manipulation and structured ideation
<table>
<thead>
<tr>
<th>Assignment 4</th>
<th>Blue Sky Ideation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>My General Ideas</strong></td>
<td>2 = Before organizing/conducting any group brainstorming session, you should individually spend an hour sketching your ideas for the general theme challenge. Include a photo of the pages of ideas from your notebook. You are welcome/encouraged to incorporate these ideas into the first session. 0 = No Documentation</td>
</tr>
<tr>
<td><strong>New Warm-Up Game</strong></td>
<td>1 = Description with photo/image of your new type of warm-up game. “New” meaning you developed the activity and not simply tried something new. In addition to the game you develop, you are encouraged to also use warm-up games you learned in class and at HUGE. 0 = No Documentation</td>
</tr>
<tr>
<td><strong>Session Organization</strong></td>
<td>2 = Photo documentation that you organized a group of at least 4 people with relatively different backgrounds (not including yourself, not including people from this class, two people should have some relation to your topic) supplemented with a short description of the participants, the setting, the warm-up games used, the length of time of idea generation, the total number of ideas generated and the IPM for the session. You should follow the process we taught in class. You should tell all participants the prompt a day in advance and ask them to come in to the session with ideas. 0 = No Documentation</td>
</tr>
<tr>
<td><strong>Sorting and Voting</strong></td>
<td>1 = Photo of the ideas sorted into categories showing the results of a multi-voting processes. A textual description that includes the category names and the process you used in the multi-voting. 0 = No Documentation</td>
</tr>
<tr>
<td><strong>Top Ideas</strong></td>
<td>3 = Re-sketch and scan the 10 best ideas from this playful session so all ideas are legible and in the same handwriting. You should determine the “best” ideas based on the clients needs and whatever criteria you deem important. You may want to take into account the results of the multi-voting. Each idea should be a separate image with a title and credit to the person who came up with the idea. In this top 10, you could pull ideas from your personal 45 minute session prior to the group meeting. You will bring these 10 physical pages into team discussion. 0 = No Ideas</td>
</tr>
</tbody>
</table>
fourth assignment
individual idea generation

- Watering system for yard
- Watch that cools you down
- Superhero "Flash" water dispersion
- Filter for good/bad water
- Glasses that cool you
- Water Blanket for yard
- Water Strips
- Water Tapes
- Back of bike that collects water for engine
- Slow Drip Water system for plants

MY GENERAL IDEAS
fourth assignment
design a warm up game
fourth assignment
arrange a brainstorming
ideas per minute per person
fourth assignment
sort, categorize, vote
fourth assignment

top 10 idea drawings

Automatic Morning Pet Cave
automatically lets pets in/ out of house and feeds them ⇒ you sleep in.

Star / Aurora Borealis Projector

Breathing Bed
matches breathing rhythm

Shake Awake Bed
shaking gradually increases arrival wake up time

Aquarium Archway
(view from behind headboard)

Fully Reclining Office Chair

May as well work!
manipulating ideas
changing a product/idea/process
**SCAMPER**

- substitute
- combine
- adapt
- magnify
- modify
- put to other use
- eliminate
- reverse
- rearrange

Bob Eberle, Michael Michalko
substitute

• Can I replace or change any parts?
• Can I replace someone involved?
• Can the rules be changed?
• Can I use other ingredients or materials?
• Can I use other processes or procedures?
• Can I change its shape?
• Can I change its color, roughness, sound or smell?
• What if I change its name?
• Can I substitute one part for another?
• Can I use this idea in a different place?
• Can I change my feelings or attitude towards it?
• Can I change my perspective?
• Can the packaging be changed?
• Can I use a different energy source?
morphological analysis
fritz zwicky, 1967

attribute listing or functional requirements

- holds roll of tape in place
- keeps end of tape accessible
- means of cutting tape
- resists translation
- allows for loading and unloading of tape
## morphological analysis

<table>
<thead>
<tr>
<th>holds food</th>
<th>conducts heat from stovetop</th>
<th>means of manipulating pan</th>
</tr>
</thead>
<tbody>
<tr>
<td>bowl</td>
<td>steel</td>
<td>handle</td>
</tr>
<tr>
<td>plate</td>
<td>copper</td>
<td>knob</td>
</tr>
<tr>
<td>wire basket</td>
<td>clay</td>
<td>bakeware handle</td>
</tr>
<tr>
<td></td>
<td>glass</td>
<td></td>
</tr>
</tbody>
</table>

Possible combinations = multiplying # in each row
<table>
<thead>
<tr>
<th>functional requirements</th>
<th>holds roll of tape in place</th>
<th>resists translation</th>
<th>means of cutting tape</th>
</tr>
</thead>
<tbody>
<tr>
<td>morphological analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>matrix</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>design embodiments (2-6 per row)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
morphological analysis
matrix

for sanitary pad assembly machine
• What ideas or parts can be combined?
• Can I combine or recombine its parts’ purposes?
• Can I combine or merge it with other objects?
• What can be combined to maximize the number of uses?
• What materials could be combined?
• Can I combine different talents to improve it?
<table>
<thead>
<tr>
<th></th>
<th>portable</th>
<th>allows easy (un)loading</th>
<th>easy cutting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>holds item in place</td>
<td>easy cutting</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>easy cutting</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

apply features from these products

“ideal solution elements (ISE)”
holds tape in place
easy to cut tape
allows for easy loading of tape
portable
### Heuristic Ideation Technique

**HIT matrix**

edward tauber

---

**structured “cross products”**

attribute listing not F.R.s

---

<table>
<thead>
<tr>
<th></th>
<th>table</th>
<th>coffee</th>
<th>legs</th>
<th>surface</th>
<th>wood</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>collar</strong></td>
<td>table, collar</td>
<td>coffee, collar</td>
<td>legs, collar</td>
<td>surface, collar</td>
<td>wood, collar</td>
</tr>
<tr>
<td><strong>dog</strong></td>
<td>table, dog</td>
<td>coffee, dog</td>
<td>legs, dog</td>
<td>surface, dog</td>
<td>wood, dog</td>
</tr>
<tr>
<td><strong>snap release</strong></td>
<td>table, snap release</td>
<td>coffee, snap release</td>
<td>legs, snap release</td>
<td>surface, snap release</td>
<td>wood, snap release</td>
</tr>
<tr>
<td><strong>colorful</strong></td>
<td>table, colorful</td>
<td>coffee, colorful</td>
<td>legs, colorful</td>
<td>surface, colorful</td>
<td>wood, colorful</td>
</tr>
<tr>
<td><strong>ID tag</strong></td>
<td>table, ID tag</td>
<td>coffee, ID tag</td>
<td>legs, ID tag</td>
<td>surface, ID tag</td>
<td>wood, ID tag</td>
</tr>
</tbody>
</table>

**coffee table**

**dog collar**
<table>
<thead>
<tr>
<th></th>
<th>action</th>
<th>drama</th>
<th>comedy</th>
<th>horror</th>
<th>cartoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>aliens</td>
<td><img src="image1" alt="Poster" /></td>
<td><img src="image2" alt="Poster" /></td>
<td><img src="image3" alt="Poster" /></td>
<td><img src="image4" alt="Poster" /></td>
<td><img src="image5" alt="Poster" /></td>
</tr>
<tr>
<td>war</td>
<td><img src="image6" alt="Poster" /></td>
<td><img src="image7" alt="Poster" /></td>
<td><img src="image8" alt="Poster" /></td>
<td><img src="image9" alt="Poster" /></td>
<td><img src="image10" alt="Poster" /></td>
</tr>
<tr>
<td>dogs</td>
<td><img src="image11" alt="Poster" /></td>
<td><img src="image12" alt="Poster" /></td>
<td><img src="image13" alt="Poster" /></td>
<td><img src="image14" alt="Poster" /></td>
<td><img src="image15" alt="Poster" /></td>
</tr>
<tr>
<td>super hero</td>
<td><img src="image16" alt="Poster" /></td>
<td><img src="image17" alt="Poster" /></td>
<td><img src="image18" alt="Poster" /></td>
<td><img src="image19" alt="Poster" /></td>
<td><img src="image20" alt="Poster" /></td>
</tr>
</tbody>
</table>

structured “cross products” or genres and themes

super hero horror? cartoon war? dog action?
“make a it a habit to keep on the lookout for novel and interesting ideas that others have used successfully. your idea needs to be original only in its adaptation to the problem you are working on” - Thomas Edison
nature has spent billions of years designing and perfecting systems and processes. - innovator's toolkit

biomimicry

existence of earth

If a typical mature 70 g (2.5 oz) gecko had every one of its setae in contact with a surface, it would be capable of holding aloft a weight of 133 kg (290 lb)

-Scientific American

bacteria

Superhydrophobic Lotus Effect

kingfisher

humans 11:45 pm
biomimicry
- What can you add?
- What can be extended?
- Can it be done faster?
- Can it be used more often?
- What can be magnified or made larger?
- What can be exaggerated or overstated?
- What can be made higher, bigger or stronger?
- Can I increase its frequency?
- What can be duplicated? Can I make multiple copies?
- Can I add extra features or somehow add extra value?
- Can it do more things?

structured abstraction - restating problem more generally
progressive revelation in brainstorming or chunking up
TRIZ (Theory of Inventive Problem Solving)  
Genrich Altshuller, 1969

More specific to engineering innovation based on 40,000 patents → adaptation!

Abstracting the problem into contradictions

How can we design “pop” cans to support heavy loads when stacked?
TRIZ (Theory of Inventive Problem Solving)
abstracting the problem into contradictions

wall needs to be thin but thin walls can’t withstand high pressure
(to hold more liquid, lower cost, lower weight, keep OD handheld)

thin walls need to be improved to manage undesired issues with pressure

39 Problem Parameters
(force, speed, brightness, length, time, etc)

1. Weight of moving object
2. Weight of nonmoving object
3. Length of moving object
4. Length of nonmoving object
5. Area of moving object
6. Area of nonmoving object
7. Volume of moving object
8. Volume of nonmoving object
9. Speed
10. Force
11. Tension, pressure
12. Shape
13. Stability of object
14. Strength
15. Durability of moving object
16. Durability of nonmoving object
17. Temperature
18. Brightness
19. Energy spent by moving object
20. Energy spent by nonmoving object
21. Power
22. Waste of energy
23. Waste of substance
24. Loss of information
25. Waste of time
26. Amount of substance
27. Reliability
28. Accuracy of measurement
29. Accuracy of manufacturing
30. Harmful factors acting on object
31. Harmful side effects
32. Manufacturability
33. Convenience of use
34. Repairability
35. Adaptability
36. Complexity of device
37. Complexity of control
38. Level of automation
39. Productivity
TRIZ (Theory of Inventive Problem Solving)

Contradiction matrix 39x39 problem parameters

feature to improve - Y axis
undesired effect - X axis
elaboration on these in web references

1. Segmentation
   Divide an object into independent parts.
   - Replace mainframe computer by personal computers.
   - Replace a large truck by a truck and trailer.
   - Use a work breakdown structure for a large project.

Make an object easy to disassemble.
   - Modular furniture
   - Quick disconnect joints in plumbing

Increase the degree of fragmentation or segmentation.
   - Replace solid shades with Venetian blinds.
   - Use powdered welding metal instead of foil or rod to get better penetration of the joint.

from triz40.com
14. Spheroidality - Curvature
Instead of using rectilinear parts, surfaces, or forms, use curvilinear ones; move from flat surfaces to spherical ones; from parts shaped as a cube (parallelepiped) to ball-shaped structures.
- Use arches and domes for strength in architecture.
- Use rollers, balls, spirals, domes.
- Spiral gear (Nautilus) produces continuous resistance for weight lifting.
- Ball point and roller point pens for smooth ink distribution.
- Go from linear to rotary motion, use centrifugal forces.
- Produce linear motion of the cursor on the computer screen using a mouse or a trackball.
- Replace wringing clothes to remove water with spinning clothes in a washing machine.
- Use spherical casters instead of cylindrical wheels to move furniture.

from triz40.com
40 Innovative Principles

elaboration on these in web references

35. Parameter changes

- Freeze the liquid centers of filled candies, then dip in melted chocolate, instead of handling the messy, gooey, hot liquid.
- Transport oxygen or nitrogen or petroleum gas as a liquid, instead of a gas, to reduce volume.

35. Parameter changes

- Liquid hand soap is concentrated and more viscous than bar soap at the point of use, making it easier to dispense in the correct amount and more sanitary when shared by several people.

35. Parameter changes

- Use adjustable dampers to reduce the noise of parts falling into a container by restricting the motion of the walls of the container.
- Vulcanize rubber to change its flexibility and durability.

35. Parameter changes

- Raise the temperature above the Curie point to change a ferromagnetic substance to a paramagnetic substance.
- Raise the temperature of food to cook it. (Changes taste, aroma, texture, chemical properties, etc.)
- Lower the temperature of medical specimens to preserve them for later analysis.

from triz40.com
TRIZ

want a portable tape dispenser that doesn’t require two hands

feature to improve?

“convenience of use” needs to be improved
to manage issues with weight

2. weight of non moving object
vs. 33. convenience of use

6 - universality (multiple functions, eliminate need for other parts)
13 - the other way round (invert action, movable parts, upside down)
1 - segmentation (divide object, ease to disassemble, fragment more)
25- self-service (make an object serve itself)
put to other use — reverse adaptation

• What else can it be used for?
• Can it be used by people other than those it was originally intended for?
• How would a child use it? An older person?
• How would people with different disabilities use it?
• Are there new ways to use it in its current shape or form?
• Are there other possible uses if it’s modified?
• If I knew nothing about it, would I figure out the purpose of this idea?
• Can I use this idea in other markets or industries?
• What else can it be made from?
eliminate
functional analysis

• How can I simplify it?
• What parts can be removed without altering its function?
• What’s non-essential or unnecessary?
• Can the rules be eliminated?
• What if I made it smaller?
• What feature can I understate or omit?
• Should I split it into different parts?
• Can I compact or make it smaller?
• What if it had less of something?

“If a thing can be done adequately by means of one, it is superfluous to do it by means of several; for we observe that nature does not employ two instruments [if] one suffices.”  -Thomas Aquinas

You're fired in 3...2...1...
I think we all saw this coming, you're being fired. Into space.
Must the part move relative to all other parts?

Must the part be a different material from the other parts?

Must the part be different to allow for (dis)assembly/access?
reverse/rearrange

- What other arrangement might be better? Changing Layout?
- Can I interchange components?
- Are there other patterns, layouts or sequences I can use?
- Can I transpose cause and effect?
- Can I change pace or change the schedule of delivery?
- Can I transpose positives and negatives?
- Should I turn it around? Up instead of down? Down instead of up?
- What if I consider it backwards? Inside out?
- What if I try doing the exact opposite of what I originally intended?

reverse engineering mcdonald's fries
kenji alt

negative brainstorming

reversal can appear to be parody

product teardown
reverse/rearrange

• What other arrangement might be better? Changing Layout?
• Can I interchange components?
• Are there other patterns, layouts or sequences I can use?
• Can I transpose cause and effect?
• Can I change pace or change the schedule of delivery?
• Can I transpose positives and negatives?
• Should I turn it around? Up instead of down? Down instead of up?
• What if I consider it backwards? Inside out?
• What if I try doing the exact opposite of what I originally intended?
The first part of this assignment is to generate more ideas in a structured manner using some of the tools discussed in lecture.

1- Apply the SCAMPER prompt questions (substitute, combine, adapt, magnify/minify, put to other use, eliminate, reverse/rearrange) to a existing product. It could be same product or different products for each of these items. list at least 10 ideas (in text) for each of the prompts make a sketch of the best idea from each prompt... so... 7 new idea sketches (SAME FORMAT AS BEFORE)

2- Use one table-based tool to generate some ideas. You can use Morphological Analysis, TILMAG, or HIT Matrix on an existing product related the theme OR you can try to use TRIZ directly on your problem statements. Document the use of the tool, list 10 ideas, sketch the best.

Finally, select 10 ideas from any week that you feel could be realized into a product You can use a first order “NVF” (Novel, Valuable, Feasible) Test to winnow. Present these 10 Ideas as 10 legible separate images in the blog post. These could be reposted images.
For the SCAMPER portion of this assignment, choose an existing product related to your HMW statement and use the prompts in the slides to generate ideas for improvements or changes to transform it into a new product. You can use the same product for each of SCAMPER or you can choose different products for each item.

<table>
<thead>
<tr>
<th><strong>SCAMPER</strong></th>
<th><strong>Documentation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substitute</strong></td>
<td>1 = Typed list of at least 10 brief ideas and a sketch of the best idea 0 = No Documentation</td>
</tr>
<tr>
<td><strong>Combine</strong></td>
<td>1 = Typed list of at least 10 brief ideas and a sketch of the best idea 0 = No Documentation</td>
</tr>
<tr>
<td><strong>Adapt</strong></td>
<td>1 = Typed list of at least 10 brief ideas and a sketch of the best idea 0 = No Documentation</td>
</tr>
<tr>
<td><strong>Magnify/Modify</strong></td>
<td>1 = Typed list of at least 10 brief ideas and a sketch of the best idea 0 = No Documentation</td>
</tr>
<tr>
<td><strong>Put to Other Use</strong></td>
<td>1 = Typed list of at least 10 brief ideas and a sketch of the best idea 0 = No Documentation</td>
</tr>
<tr>
<td><strong>Eliminate</strong></td>
<td>1 = Typed list of at least 10 brief ideas and a sketch of the best idea 0 = No Documentation</td>
</tr>
<tr>
<td><strong>Reverse/Rearrange</strong></td>
<td>1 = Typed list of at least 10 brief ideas and a sketch of the best idea 0 = No Documentation</td>
</tr>
<tr>
<td><strong>Table Based Tool or TRIZ</strong></td>
<td>1 = Documentation of the process used in the form of a visual table or details of the TRIZ process. If using TRIZ, use your problem statement. If using a table, you can choose any existing product as a starting point. Include a typed list of at least 10 brief ideas and a sketch of the best idea. 0 = No Ideas/process</td>
</tr>
</tbody>
</table>

**10 BEST IDEAS SO FAR**

1 = Review the 10 silly ideas from Assignment 2, the ideas you developed in Assignment 4, the ideas you developed in class sessions, and the ideas from this assignment. Out of these ideas combined (plus any new ideas or modifications of ideas) select your favorite 10 ideas that pass a basic NVF test. Under this heading you should simply present these 10 ideas which could be reposting the same images if they are of good quality. Again, make sure each idea has a legible sketch and title and is a separate image.
logistics

3M this Thursday

building 275 (colored in yellow below).
If taking bus, meet at normal spot at class start time
If driving, take 94 E to the McKnight exit North. Go North on McKnight then right on Conway. The building 275 complex will be on your left past the brand new glass building. Building 275 is pointed on top.
There is some visitor parking
Come into the main visitor entrance.

also… no class next Tuesday for election day
any questions?