Utilizing models for innovation

박우진
삶향상기술연구실
서울대학교 산업공학과
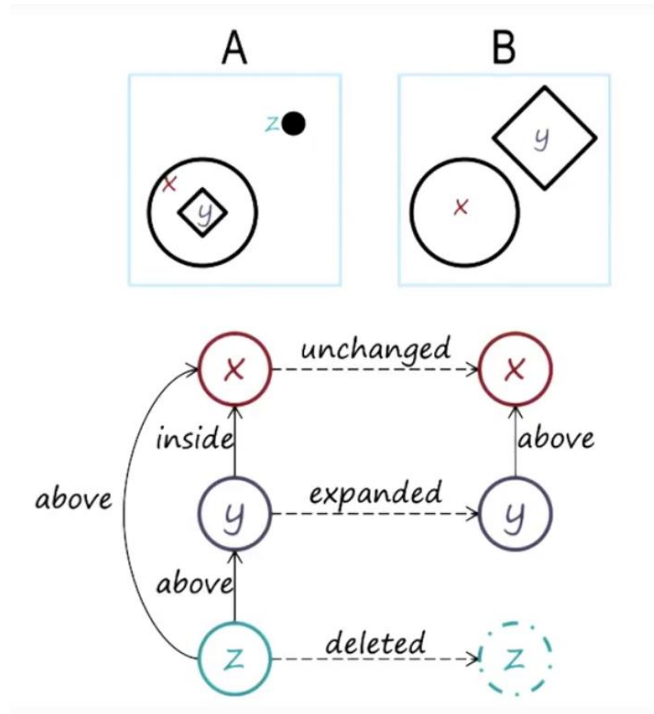
Raven's progressive matrices
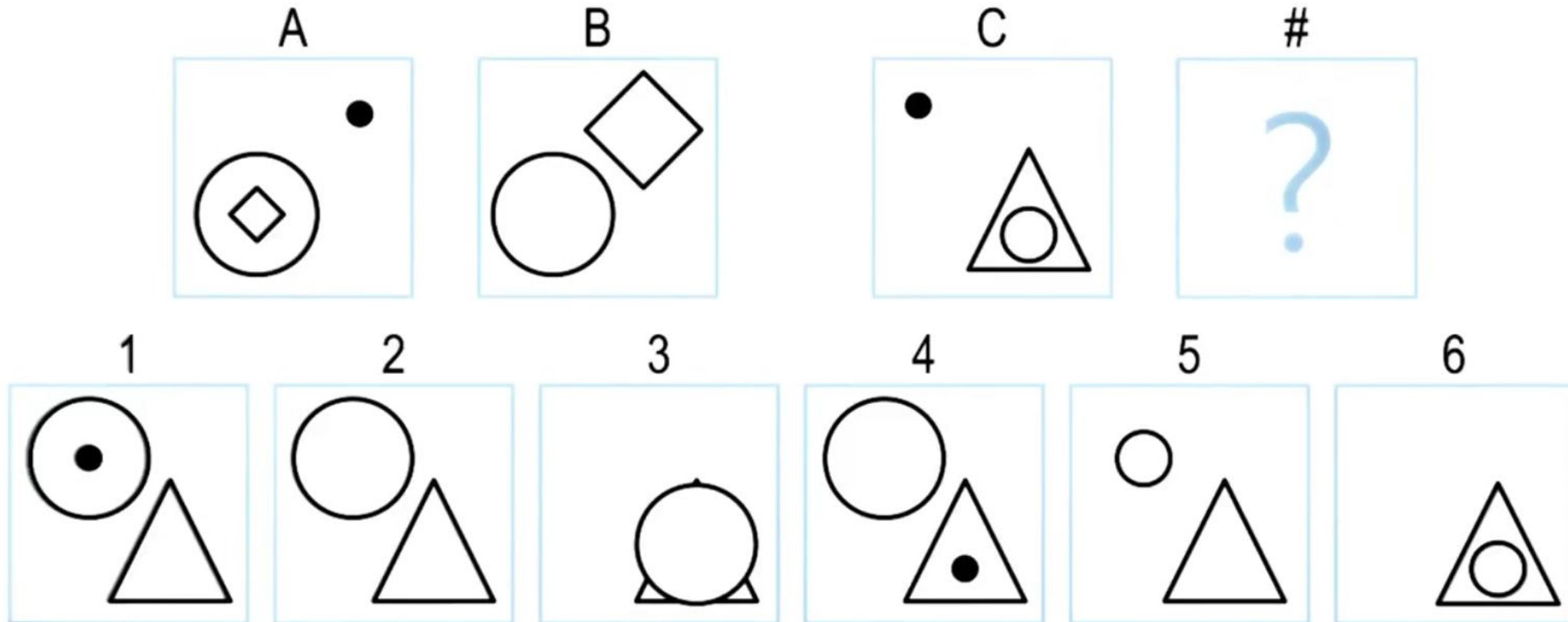
Raven's progressive matrices

• Semantic network representation

A **semantic network**, or **frame network**, is a network that represents semantic relations between concepts. This is often used as a form of knowledge representation. It is a directed or undirected graph consisting of vertices, which represent concepts, and edges, which represent semantic relations between concepts.
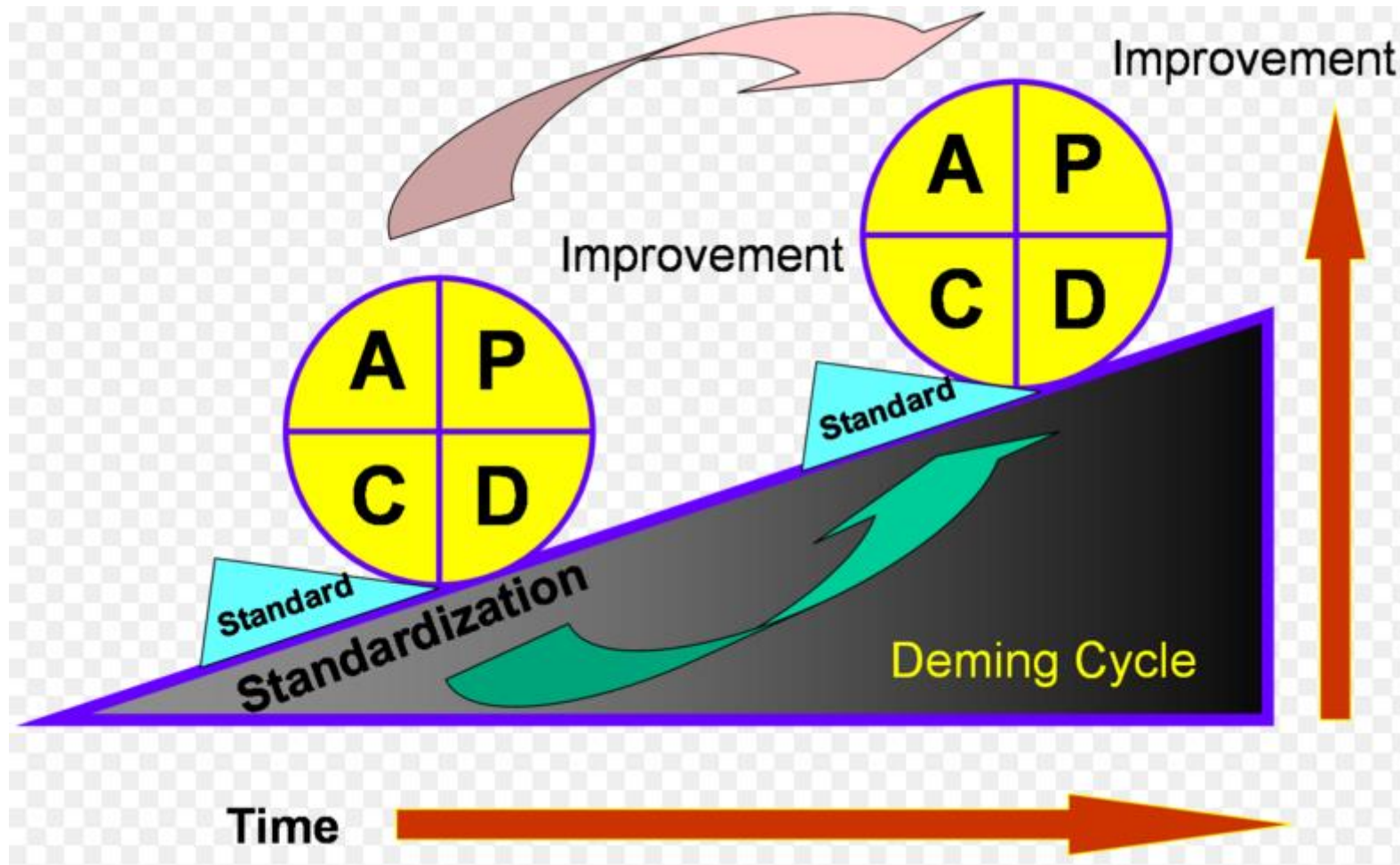
Raven's progressive matrices

• Semantic network representation
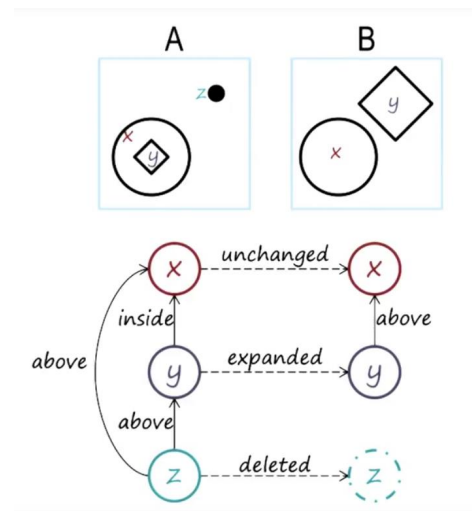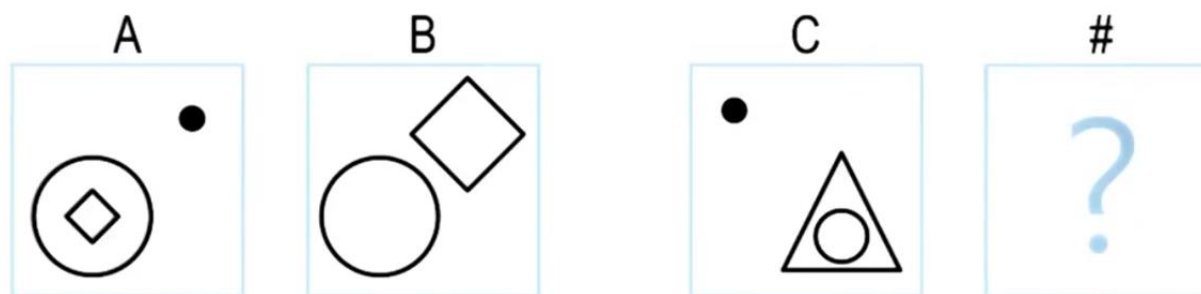
Process innovation

PDCA Cycle

프로세스 개선의 원칙

- **완벽한 프로세스는 없으며 어떠한 프로세스도 개선의 여지는 남아있다.**

Flow process chart

FLOW PROCESS CHART

Product:	Fast-Return Actuator	Part Name:	Base	Part No.:	1
Prepared by:	Insert student names	Position:			
Approved by:	Nowak	Position:	Professor		
Flow Begins:	O-1	Flow Ends:	S-1	Date:	
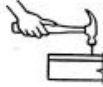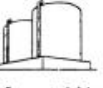
Process symbols and number used:

Operations	12	Inspections	7	Transportations	12
Delays	0	Storage	1		

Task No.	Process Symbols	Description of Task	Machine Required	Tooling Required
T-1	○ □ ➡ D ▽	Transport material to radial arm saw from storage		
O-1	● □ ⇨ D ▽	Crosscut material to rough length of 12"	Radial Arm Saw	Fixture O-1
T-2	○ □ ➡ D ▽	Transport material to table saw		
O-2	● □ ⇨ D ▽	Rip material to 4"	Table Saw	
T-3	○ □ ➡ D ▽	Transport material to jointer		
O-3	● □ ⇨ D ▽	Joint better face	Jointer	
O-4	● □ ⇨ D ▽	Joint better edge	Jointer	
T-4	○ □ ➡ D ▽	Transport material to planer		
O-5	● □ ⇨ D ▽	Plane to ¾" thickness	Planer	
I-1	○ ■ ⇨ D ▽	Inspect thickness		Gauge I-1
T-5	○ □ ➡ D ▽	Transport to table saw		
O-6	● □ ⇨ D ▽	Rip to 3 9/16" finish width	Table saw	
T-6	○ □ ➡ D ▽	Transport planer		
O-7	● □ ⇨ D ▽	Plane to finish width of 3 ½"	Planer	Fixture O-7
I-2	○ ■ ⇨ D ▽	Inspect width		Gauge I-2
T-7	○ □ ➡ D ▽	Transport to Compound miter saw		
O-8	● □ ⇨ D ▽	Crosscut to finish length of 2 ½"	Compound Miter Saw	Fixture O-8

Examples of process chart symbols

OPERATION — A large circle indicates an operation, such as: Drive nail / Mix / Drill hole

Paperwork operation to create a record or set of papers: Type letter / Make out repair order / Initiate broken tool record

Paperwork operation to add information to a record: Post piece count / Update balance of stores / Post production control schedule

TRANSPORTATION — An arrow indicates a transportation, such as: Move material by truck / Move material by conveyor / Move material by carrying (messenger)

STORAGE — A triangle indicates a storage, such as: Raw material in bulk storage / Finished stock stacked on pallets / Protective filing of documents

DELAY — A large capital D indicates a delay, such as: Wait for elevator / Material in truck or on floor at bench waiting to be processed / Papers waiting to be filed

INSPECTION — A square indicates an inspection such as: Examine material for quality or quantity / Read steam gauge on boiler / Examine printed form for information

Flow diagram

FIGURE 3-6
Flow diagram of the old layout of a group of operations on the Garand rifle.
(Shaded section of plant represents the total floor space needed for the revised layout [Figure 3-7]. This represented a 40 percent savings in floor space.)
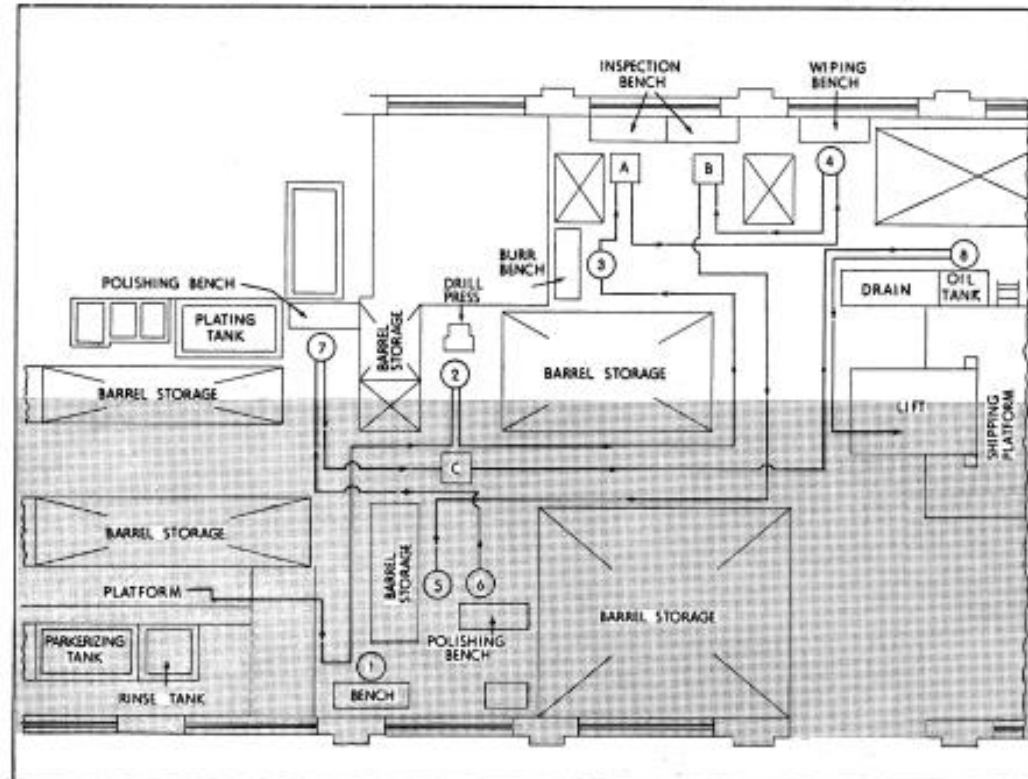
Operation process chart
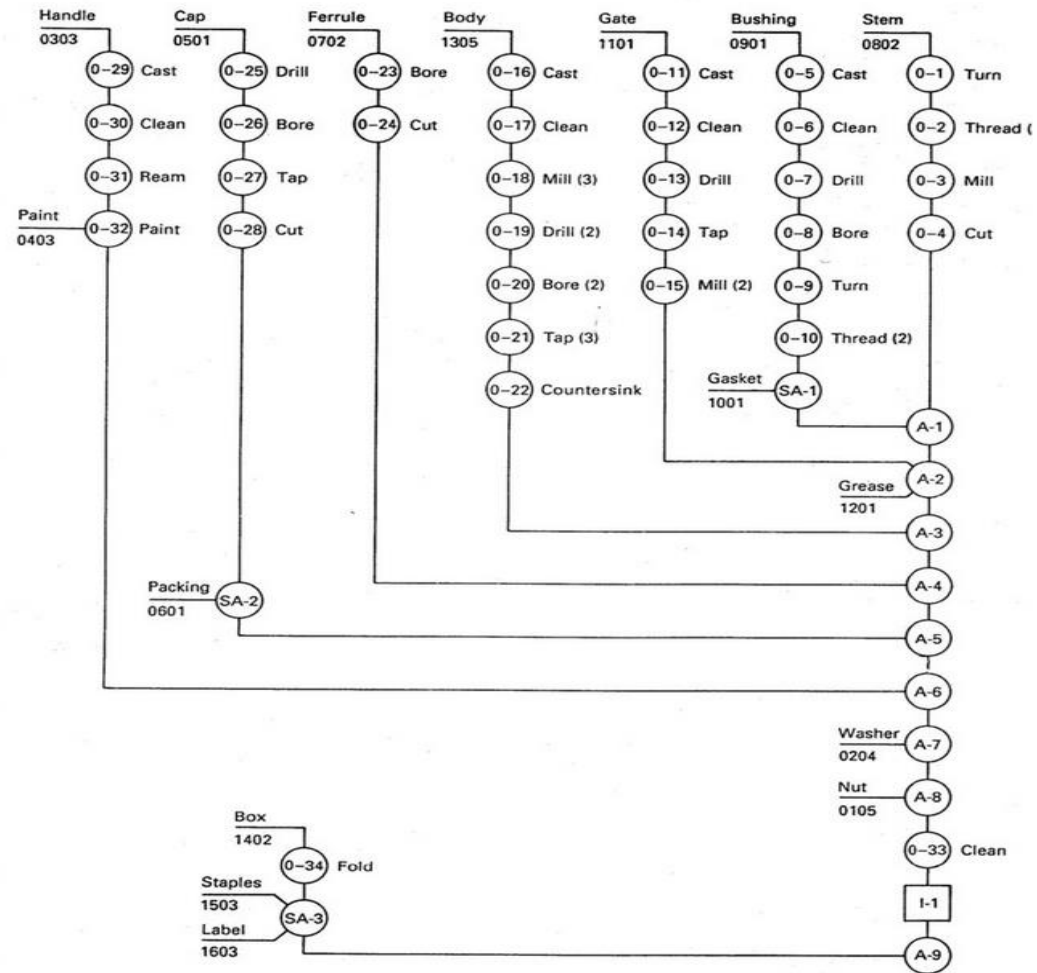
제품의 생산과 관련된 모든 작업이
(원자재~완제품)보여지고 있다.
수평선: 재료 선(Material Line)
수직선: 작업 선(Operation Line)

Operator process chart
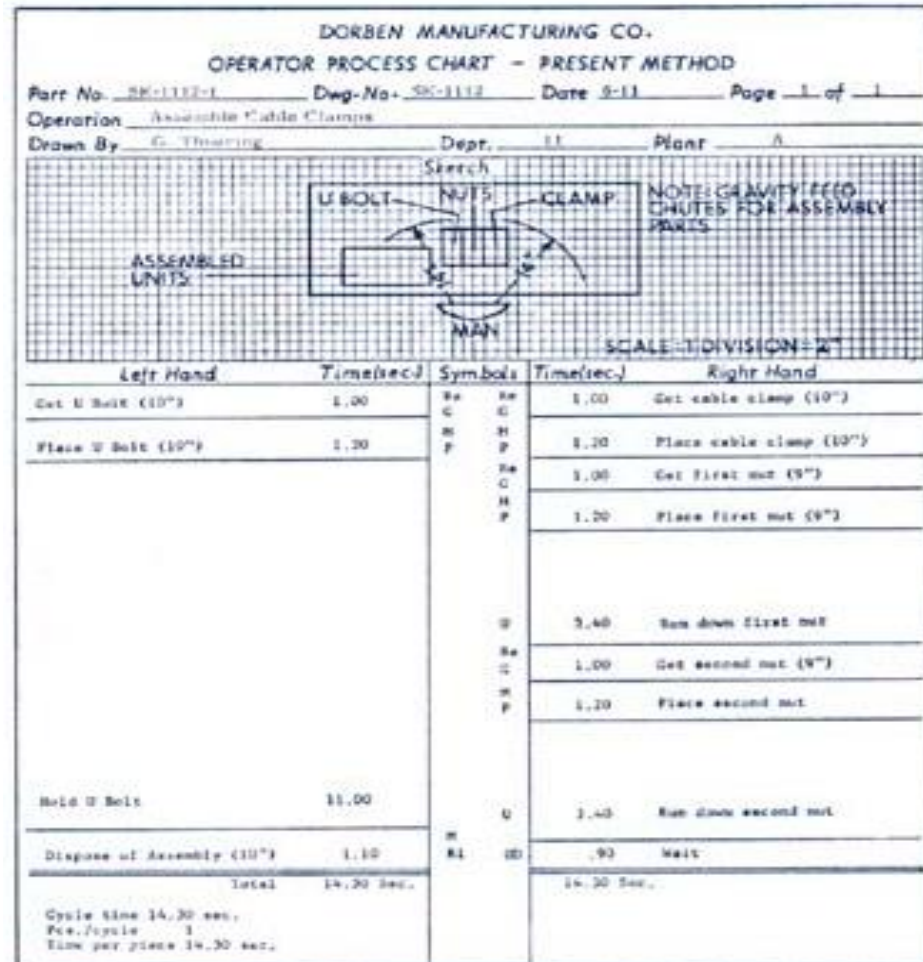
Operator process chart of assembly of cable clamps.

앉은 자세에서 양손을 이용하여 물건을
조립하는 것을 묘사한다

프로세스 개선 예시

금속제품에 광택을 내는 데 사용되는 '버핑 휠(Buffing Wheel)' 재생작업이 있다. 이 작업의 업무 개선에 흐름공정도와 흐름도를 사용하고자 한다.

버핑 휠을 여러 번 사용하고 나면 면으로 된 버핑 휠에 붙어 있던 연마제 가루가 많이 떨어져 나가서 연마 효과가 제대로 나지 않는다. 이 때 이미 사용중이던 버핑 휠에 공업용 풀칠을 해주고 연마제 가루를 붙여 말리는 작업을 2회 시행한 후 건조로에 넣고 구워주면 재사용 가능하게 된다. 이 재생 작업을 개선한 사례이다.

프로세스 개선 예시

- 버핑 휠 재생작업
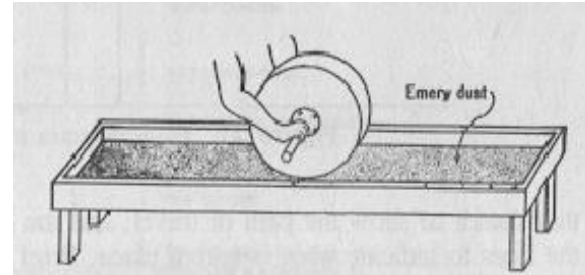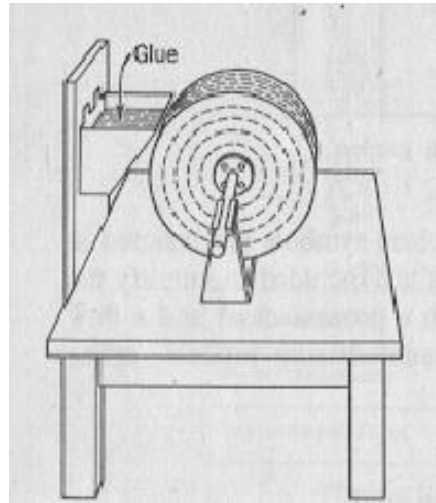
프로세스 개선 예시

- 기존 프로세스(Flow diagram)
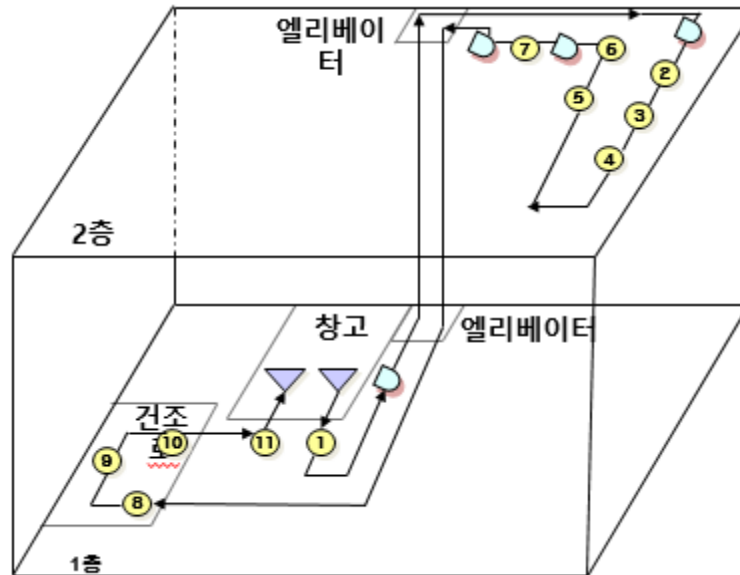
프로세스 개선 예시

- 기존 프로세스(Flow process chart)

이동거리	심볼	설명
	▽	닳아 없어진 버핑휠 (코팅 요함)
	①	휠을 트럭에 싣는다
40	Ⓗ	엘리베이터로
	▽	엘리베이터를 기다린다
20	Ⓔ	엘리베이터로 2층까지
35	Ⓗ	코팅 작업대로
	▽	코팅 작업대에서 대기
	②	접착제를 코팅
	③	연마제 가루를 코팅(1차)
	④	마루에서 건조시킴
	⑤	접착제를 코팅
	⑥	연마제 가루를 코팅(2차)
	▽	코팅 테이블 옆의 마루에서 대기
	⑦	트럭에 올림
15	Ⓗ	엘리베이터로

이동거리	심볼	설명
	▽	엘리베이터를 기다림
20	Ⓔ	엘리베이터로 1층까지
75	Ⓗ	건조로 까지 이동
	⑧	로 안의 거치대에 올림
	⑨	건조
	⑩	건조된 버핑휠을 트럭에 올림
35	Ⓗ	저장장소로
	⑪	휠을 마루위에
	▽	저장

작업의 횟수		①	11
저장 및 지연 횟수		▽	6
검사의 횟수		■	1
이동의 횟수		Ⓔ	7
총이동거리, 피트			240

프로세스 개선 예시

새로 고안된 풀칠 도구와
연마제 코팅 도구.
전기 모터를 사용한다.
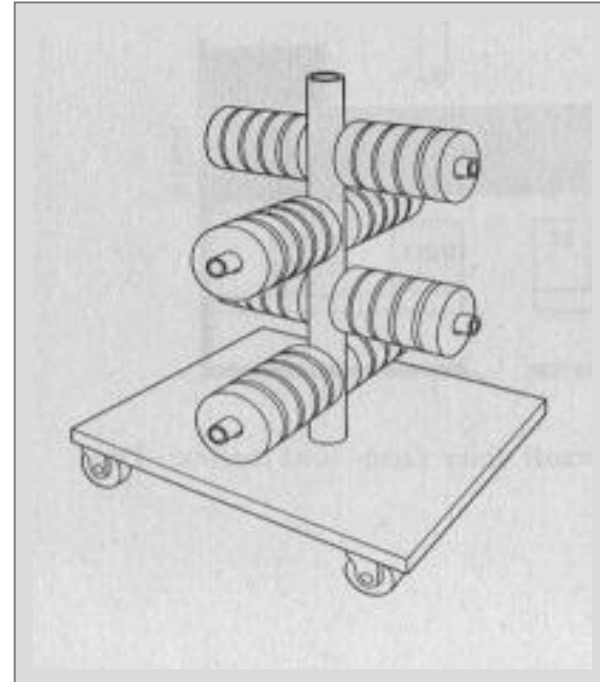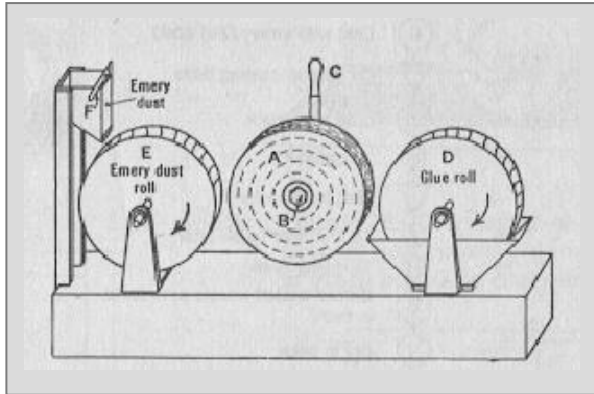
새로 고안된 이동용 랙(Truck
Rack): 건조로에서 그리고
이동시 사용된다.

프로세스 개선 예시

• 개선된 프로세스 (Flow diagram)
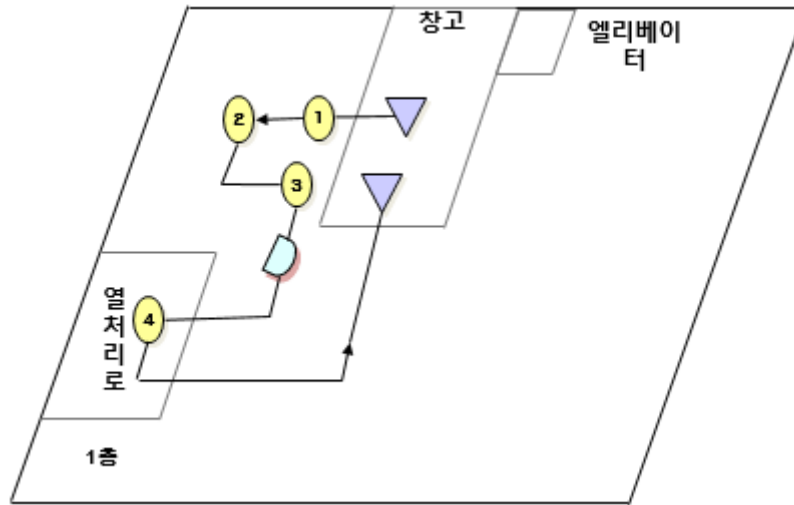
프로세스 개선 예시

- 개선된 프로세스 (Flow process chart)

이동거리	심볼	설명
	▽	특수 펠렛에 올려져 저장중인 닳아버린 휠
10	H	코팅 기계로 이동
	1	접착제 및 연마제 가루의 코팅(1차 코팅)후 특수 펠렛에 올리기
	2	특수펠렛 위에서 접착제를 말림
	3	접착제 및 연마제 2차 코팅
	▽	코팅 기계 옆에 대기
25	H	특수 펠렛을 건조로에 이동
	4	로에서 건조
35	H	특수펠렛을 저장소에
	▽	저장소에 저장

		옛날 방법		개선된 방법		차이	
작업의 횟수	◯	11					
저장 및 지연의 횟수	▽	6					
검사의 횟수	■	1					
이동의 횟수		이동거리		이동거리		이동거리	
트럭	H	5	200	3	70	2	130
엘리베이터	E	2	40	0	0	2	40
합계		7	240	3	70	4	170
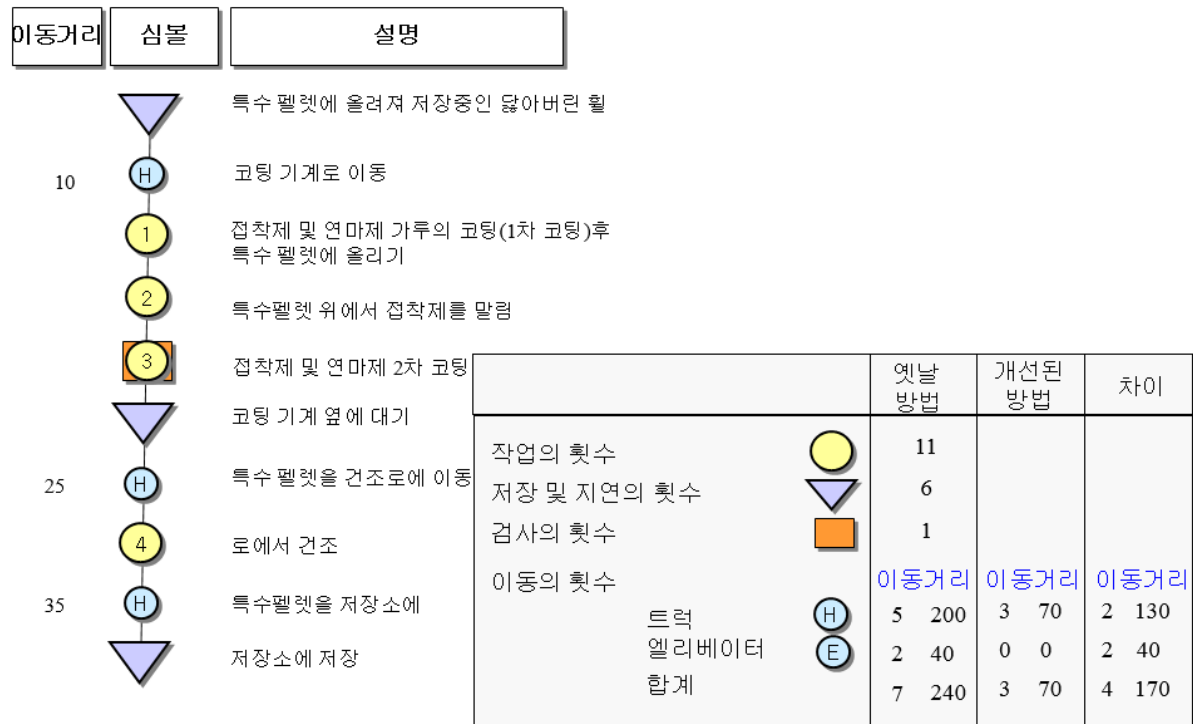
Therbligs

Therblig	Color	Symbol/Icon	Therblig	Color	Symbol/Icon
* Search	Black		Use	Purple	
Find	Gray		Disassemble	Violet, Light	
* Select	Light Gray		* Inspect	Burnt Orange	
Grasp	Lake Red		Pre-Position	Sky Blue	
* *Hold	Gold Ochre		Release Load	Carmine Red	
Transport Loaded	Green		Unavoidable * Delay	Yellow Ochre	
Transport Empty	Olive Green		Avoidable * Delay	Lemon Yellow	
* Position	Blue		* Plan	Brown	
Assemble	Violet, Heavy		*Rest for overcoming fatigue	Orange	

Therbligs
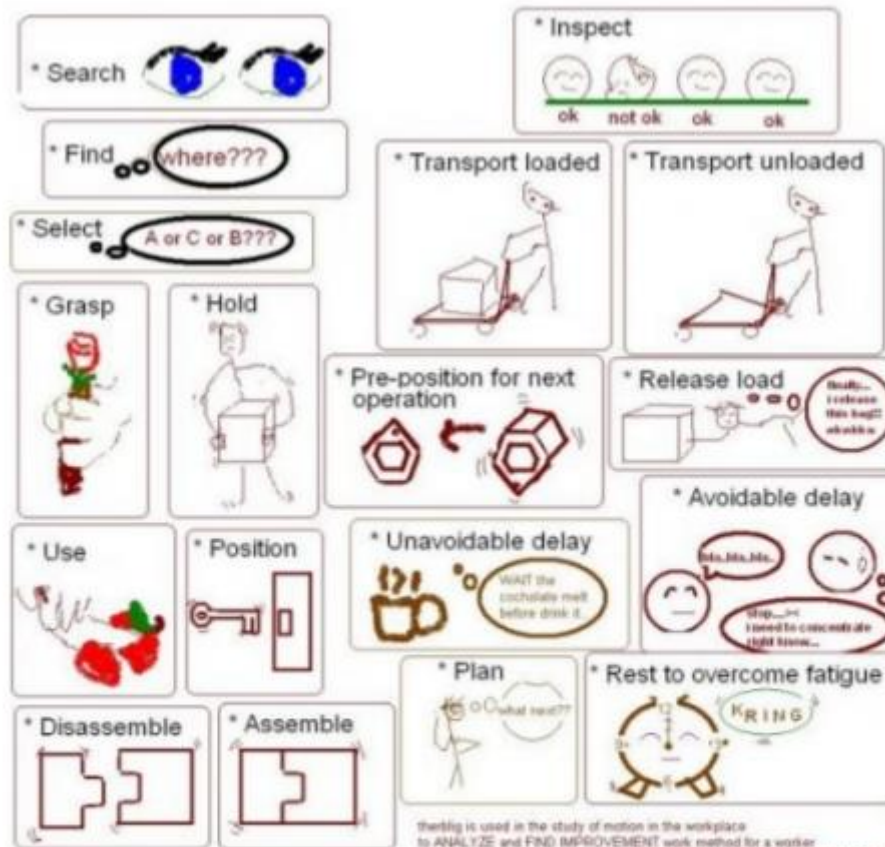
Therbligs

Layout planning

- Activity relationship diagram

Shows the desired closeness between areas

Activity or Function	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1. Carton Storage	U	U	U	U	U	U	E	E	E	U	U	U	U	U	
2. Unloading Area	U	U	U	U	U	U	U	U	U	U	U	U	U	I	
3. Raw Milk Storage	U	U	U	U	U	U	U	U	U	U	U	U	I		
4. Homogenizer	U	U	U	U	U	U	U	U	U	U	I				
5. Pasteurizer	U	U	U	U	U	U	U	U	U	I					
6. Pasteurization Storage Tanks	O	U	U	U	U	E	I	I	I						
7. Filling Machine 1	O	E	U	I	O	A	U	U							
8. Filling Machine 2	O	E	U	I	O	A	U								
9. Filling Machine 3	O	E	U	I	O	A									
10. Cooler	U	U	A	U	I										
11. Byproduct Room	O	U	U	X											
12. Restroom	U	U	O												
13. Truck Loading Area	U	U													
14. Metal Crate Loading	U														
15. Laboratory															

Layout planning

• Activity relationship diagram

Closeness Rating   **Number of Lines**

A   4 Straight
E   3 Straight
I   2 Straight
O   1 Straight
U   0
X   1 Wiggly

Note: 15 and 12 could be interchanged with little effort.
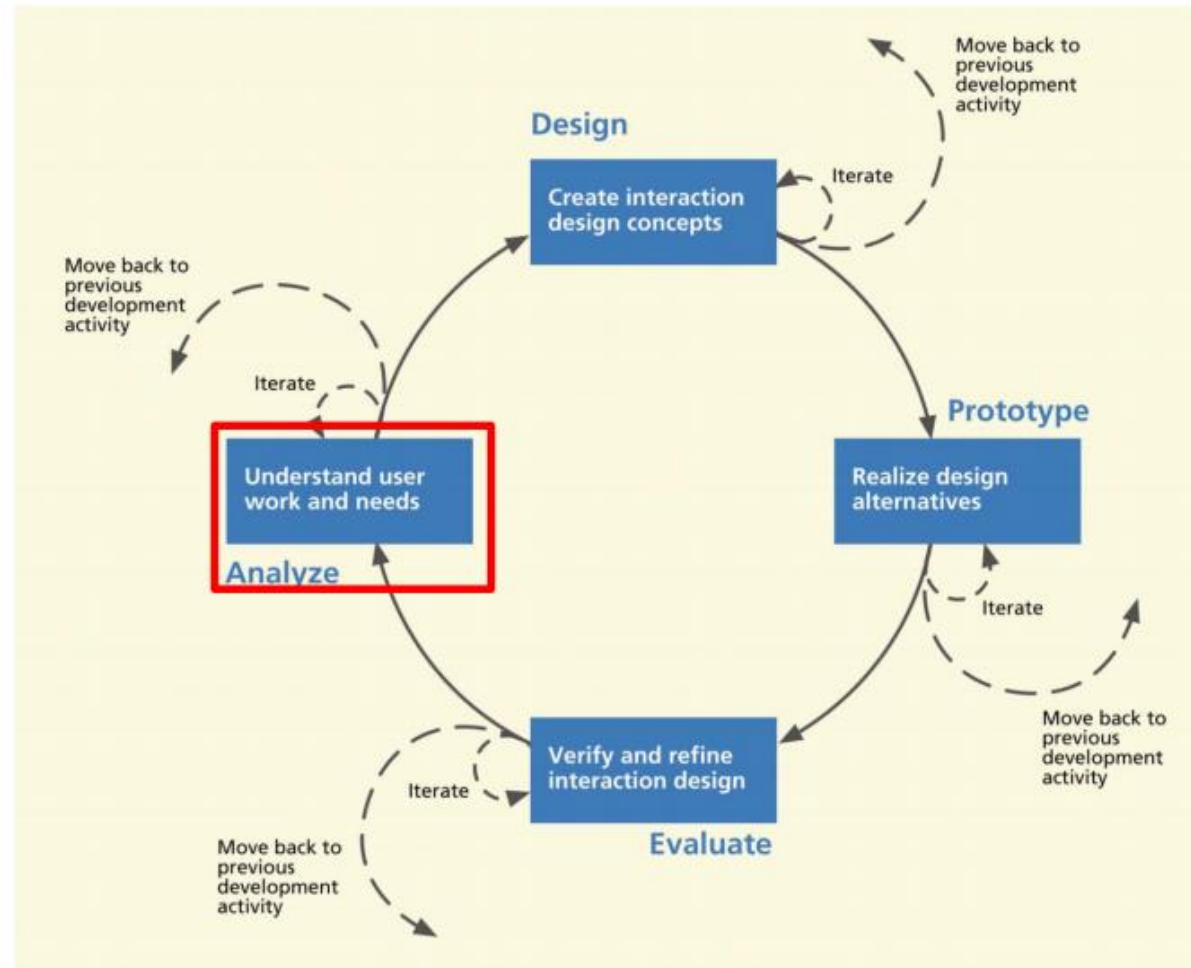7.8 and 9 have an A (4 line) relationship with 10 (Not drawn)

• Shows near optimal placement of areas without considering space requirements
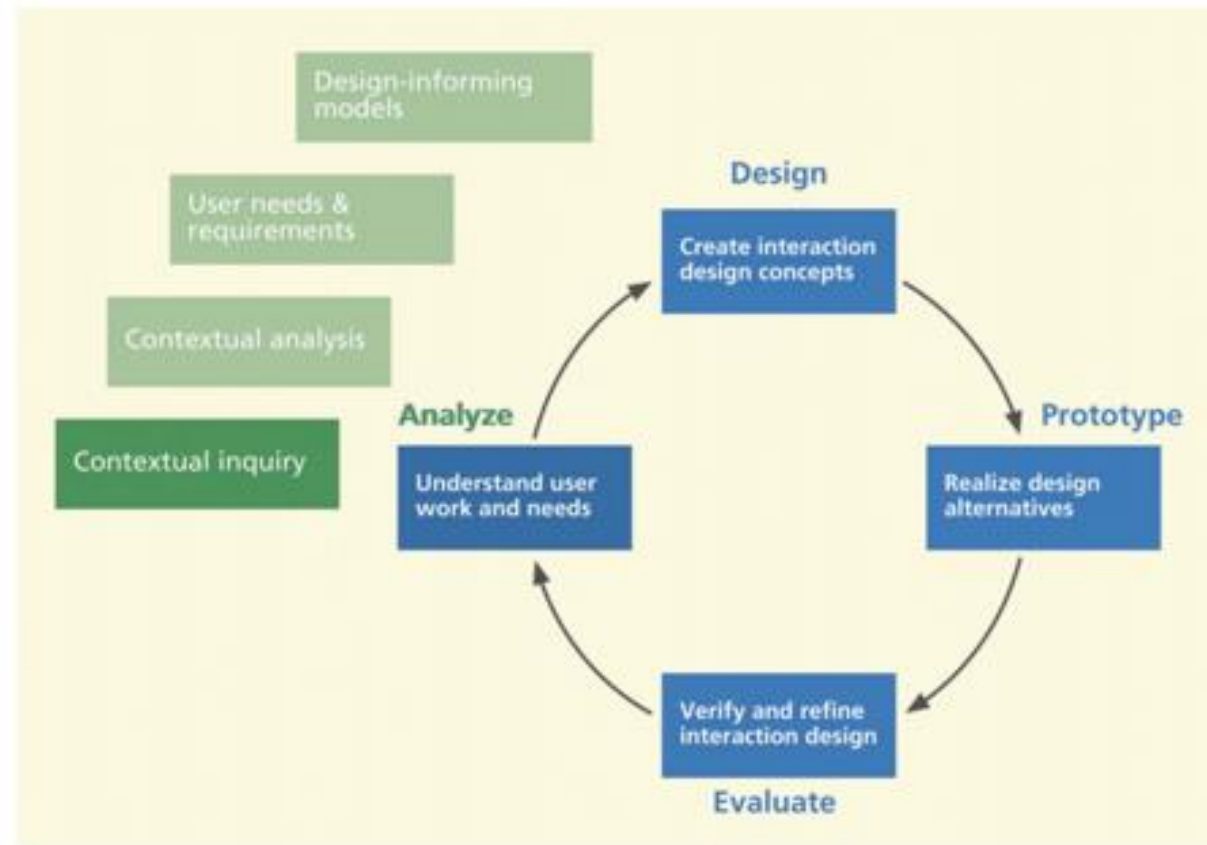• Through trial and error

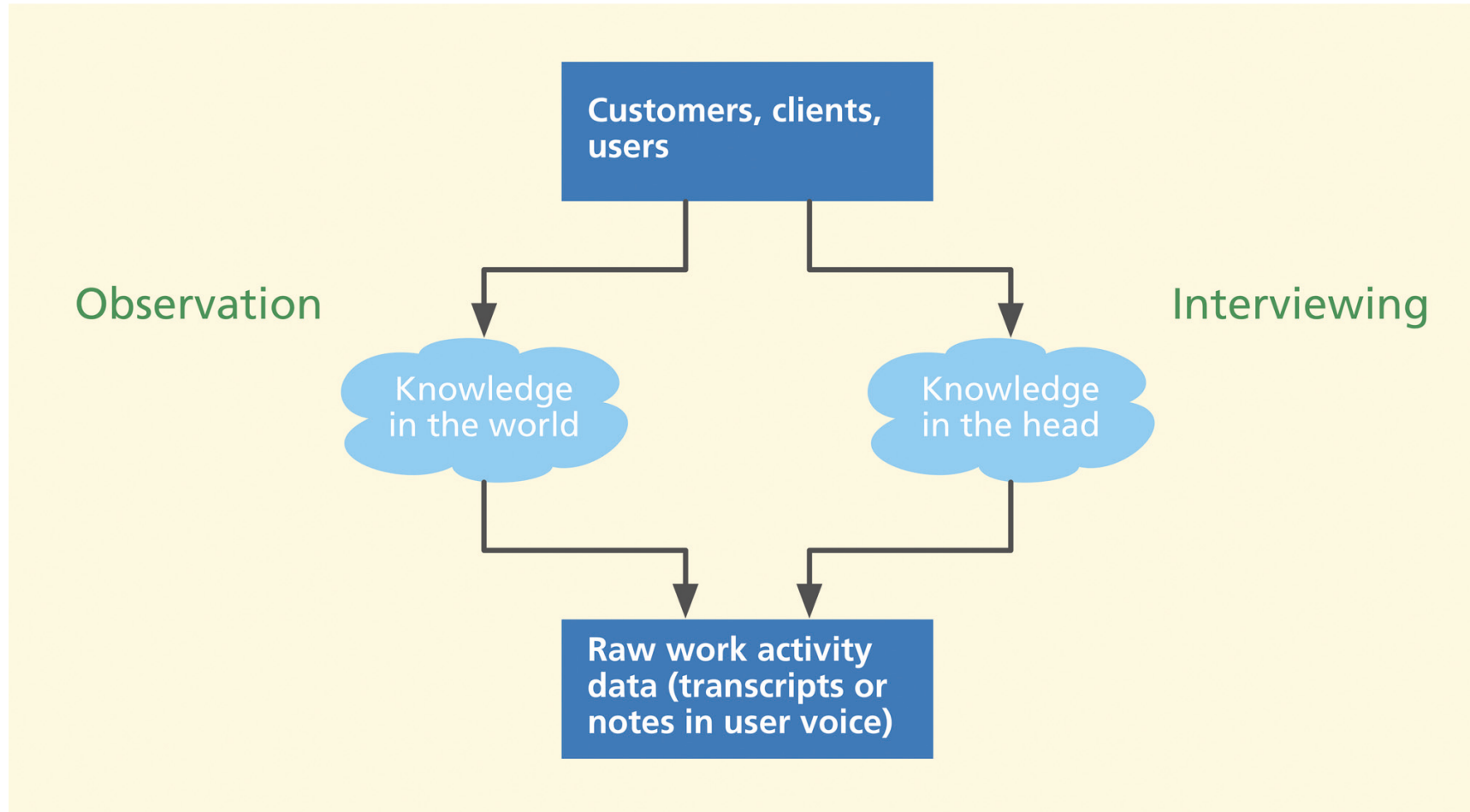# Design informing models (UXD)

Design cycle

Design cycle

Analyze = understand user work and needs

Design cycle
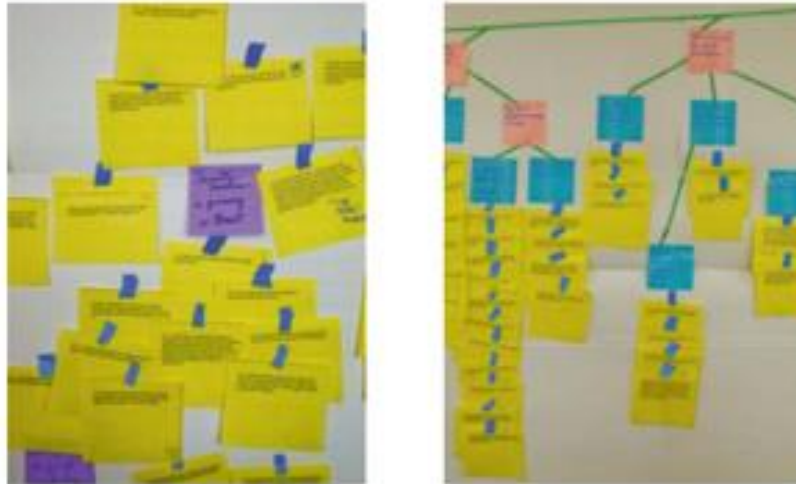
Contextual inquiry

Design cycle

Contextual analysis

Extraction of user needs and requirements
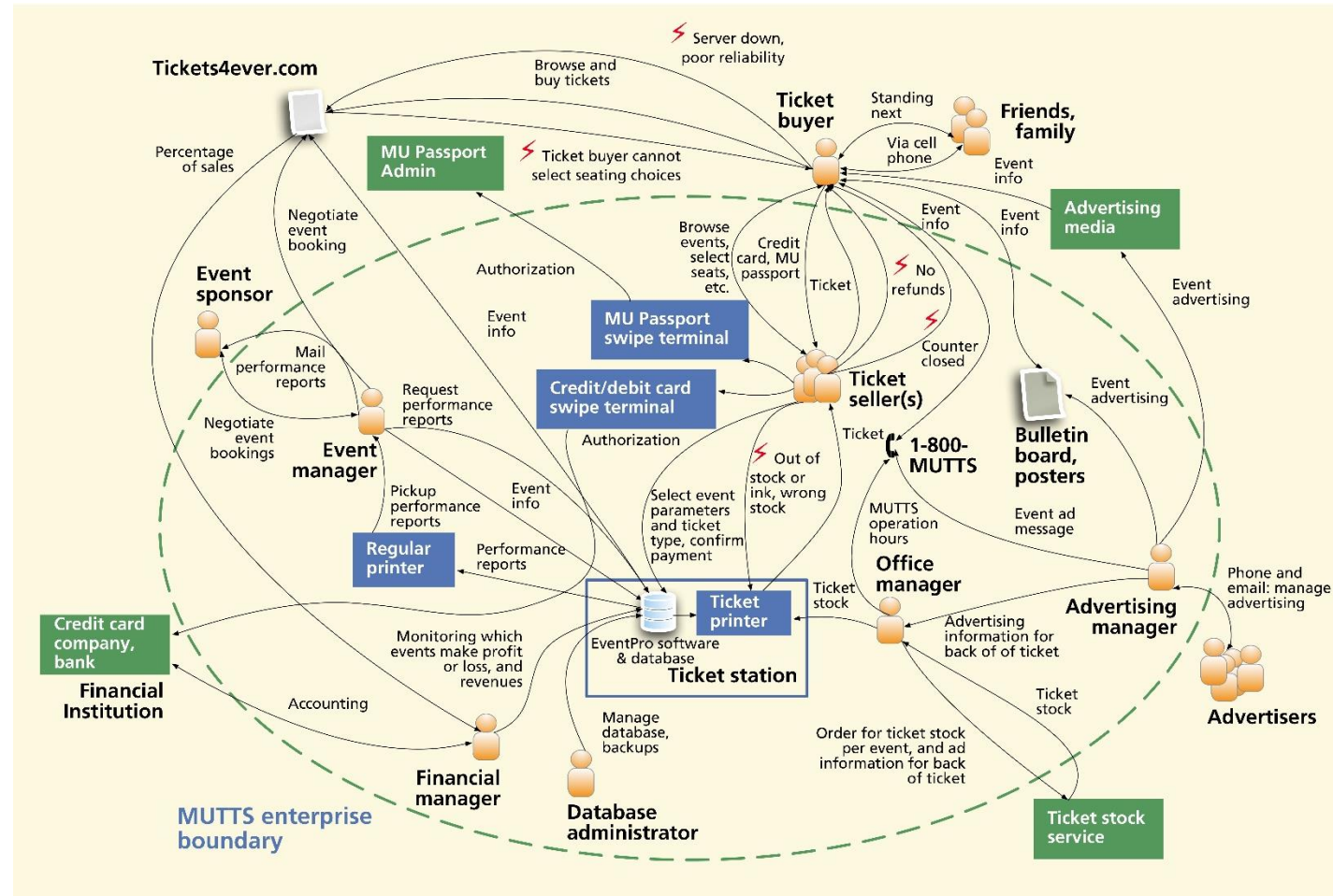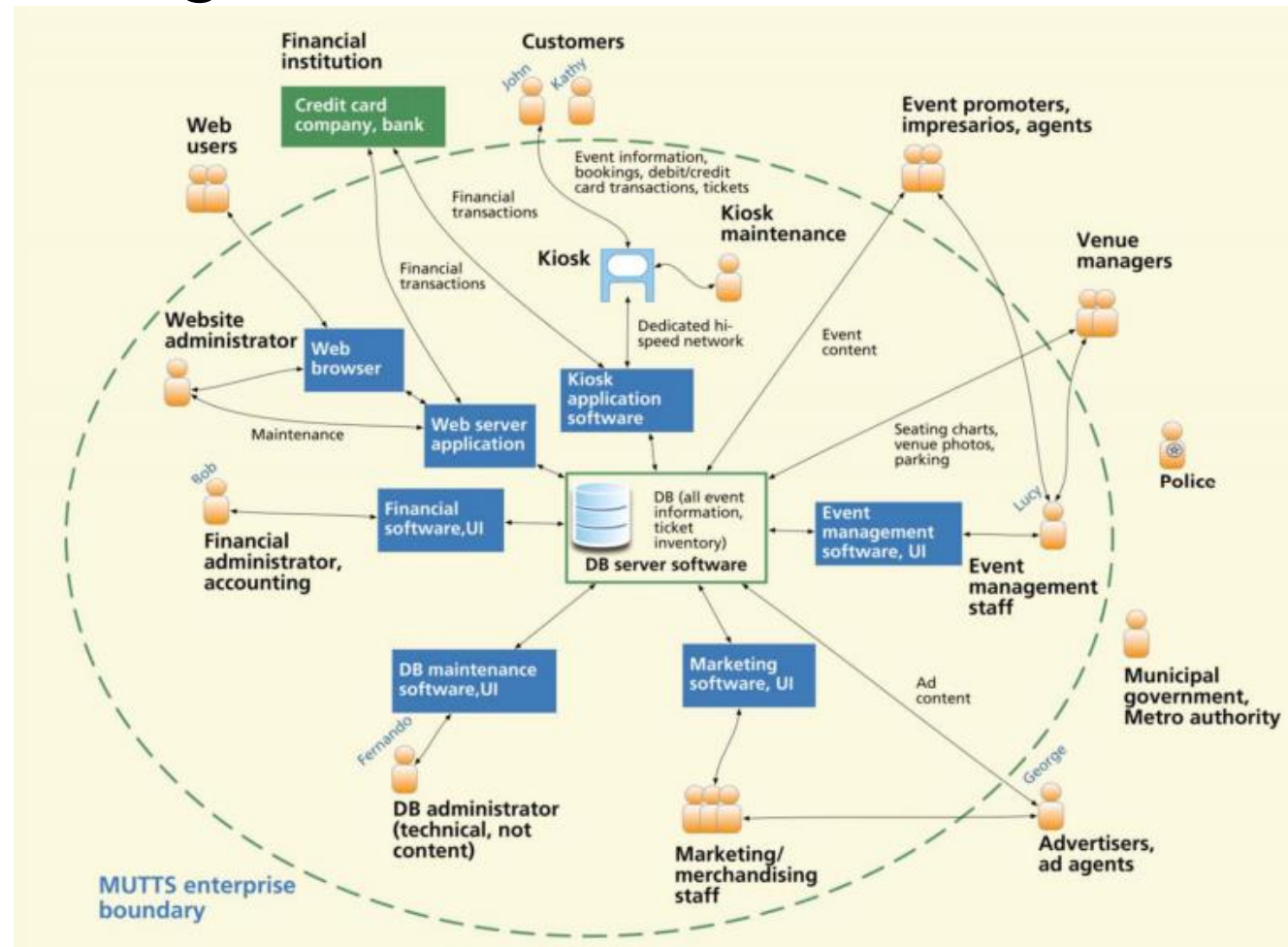

Affinity diagramming (KJ method)

Gestalt

Users
User needs
Design requirements

Design informing models

- Design informing models: flow model (before)

Design informing models
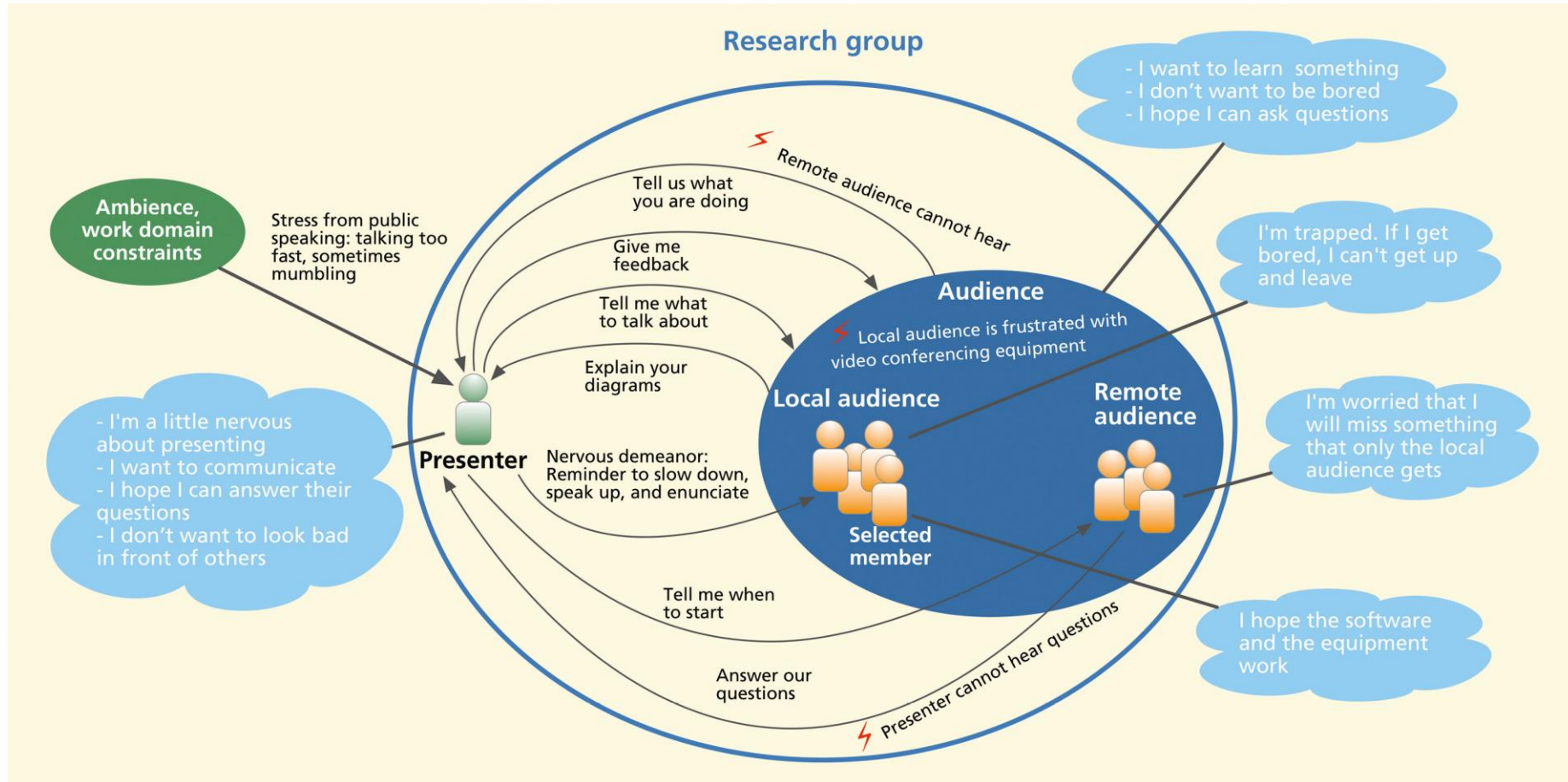
- Design informing models: flow model (after)

Design informing models

- User model (persona)

Christina
Moletti
Freelance Graphic Designer

"Living life is a creative process too"
- Has enough money but not much more
- Works hard during the day but on her own hours
- Walking is her main way to travel, day or night

Personal Information
Age: 25
Location: Pittsburgh, PA
Education: BA Graphic Design NC State Unviersity,
Profession: Freelance Graphic Designer, Part-Time Student
Home life: Lives with a roommate (Eva 25),
Hobbies: Playing guitar and xylophone, reading, drawing, sewing, watching movies, sleeping
Favorite TV shows: Doesn't watch much TV
Personality: Easygoing, outgoing, try new things

User Goals
Christina uses this information system to...
- Give her reasons to go out walking at night
- To be active and aware of her surroundings at night
- To find the safest places to go at night
- Make walking and being out at night more social with her friends

Maria
Nantes
Newspaper Editor

"I want to stay healthy both mentally and physically always"
- Health Conscious
- Use basic technology for day to day activities
- Enjoy Social groups

Personal Information
Age: 31
Location: Ann Arbor, MI
Education: Master's in English from U of Michigan
Profession: Newspaper Editor
Home life: Married, no children
Hobbies: Walking, making friends, Yoga
Favorite TV shows: Desperate Housewives
Personality: Outgoing, Passionate, Social, Cheerful, Sophisticated

User Goals
Maria uses this information system to...
- Connect and coordinate with friends
- Find safe walking routes at night
- Get a sense of safety by getting more info
- Find out about social events taking place at night, which might be of potential interest
- Wants to get emotional and mental relaxation by walking

James
Goeffsner
Senior Engineer

"I know what I'm doing, I'm willing to try everything new."
- is willing to spend money on that
- Likes to chat with others online
- Knows that health is very important & work out

Personal Information
Age: 37
Location: San Fransisco, CA
Profession: Cellphone Interface Developing
Education: Master's
Home life: Single
Hobbies: Surfing online to look for new electronic products, working out at gym
Favorite TV shows: Friends, Heros
Personality: knowledgeable in popular stuffs, talkative, keeping things on schedule

User Goals
James uses this information system to...
- Stay ahead of latest trends on mobile devices
- Take more time to walk as the substitute for exercise
- Meet new friends through this application
- Feel free to walk at night
- Discuss the new interaction
- Try to figure out a method for socializing and also provide a feeling of security
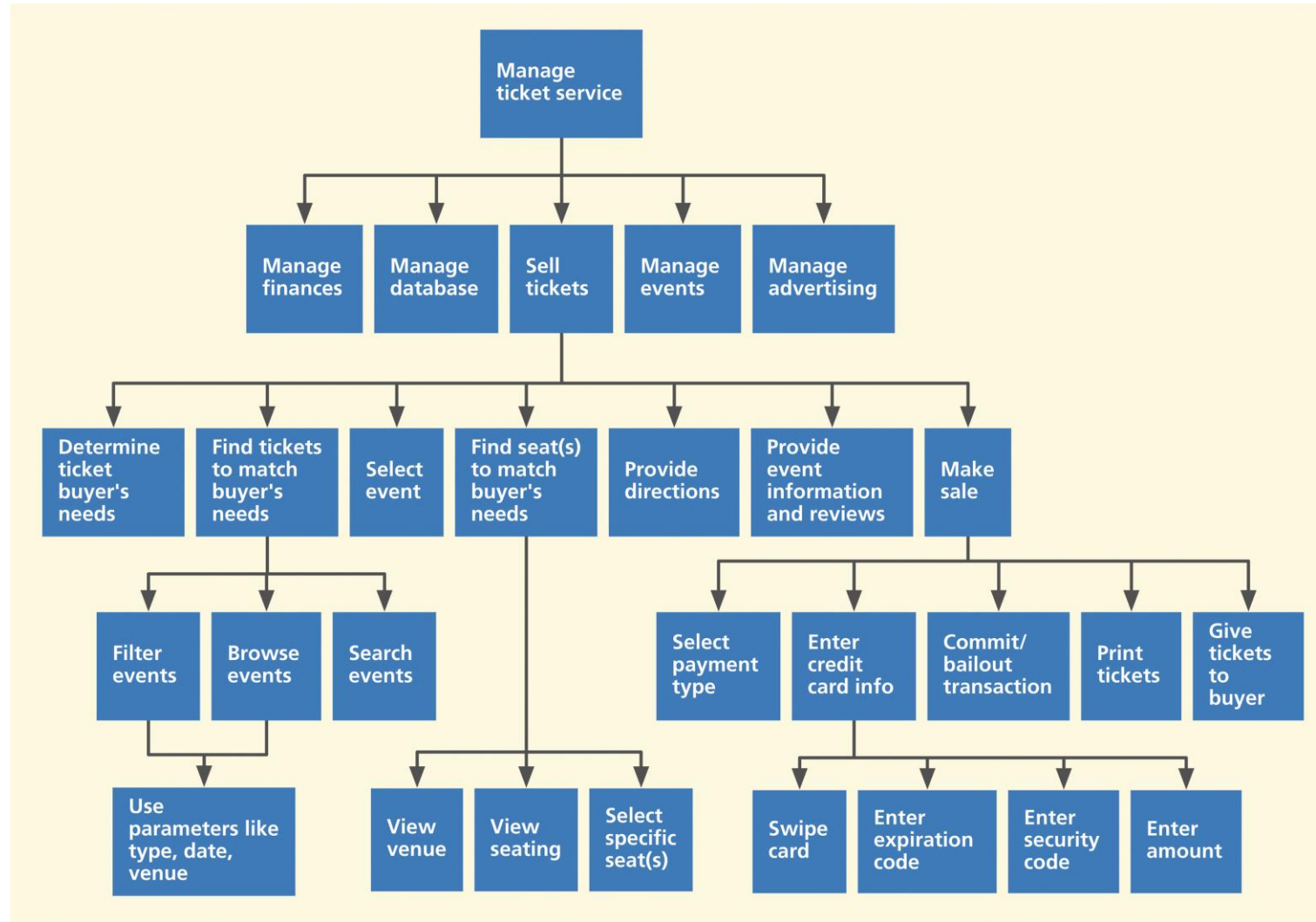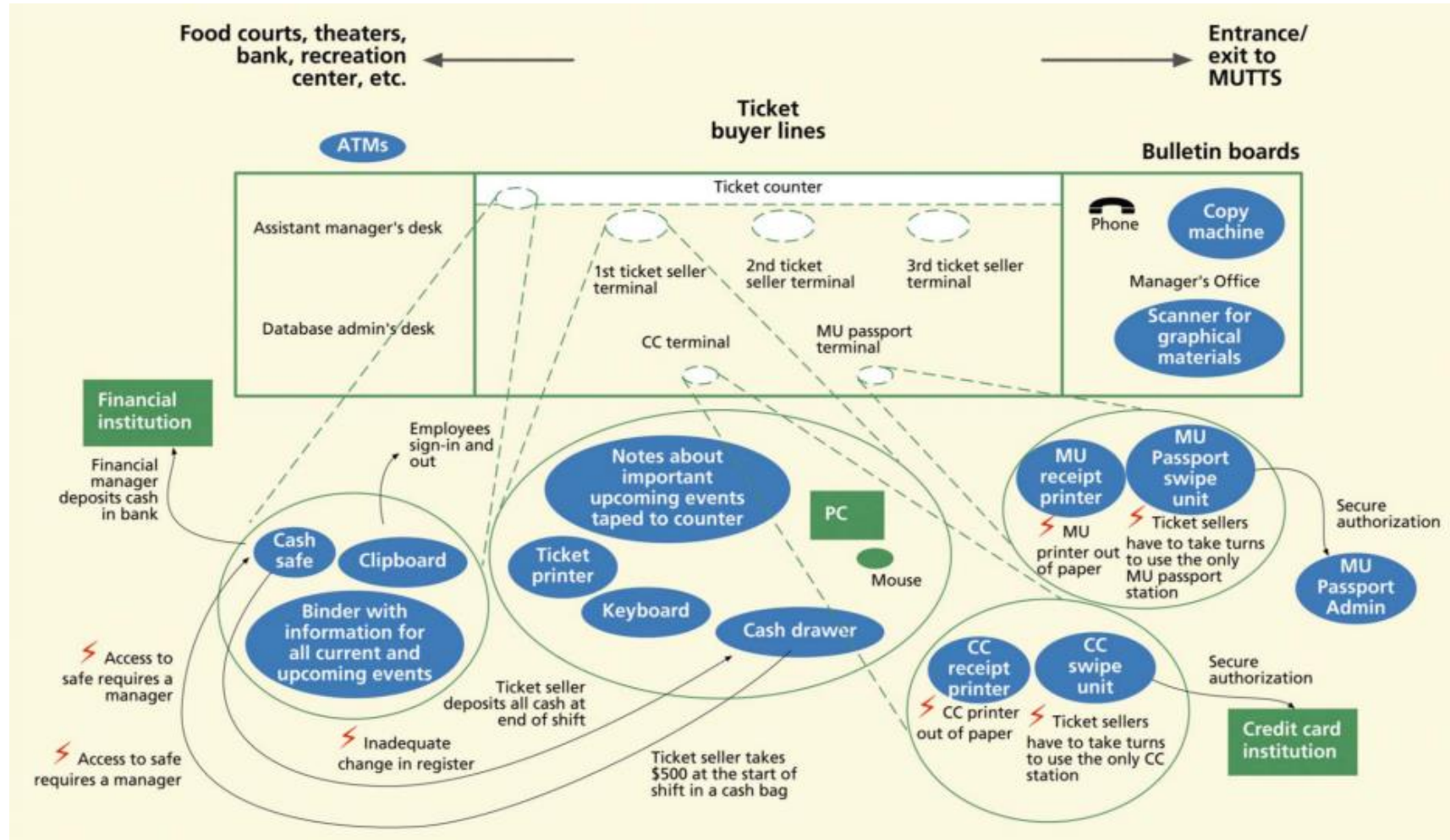
Design informing models

- Social model

Design informing models

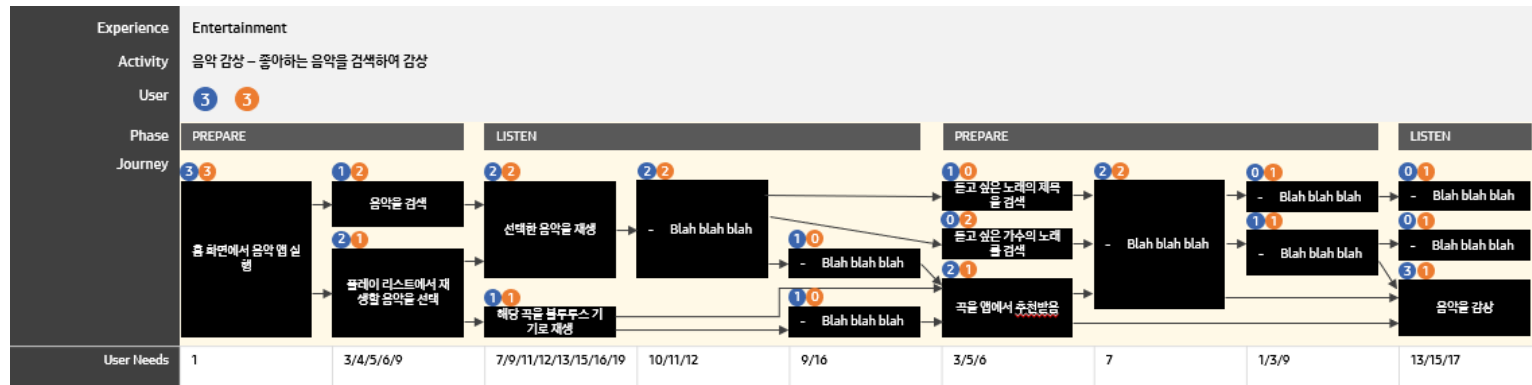• Hierarchical task inventory

Design informing models

- Physical model

Design informing models

• Customer journey map

Design informing models

• Customer journey map

Experience	Entertainment								
Activity	음악 감상 – 좋아하는 음악을 검색하여 감상								
User	③ ③								
Phase	PREPARE		LISTEN			PREPARE			LISTEN
Journey	홈 화면에서 음악 앱 실행	음악을 검색 / 플레이 리스트에서 재생할 음악을 선택	선택한 음악을 재생 / 해당 곡을 블루투스 기기로 재생	Blah blah blah / Blah blah blah	듣고 싶은 노래의 제목을 검색 / 듣고 싶은 가수의 노래를 검색 / 곡을 앱에서 추천받음	Blah blah blah	Blah blah blah / Blah blah blah	Blah blah blah / Blah blah blah / 음악을 감상
User Needs	1	3/4/5/6/9	7/9/11/12/13/15/16/19	10/11/12	9/16	3/5/6	7	1/3/9	13/15/17

번호	Needs
1	Blah blah blah
3	가수, 곡명 뿐 아니라 무드, 상황 등 다양한 키워드로 음원을 검색할 수 있다.*)
4	음악 리스트를 쉽게 관리(생성/정렬/재생순서편집/삭제) 할 수 있다
5	내 취향을 고려한 음원 또는 재생목록을 추천 받을 수 있다.*)
6	상황(시간대/장소/운전 중 등)에 맞는 음악을 추천 받을 수 있다
7	Blah blah blah
9	음악 재생에 관련된 조작(이전 곡/다음 곡/재생시간이동 등)을 쉽게 할 수 있다
10	Blah blah blah
11	Blah blah blah
12	Blah blah blah
13	Blah blah blah

번호	Needs
15	Blah blah blah
16	Blah blah blah
17	Blah blah blah
19	Blah blah blah