation	Transport	Inspect	Delay	Storage	Description of process	Time (min)	Distance (feet)
1	●	⇨	□	D	▽	Unload apples from truck	20	
2	○	➡	□	D	▽	Move to inspection station		100 ft
3	○	⇨	■	D	▽	Weigh, Inspect, sort	30	
4	○	➡	□	D	▽	Move to storage		50 ft
5	○	⇨	□	D	▼	Wait until needed	360	
6	○	➡	□	D	▽	Move to peeler		20 ft
7	●	⇨	□	D	▽	Apples peeled and cored	15	
8	○	⇨	□	D	▼	Soak in water until needed	20	
9	●	⇨	□	D	▽	Place in conveyor	5	
10	○	➡	□	D	▽	Move to mixing area		20 ft
11	○	⇨	■	D	▽	Weigh, inspect, sort	30	
	Page 1 0f 3					Total	480	190 ft

Tool: Flow diagram



Tool: Spaghetti diagram





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Tool: From-to matrix

From \ To	A	B	C	D
A		2	7	4
B	3		5	5
C	6	7		3
D	8	2	3	

(a) Number of materials handling trips per hour

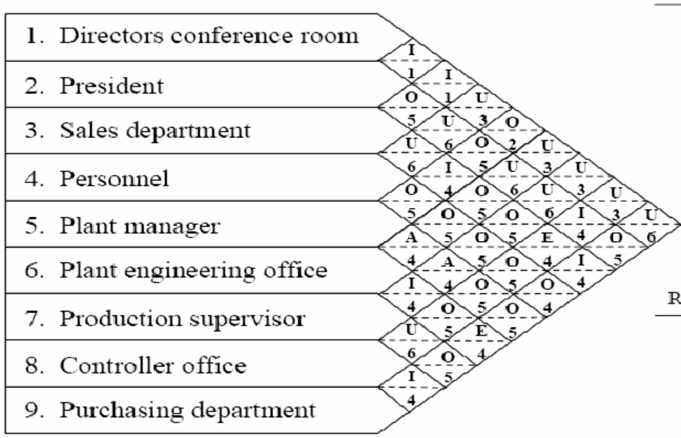
From \ To	A	B	C	D
A		50	35	65
B	50		85	35
C	35	85		50
D	65	35	50	

(b) Rectilinear distance between departments in initial layout

From \ To	A	B	C	D	Totals
A		100	245	260	605
B	150		425	175	750
C	210	595		150	955
D	520	70	150		740
Totals:	880	765	820	585	3,050

(c) Total distance traveled per hour between departments in initial layout

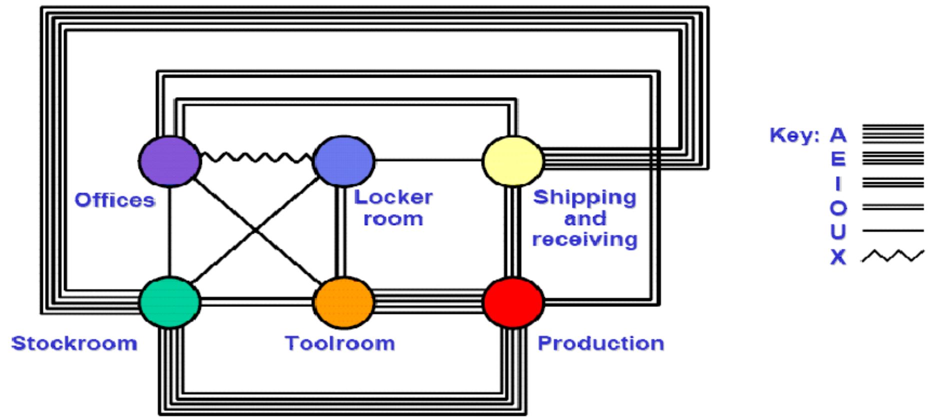
Tool: Relationship chart



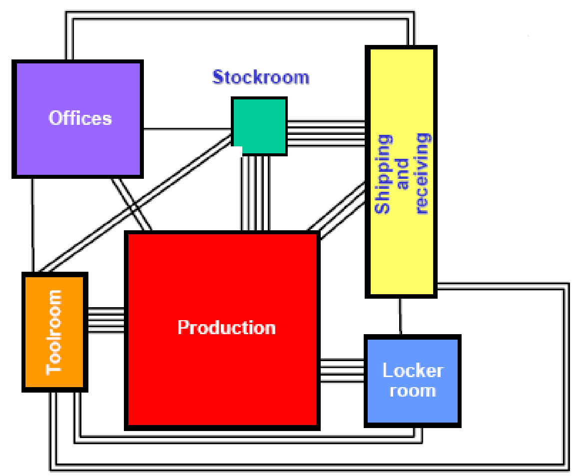
Code	Reason
1	Frequency of use high
2	Frequency of use medium
3	Frequency of use low
4	Information flow high
5	Information flow medium
6	Information flow low

Rating	Definition
A	Absolutely Necessary
E	Especially Important
I	Important
O	Ordinary Closeness OK
U	Unimportant
X	Undesirable

Tool: Relationship diagram



Tool: Space-relationship diagram



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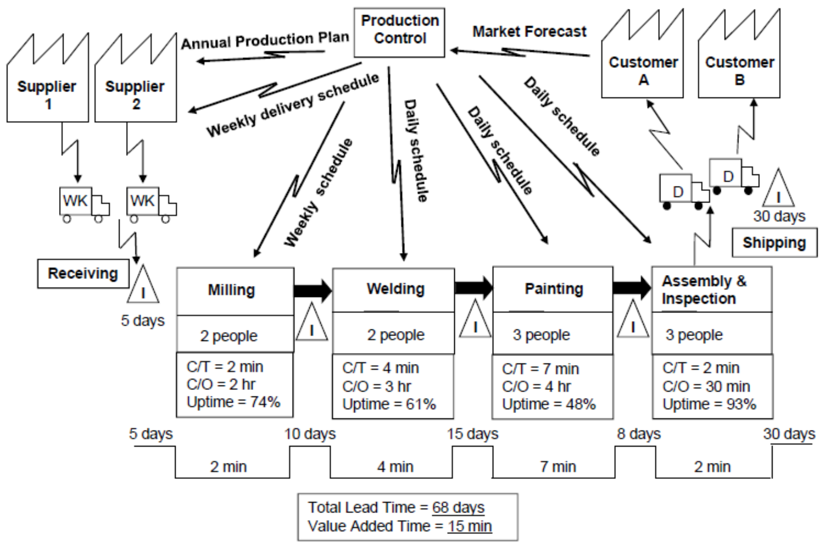
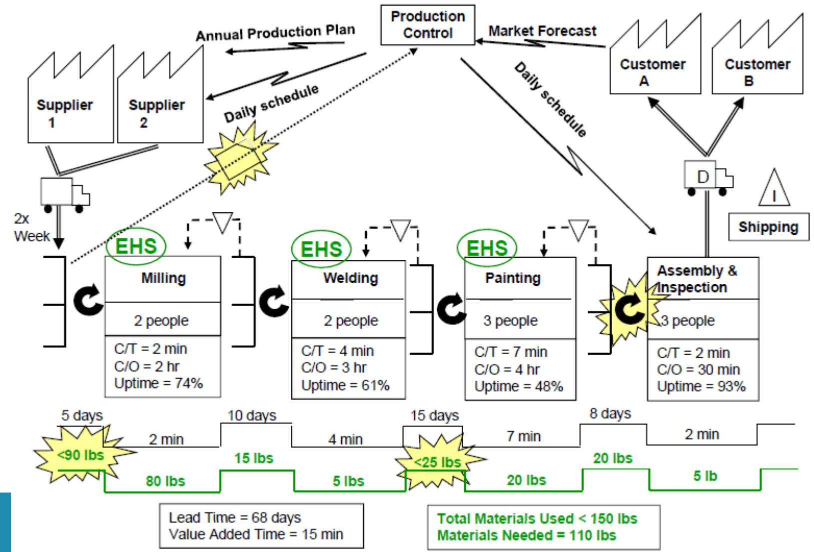
Tool: value stream mapping

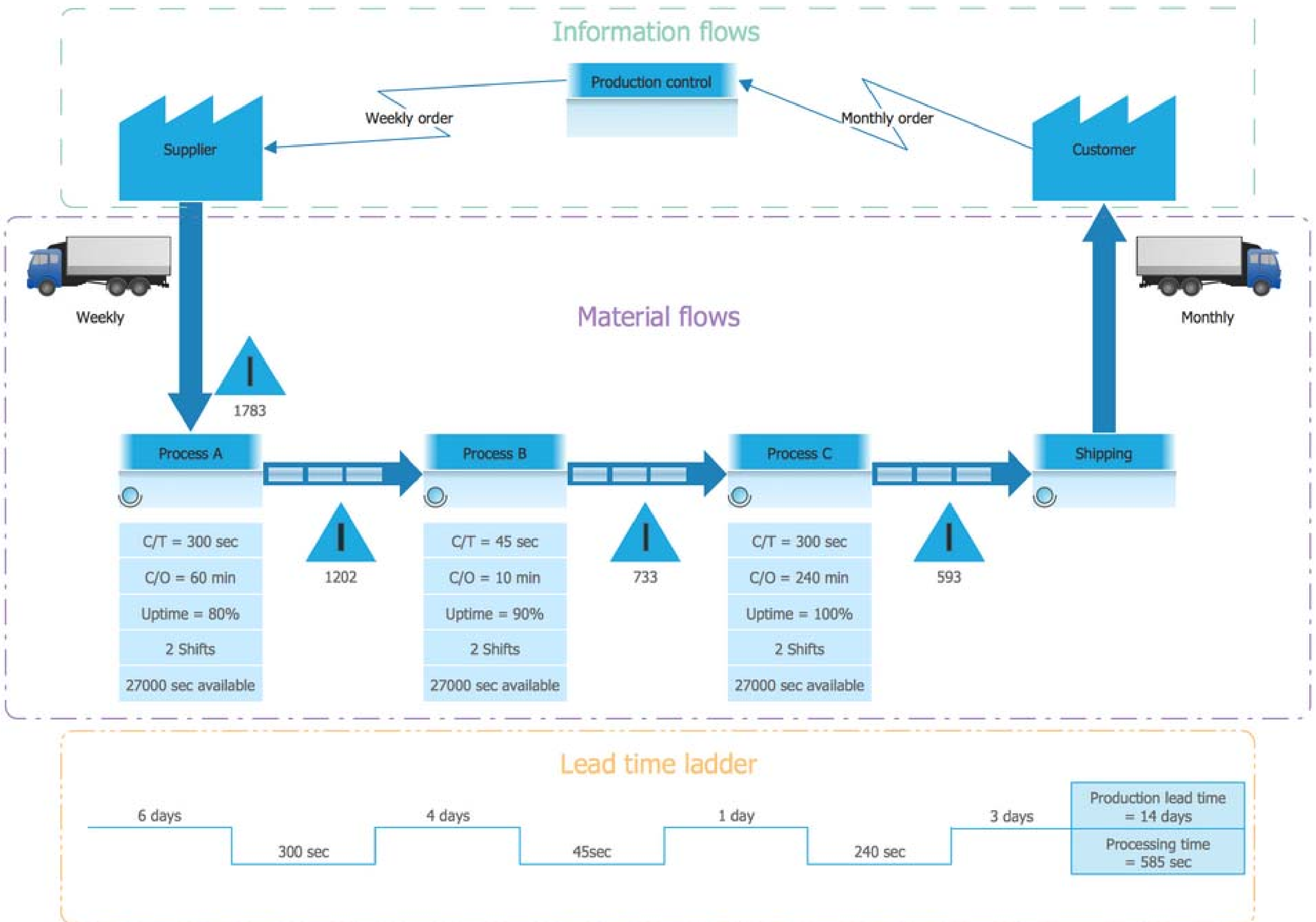
Current state map



(see later)

Future state map

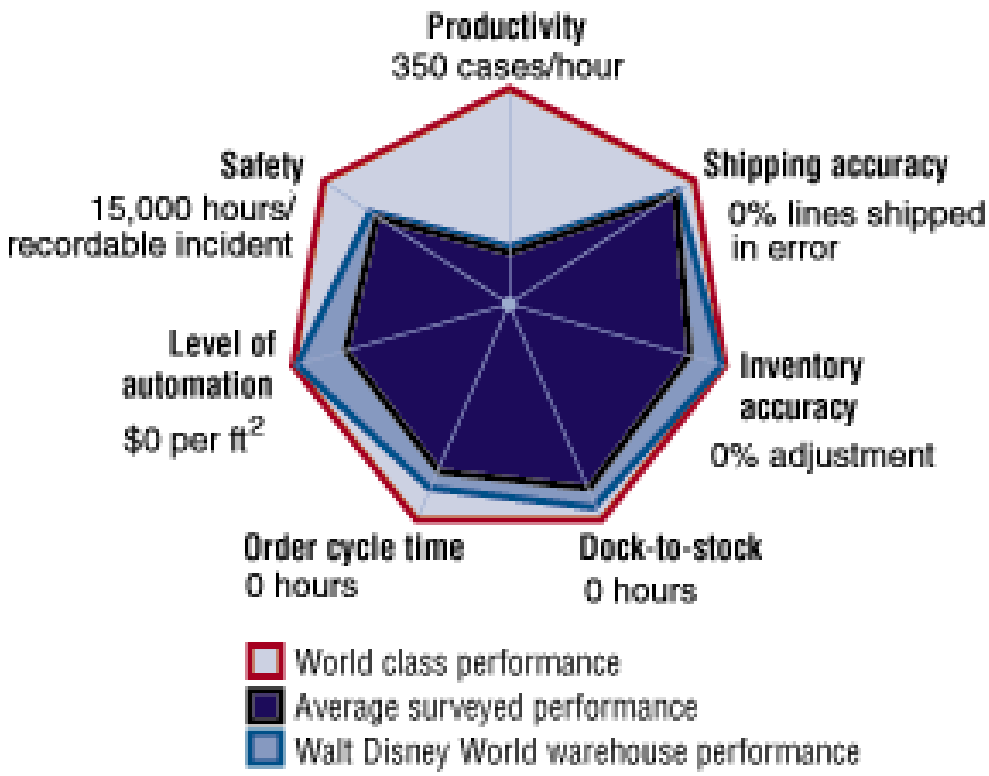




Information flows
Production control
Weekly order
Monthly order
Supplier
Customer
Material flows
Weekly
Monthly
1783
Process A
Process B
Process C
Shipping
C/T = 300 sec
C/O = 60 min
Uptime = 80%
2 Shifts
27000 sec available
1202
C/T = 45 sec
C/O = 10 min
Uptime = 90%
2 Shifts
27000 sec available
733
C/T = 300 sec
C/O = 240 min
Uptime = 100%
2 Shifts
27000 sec available
593
Lead time ladder
6 days
300 sec
4 days
45sec
1 day
240 sec
3 days
Production lead time = 14 days
Processing time = 585 sec

General management tools

Tool : Gap analysis



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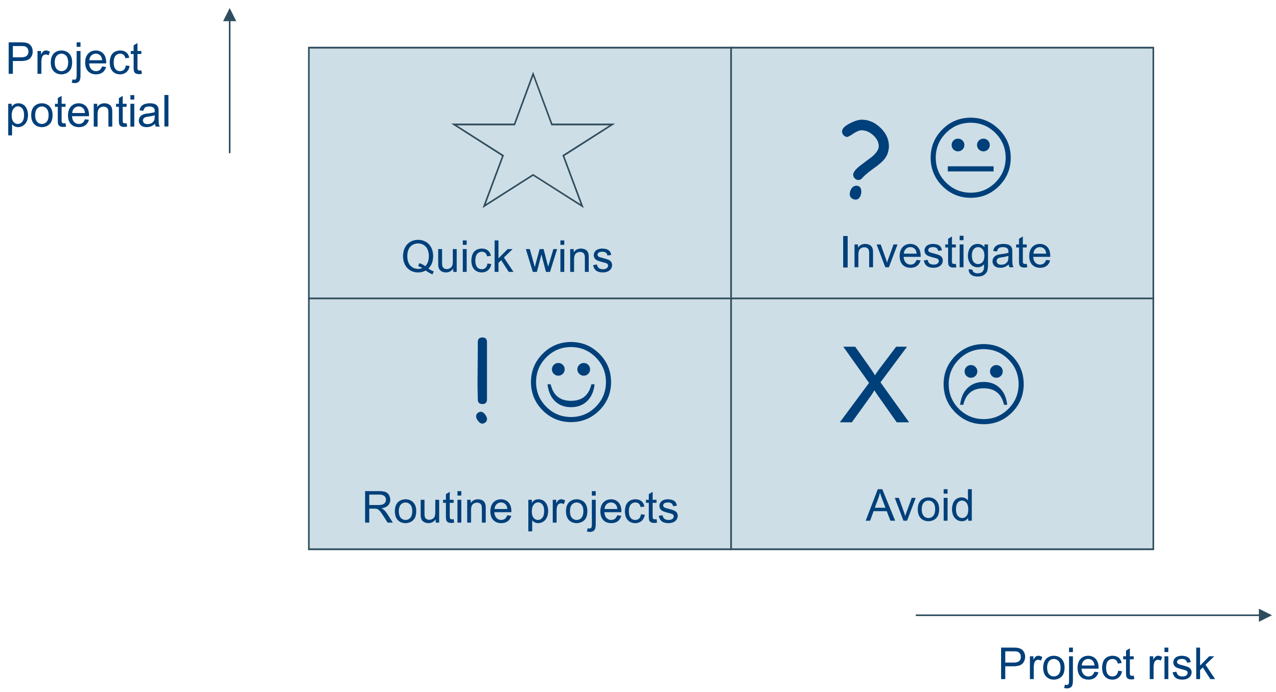
Tool: Opportunity matrix



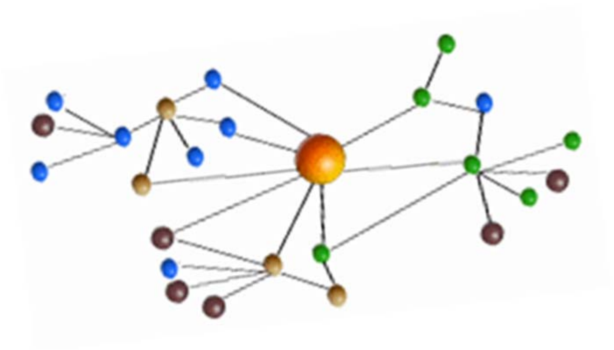
Tool: SWOT –Confrontatiematrix

	HELPFUL to achieving the objective	HARMFUL achieving the objective
INTERNAL attributes of the organization	**Strengths** core competencies and resources in which it is one of the market or industry leaders	**Weaknesses** area of substandard business performance compared to others in the industry or market segments
EXTERNAL attributes of the environment	**Opportunities** potential for new business markets or innovative breakthroughs that might greatly expand present markets	**Threats** potential for business & market losses posed by the actions of competitors and other competitiveforces, changes in government policies, disruptive new technologies, ...

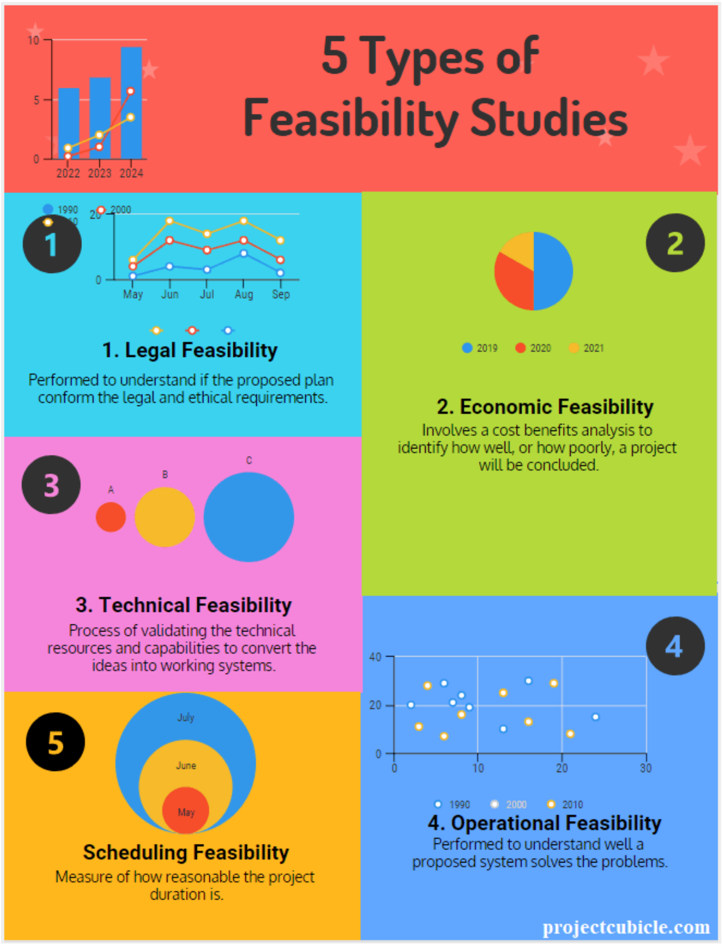
	opportunities	threats
strenghts	How to use a strong point to take advantage of an opportunity ? *Make the most of these !* **Offensive approach**	How to use a strong point to battle a threat ? *Restore strenghts !* **Adjusting approach**
weaknesses	How to improve a weak point so that an opportunity can be seized ? *Watch "competition" closely !* **Defensive approach**	How to improve a weak point so that a threat can be faced ? *Turn around !* **Surviving approach**

Example: FarmaLabX

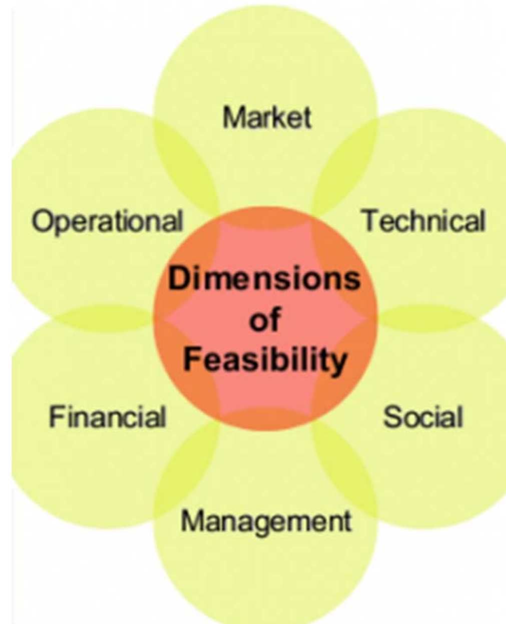
European distribution network
pharmaceutical products and lab material



Tool: SWOT –Confrontatiematrix



Only for projects that add **value**



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Will San Francisco ban on facial recognition affect digital signage?

June 14, 2019

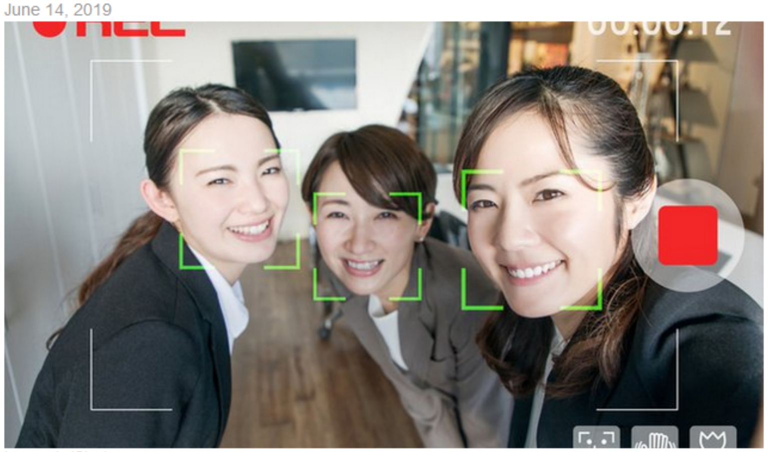

Image via iStock.com

Vanaf 23 september zal één dag per week een drone tussen 21 ziekenhuizen van Antwerpen vliegen. Ook Turnhout en Gent zitten mee in het experiment.

Bij dronesspecialist Helicus, dat volgende maand het transport tussen de ziekenhuizen mee zal verzorgen, opteert om stapgewijs te werk te gaan. Bij aanvang gaat het om één transport per week en per definitie overdag. Het project begon met een beperkte selectie van Antwerpse ziekenhuizen, maar wordt nu breed gedragen.

Vanaf de week van 23 september zullen de onbemande luchtvaartuigen een dag per week weefsel, monsters, medicijnen en bloed tussen 21 ziekenhuizen vervoeren. Turnhout en Gent volgen.

(www.computable.be – 19 aug 2019)

Tool: mudas

THE 7 WASTES
VALUE ADDED
OVERPRODUCTION
Creating too much material or information
INVENTORY
Having more material or information than you need
TRANSPORTATION
Moving material or information
MOTION
Moving people to access or process material or information
WAITING
Waiting for material or information, or material or information waiting to be processed
DEFECTS
Errors or mistakes causing the effort to be redone to correct the problem
OVERPROCESSING
Processing more than necessary to produce the desired output
The 7 wastes are activities identified in an organization that do not add value but cost money. Usually, only 5% of our time actually adds value to the customer, rest everything is waste. Identify and eliminate these wastes to become a Lean organization

Justification

Important!!

Selling Your Plan

The Layout

- Try to illustrate how the design works
- 2-D or 3-D CAD Drawing
- May need large plots
- Include flow lines
- Show analysis results
- Show multiple alternatives
- Simulation model if possible

The Written Report

- Make it easy to read and understand
- Avoid detailed calculations in body of report, use summary tables, plots etc.
- Label all Figures and Tables with a sequential number and add a caption
- Be organized and neat, use consistent headers, sub-headers, 1.0, 1.1, 1.1.1
  - Letter of Transmittal
  - Cover Page
  - Executive Summary (1-page only)
  - Table of Contents
  - Introduction (Problem description, be specific)
  - Current System (if applicable)
    - Operation and Analysis
    - Critique
  - Proposed System
    - Design Methodology
    - Operations and Analysis
    - Results/List of Features
    - Cost Justification
    - Plan of Implementation (optional)
  - Conclusions (rephrase and restate intro) and Recommendations
  - Appendices (with supporting data, reference them in order)
- Don't teach FP, SELL your design!
- Writing IS re-writing!

The Oral Presentation

- Be brief and direct
- Be confident, well-dressed
- Use quality visuals and avoid gimmicks
- Match speech to sequence of slides
- Be open to questions at any time
- Stay on point!
  - What is the problem?
  - What should be done?
  - How should it be done?
  - Why should your design be implemented?
- List features

7-steps to consider

1. Specify the alternatives
2. Define the planning horizon
3. Estimate the cash flows
4. Specify the interest rate
5. Compare the alternatives
6. Perform sensitivity analysis
7. Select the best alternative

1. Specify alternatives

Many possible solutions usually exist.

Define a mutually exclusive set of feasible alternatives.

Don't forget the "Do-Nothing" alternative.

Get the big picture.

Design the whole, justify the whole, and implement the pieces.

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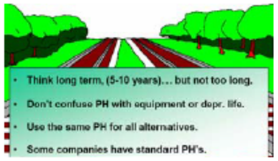
2. Define planning horizon (PH)



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3. Estimate cash flows

Yearly estimates of costs and benefits

Most difficult aspect

Comprised of direct, indirect, and intangible factors.

Must be based only on future costs and benefits only.

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4. Specify the "interest rate"

– hurdle rate
– return on investment
– minimum attractive rate of return (MARR)
– interest rate used in DCF calculations

• **Should reflect opportunity cost of alternative uses for capital**
  – most American companies use MARR of 10-20%
  – Japanese firms use 5-10%

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5. Compare the options

• Many different methods exist
• Companies have preferred ones
• Most popular are:
  – Net Present Worth (NPW)
  – Internal Rate of Return (IRR)
  – Compute After Tax with inflation

• *easy to use, but <u>incorrect</u>*
• *assumes i=0%*
• *fails to consider cash flows beyond PP*

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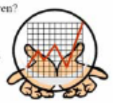
6. Supplemental analysis

What if some of your data is wrong?

How much error will impact the decision to invest?

• <u>Breakeven Analysis</u>
  – requires least amount of information
  – Is true value above or below breakeven?
• <u>Sensitivity Analysis</u>
  – requires more information
  – What's the range of possible values?



• <u>Risk Analysis</u>
  – requires the most information
  – What are the possible values and their probabilities?

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7. Select the preferred option

• *Obtain support from users of the system*
• *Speak the language of the listener*
• *Don't oversell technical aspects*
• *The decision maker's perspective is broad*
• *This proposal is just one of many*
• *Selling is the name of the game*
• *Show well-being to the firm!*
• *THE GOLDEN RULE . . .*

Those with gold make the rules.

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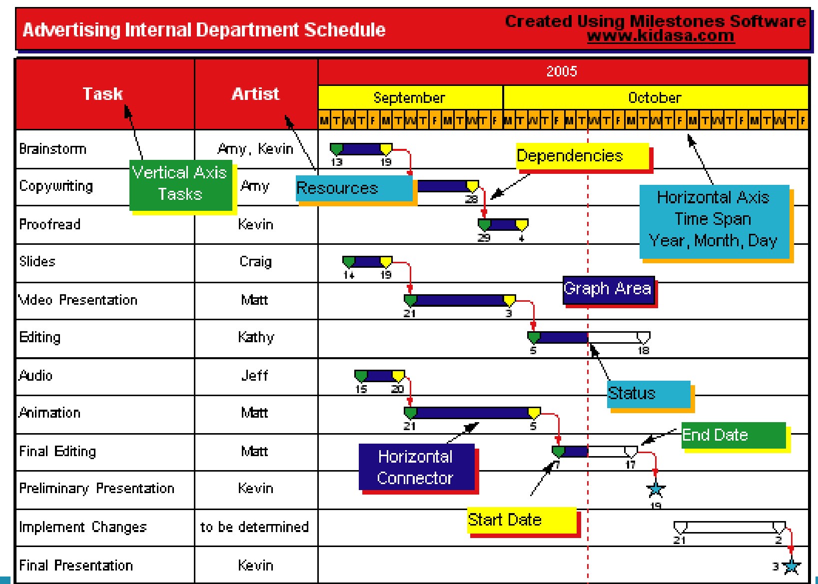
Project planning

Typical phases

- Initiating/Defining
- Planning
- Executing
- Controlling
- Closing

NOT IN THE SCOPE OF THIS COURSE, BUT IMPORTANT!



Useful tips & techniques

Cash flows

(in)direct costs, sunk costs

Estimates

(sensitivity – quid zero?)

Intangibles?

Models

(PW, AW, …- ABC)

Some effects can be tricky to evaluate

1. Increased Throughput
2. Decreased Labor
3. Improved Quality
4. Improved Safety
5. Decreased Inventory
6. Space Savings

Demand > or < Capacity

E.g. with automation

Fewer rejects
Happier customers
Fewer returns

(In)tangible ?

Capital immobilisation ↓
Storage space ↓
Damage and quality issues ↓
But also ...

Value of m^2 ?

Stuff-to-think about

What about the tools?

Many, many tools available

- From quick & dirty to very sophisticated ...
- From very narrow to very broad ...
- From specific to all-round ...
- From intuitive to rather strict ...

Often multipurpose for design and redesign

Different outcome, different input

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Situation 1:

The manager of the packaging department of a cookie factory is worried about productivity. In his perception a lot of time is lost with just running around without doing anything productive, there are regular arguments about who is to do what, quite some mistakes are made, …

What would you recommend as actions to take ?

Situation 2:

Hospital management of a oncological day clinic receives a lot of complaints from patients that about the long time spent in the clinic. Even patients whose actual treatment takes only 10-30 min complain that their actual stay at the hospital is taking more than half a day.

What steps would you recommend to the hospital management ?

Most patients follow a standard trajectory": reception – blood sample taken – blood sample analysed – MD prescribing drugs – pharmacy making drugs – nurse picking up the drugs – drugs administered – leaving hospital trhough reception (making new appointment)

Problem-Scope & Objectives; Analysis

Manufacturing

Productivity issues

Packaging unit

Specify productivity expectations

Measuring the problem

What exaclty is the problem ?
How big ?

Waste analysis, Ishikawa, Pareto

Involve mgmt & workers

Data collection

quantitative, qualitative

Healthcare

Patient waiting times

Oncological day clinic

Scope: all patient groups ?

Defining/Measuring the problem

Map the process, step by step

(Non)existing documentation + interviews

Swimlane or flow chart – VSM

Involve mgmt & workers - patients

Data collection

quantitative, qualitative

Different needs, different tools – combination of tools – quid spaghetti diagram ?

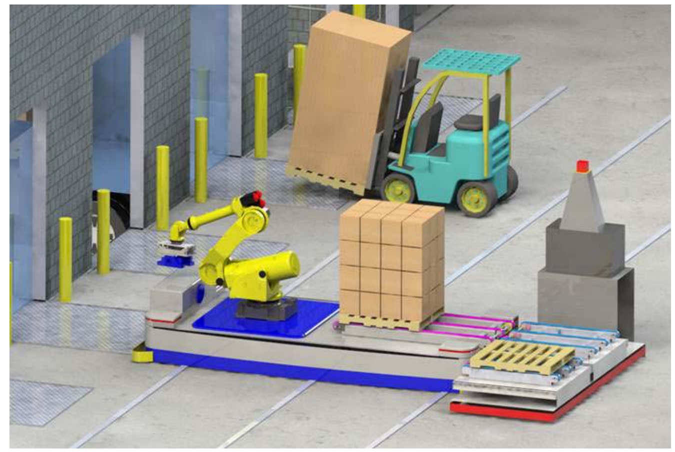
Stakeholders

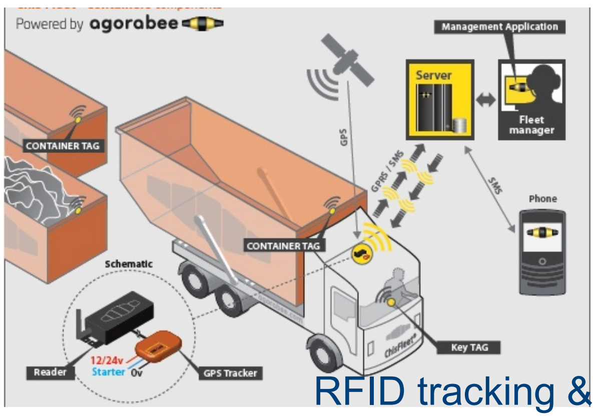
Old & new data

What about technology?

For example …

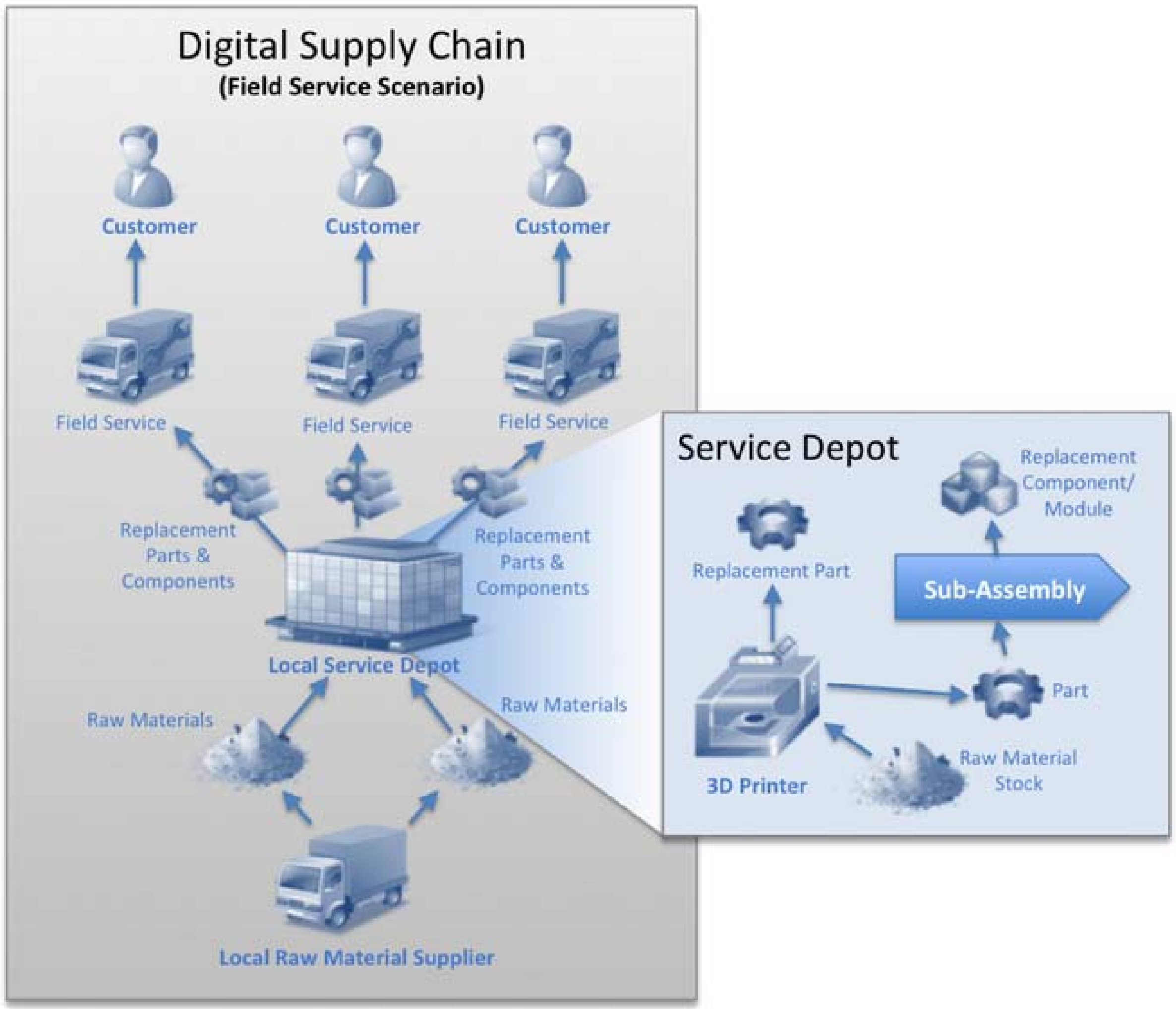
Robot-AGV for order picking





RFID tracking & tracing

Spare part transport in large plants


Digital Supply Chain
(Field Service Scenario)
Customer
Customer
Customer
Field Service
Field Service
Field Service
Replacement Parts & Components
Replacement Parts & Components
Local Service Depot
Raw Materials
Raw Materials
Local Raw Material Supplier
Service Depot
Replacement Component/ Module
Replacement Part
Sub-Assembly
Part
3D Printer
Raw Material Stock

What about the data needed?

Hard, undeniable, objective data
Ideal for decision making, but rarely available

F Facts

Based on rumours or practical experiences
Can be valuable, but keep in mind that they are NOT facts

O Opinions

Uncertain ideas
Can be useless or lead to breakthroughs

G Guesses

Finding data …

- recall: complex, unique projects
- data situation
  - sparse or abundant
  - often poorly organized
  - often need for new collection
- requires engineering judgement
- also consider ROI

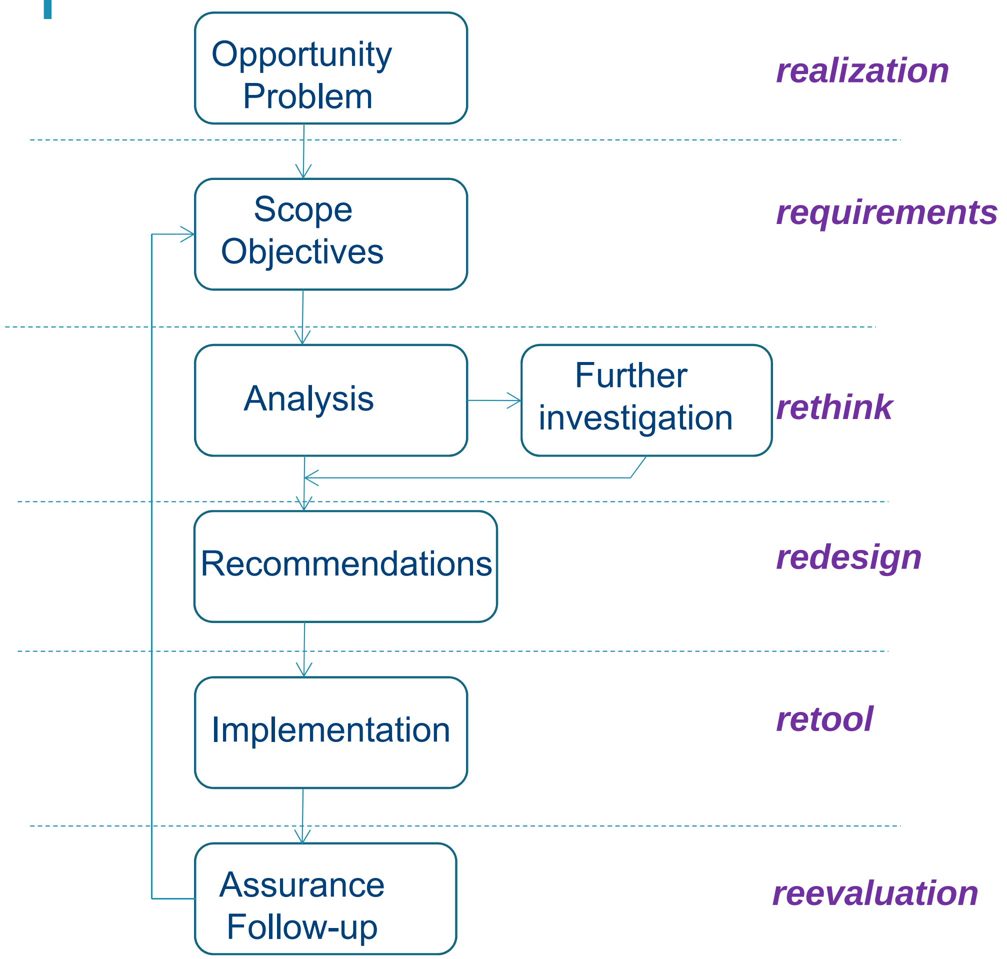
Log files
Observations
Interviews
Measurements
Literature

Head count will be down with 3 FTE. In order to keep up the current production capacity, you need to improve the current production process. You are thinking of reducing the number of manual operations and reducing the changeover time.
First of all, you need precise data. How do you want to collect data – more specifically times – on the operations?

Options

Ask people to write down the times 	**Observe and use a stopwatch** 	**Film the operations and analyse** 	**???**

Generic aproach - 1



Example

Problem: many complaints from the wards about the hospital pharmacy: errors, too late, unexpected delivery moments,….

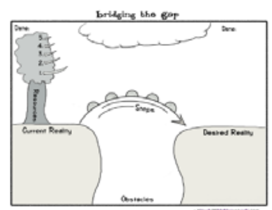
Scope: pilot VPE

Objectives: error max 5%, 95 % deliveries within 10 min of time agreed

Analysis & (Re)Design: (1) mapping process flow; "now" measurement – (2) quantitative insights: on orders: how ? what ? when ? rush orders ? … - (3) qualitative insights : expectations stakeholders, technical & logistic constraints (4) AS IS (DN) & TO BE scenarios analysis (feasilbility check - simulation, optimization)

Recommendations: what – how - who

Implementation: project mgmt, change mgmt



Assurance & Follow-up: plan-do-check (KPI lity solution

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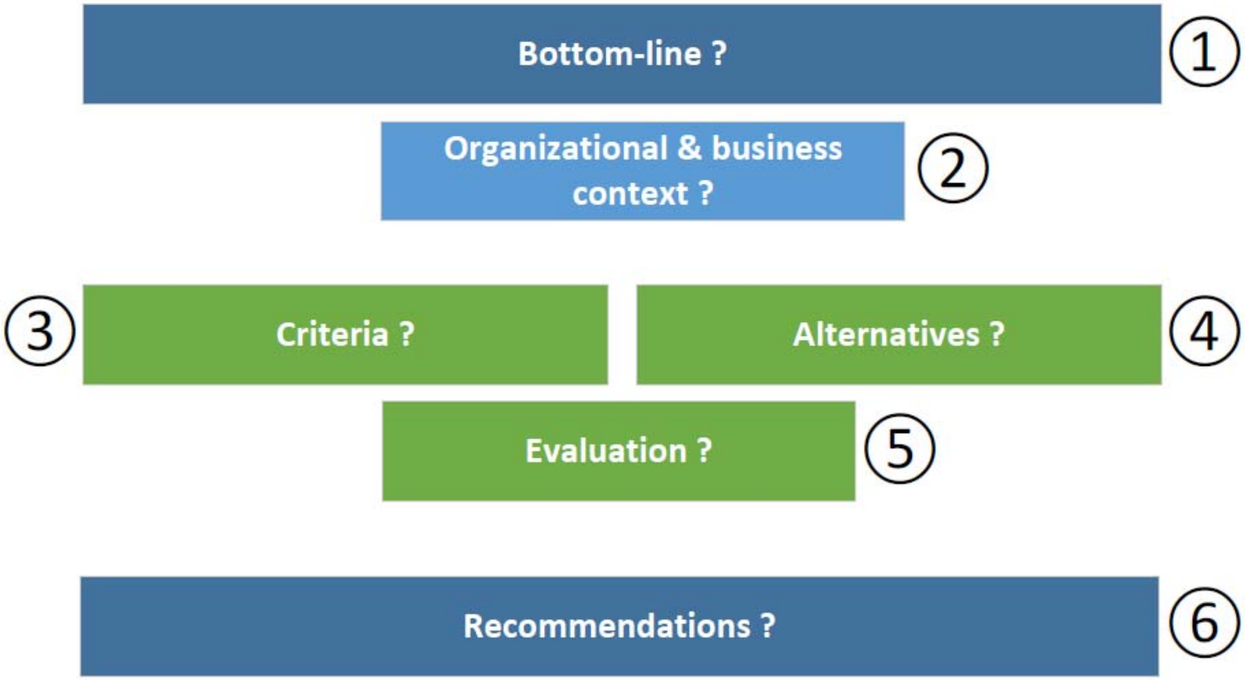
Generic aproach - 2



(see chapter on Material Handling)

"What exactly is the problem ?" = Bottom-line
Separate problems & symptoms
Identify most important issues

Typical characteristics of the **organization** (e.g. start-up, highly skilled personnel, …) and of the **business** sector (e.g. very competitive, low tech, ….)

Stakeholders to be considered (and their stakes)

Assumptions if necessary (e.g. stable market)

Key issues translated into **criteria**

- Socio-technical systems
- Specific, determined by ①②, both tangible & intangible
- Feasibility: organizational, economic, technical, operational, legal
- Criteria for criteria: relevant, exhaustive, exclusive, definition & measurement

Given or to be determined (DN !)
To-the-point (RCA, waste analysis ?)
Clear description – Mutual exclusive
Keep in mind ①②
Can require changes: organizational, technological, management
Keep in mind constraints (hard, soft)

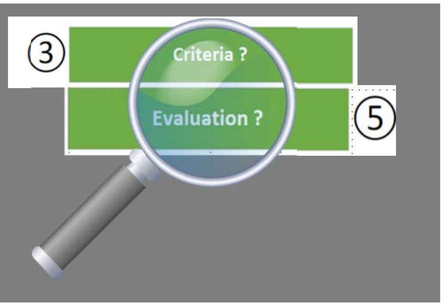
③ **Criteria ?**

Alternatives ? ④

Evaluation ? ⑤

Step 1: **score alternatives** for criteria based on stakeholder input
Step 2: calculate an **“overall score”**

- brainstorming – absolute: LAM, TOPSIS – relative: AHP/ANP, Promethée – C/E



Brainstorming

MCDM

Absolute methods

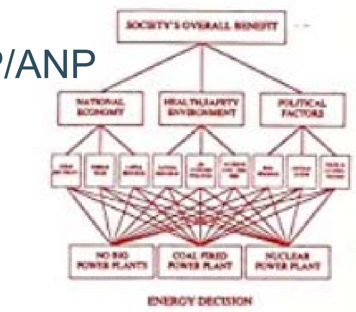
e.g. **LAM**, TOPSIS

MCDM

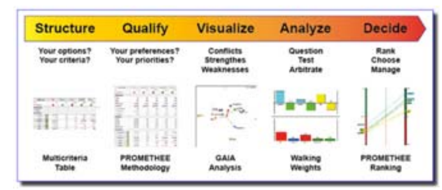
Relative methods

e.g. AHP/ANP, Promethée

AHP/ANP



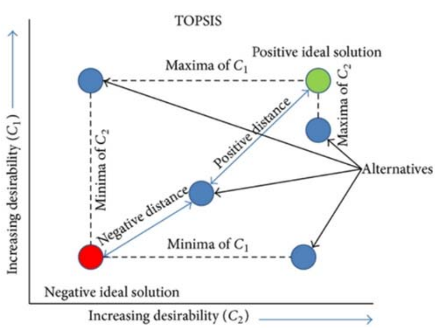
Promethée



LAM

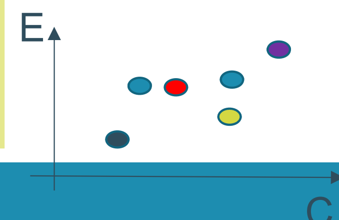
	Weights	Alt. 1	Alt. 2	...	Alt. n
Crit. 1					
Crit. 2					
...					
Crit. m					
	Total score				

TOPSIS



C/E

analysis



MCDM=multi-criteria decision making; C/E=cost-effectiveness analysis; LAM=linear additive method; AHP/ANP=analytic hierarchy/network process;

Recommendations ?

6

Management reporting (style)
Recommendation + justification

Critical reflection
(> case study)

Wrap-up

Important conclusions

Facilities planning process

Problem complexity due to …

Tools …

many tools to choose from

Stuff to think about