APSC 101 FINAL SUPER CHEAT SHEET (it's actually 19 pages, no wait now it's 20)

Photos and information collected from the 2021 APSC 101 screencasts and lectures

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- USE TABLE OF CONTENTS ON LEFT TO NAVIGATE (Gray Checklist Icon)
- Use Command F to search up words
- Please don't delete anything, just comment instead
- Be sure to download before the test. Don't use the Google Doc version during the test! (It's not that type of cheat sheet)
    - Want to see the table of contents on the downloaded version?
    - File>Download>MicrosoftWord,
    - On Word: View>Check the navigation pane box,(under show heading)
- Good Luck! :)

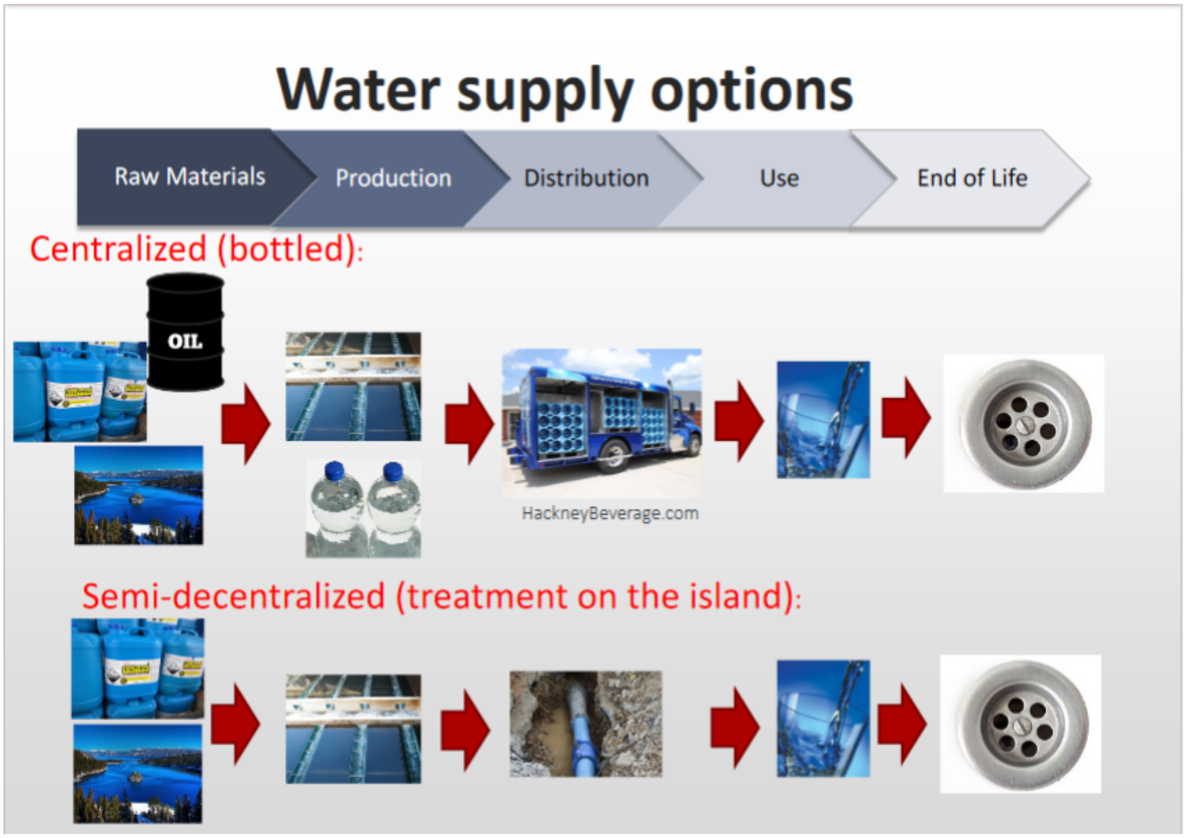
Module 6: Van Anda Context

Van Anda and Water Stress

- Water stress: lack of access to clean water
    - Need both sufficient quality and quantity of clean water available
- Small Community Issues:
    - High cost
    - Lack of resources/workers
    - Lower water quality
    - Difficult to supply chemicals and parts
    - Economies of scale: more $ per L of water treated in small systems compared to larger ones

Water treatment

- Centralized system
    - One Large central treatment plant
        - (Shipping bottled water from the mainland to Van Anda)
    - Advantages:
        - Easy to maintain and monitor the plant
        - $ per L is low
    - Disadvantages:
        - Lots of infrastructure, difficult to maintain the infrastructure, hard to adjust to growing city (easier to add decentralized systems)
- Semi-Decentralized
    - Multiple small treatment plants
        - (One treatment plant on Van Anda)
- Decentralized system
    - Water Treatment center at every house (rain water, well)
    - Point of Entry: source of treatment for each building
    - Point of Use: Treatment at each point of use. Ex: Brita filter
    - Advantages:
        - No transportation costs
    - Disadvantages:
        - Difficult to supply parts/chemicals/recruit operators
        - Source water quality may be low
        - High $ per L



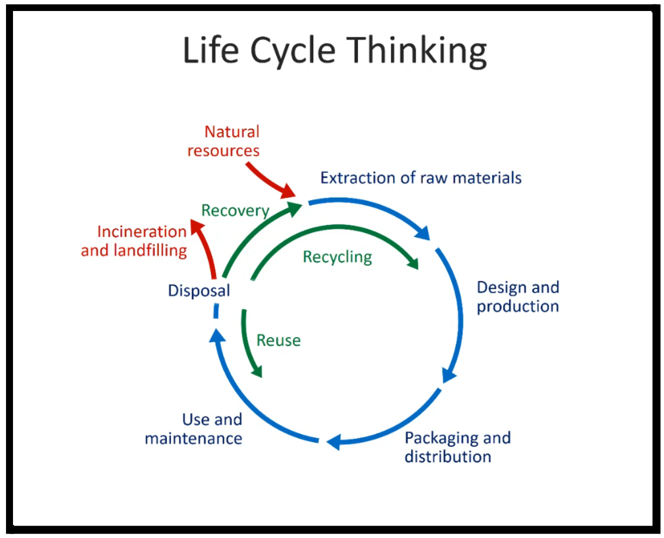
Call for Proposal

- 3 steps:
    - EOI-plans, considerations
        - Focuses heavily on the first three stages of the APSC 100-101 design framework
    - Conceptual Design-details
    - Full project design-ready for implementation
- To consider:
    - Scale: users, treatment, storage, water cycle, etc
    - Water users: population growth, consumption, seasonal variation of consumption, geography
    - Source water: possible options, quality and quantity available, distance from users, seasonal variation

LCA

- Life Cycle Assessment
- Systemic evaluation of environmental aspects of a product or service system in all stages of its life cycle

- 4 Stages of product
    - Manufacturing
    - Package and Delivery
    - Usage
    - Reuse, Recovery, Recycling and Disposal
        - WasteWater Reclamation
            - The process of converting wastewater into water that can best used for other purposes, such as irrigation



- 4 main stages :
    1) Goal definition and scope
        a) Look at what outputs come from inputs after going through life cycle stages
        b) Set the system boundary: which aspects of the product/process are we considering? Which life cycle stages?
    2) Inventory analysis
        a) Material and energy flow in and out of system within the system boundary
    3) Impact Assessment
        a) Impacts of material and energy flow
    4) Interpretation (interpretation occurs throughout)
        a) Find impacts based on lifecycle stages, improve design

SLCA

- Streamlined Life Cycle Assessment
- Compared to LCA, SCLA is
    - Quicker than LCA
    - Qualitative (LCA is quantitative)
    - Requires less info than LCA
    - Suitable for use early in the design process
    - Reveals ~80% of the environmental issues identified by a full LCA
    - Captures a limited number of aspects
- Sum up the scores for an overall product rating: called ‘Rating of Environmentally Responsible Product’
- Higher rating = more environmentally friendly

Functional Unit

- A reference unit to compare different options in an LCA or SLCA
- Used to achieve a fair assessment of impacts from different decision options in an SLCA
- Generally looking for something that captures all aspects of sustainability (more than just one dimension such as cost/environmental impact)
- Ex: Amount of light intensity over the lifespan of a lightbulb

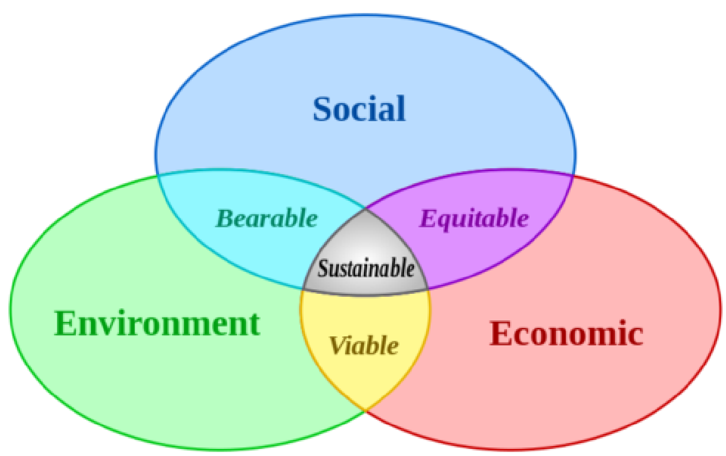
Engagement

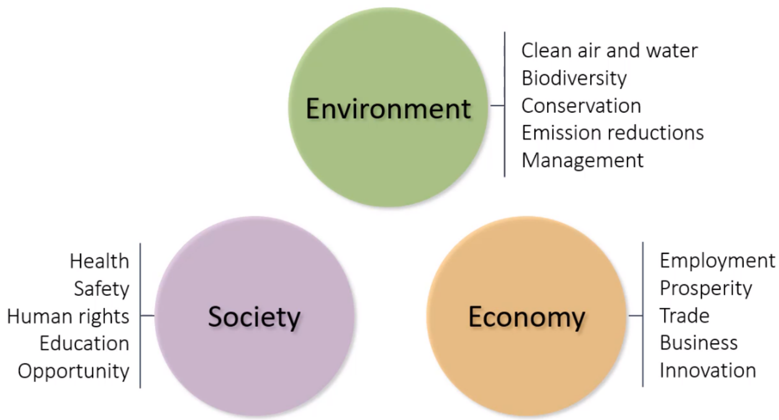
1. Engage
   a. Are engagement processes in place and do they work effectively?
2. Synthesize
   a. Is the context considered such that the project will proceed as planned?
3. Learn
   a. Will there be a periodic reassessment to learn and improve?

Engagement	Engagement processes are in place and are working effectively
Synthesis and Learning	Periodic re-assessment of the project is ensured in order to determine whether or not the net result of the entire project continues to be positive over the long term

Sustainability

- 3 Pillars of sustainability
  - Social
  - Economic
  - Environmental
    - Social and Environment = Bearable
    - Social and Economic = Equitable
    - Environment and Economic = Viable
- No tradeoffs between dimensions
- About positive contributions, not mitigating adverse effects



- Assessing for sustainability goes past just the environment, and occurs in all life cycle stages
- Sustainability is a property of the system (one component can have a negative impact on another component)
- 

Resiliency

- Ability to adapt to changing conditions and maintain or regain functionality and vitality in face of a disturbance
- Key concepts:
    - Transcends scales, diverse/redundant, simple, locally available/renewable/reclaimed resources
    - Social equity and community contributes to resiliency
- Can use CLD to assess resiliency

Appropriate Technology

- Design solution considers key stakeholders across all life cycle stages
- Solution is appropriate for context
- Bottom up approach that involves the community
- Attributes:
    - Suitable to social and economical context of where it is being implemented
    - Environmentally sound
    - Locally accepted and adapted
    - Community consultation in all stages
    - Doesn’t have to meet all requirements
    - Doesn’t have to be the most technical option

Business Letters

- Format:
  - 1” to 1-¼” margins
  - Left-block format (ragged right side)
  - 11-12pt font
- Fonts:
  - Sans serif fonts have a straight block format. Ex: “T”
  - Serif fonts have curvy edges or embellishments on them: Ex: “T”
  - For conserative/traditional people use Times New Roman
- Header:
  - Address of sender (top left)
  - Date (month dd, year)
  - Could have a company header (only used on pg. 1)
  - Could use Re: as the subject
- Inside address:
  - Mr./Mrs. ______ (recipient name and title)
  - Recipient address
- Salutation:
  - Dear Mr./Mrs. ____: (include recipient title and end with a colon)
  - Follow with body of letter (no indents and blank space after each paragraph - use block format)
- Conclusion:
  - Sincerely, (use comma)
  - Signature of sender
  - Name and title of sender
  - Footer could contain enclosures (appendixes)
  - Footer could also cc. other people
- 7C’s in relation to Letter

7 Cs

1. **Clear** – writing is simple and easy to understand
2. **Concise** – message is brief and to the point
3. **Correct** – document is free of errors
4. **Concrete** – main point is evident, vivid and detailed
5. **Complete** – all necessary information is included
6. **Courteous** – writing has friendly, appropriate tone
7. **Considerate** – writing takes receiver into account

Feedback

- 3 kinds of feedback:
    - Appreciation: acknowledge a job well done
    - Coaching: help someone improve
    - Evaluation: rate someone's performance against standards

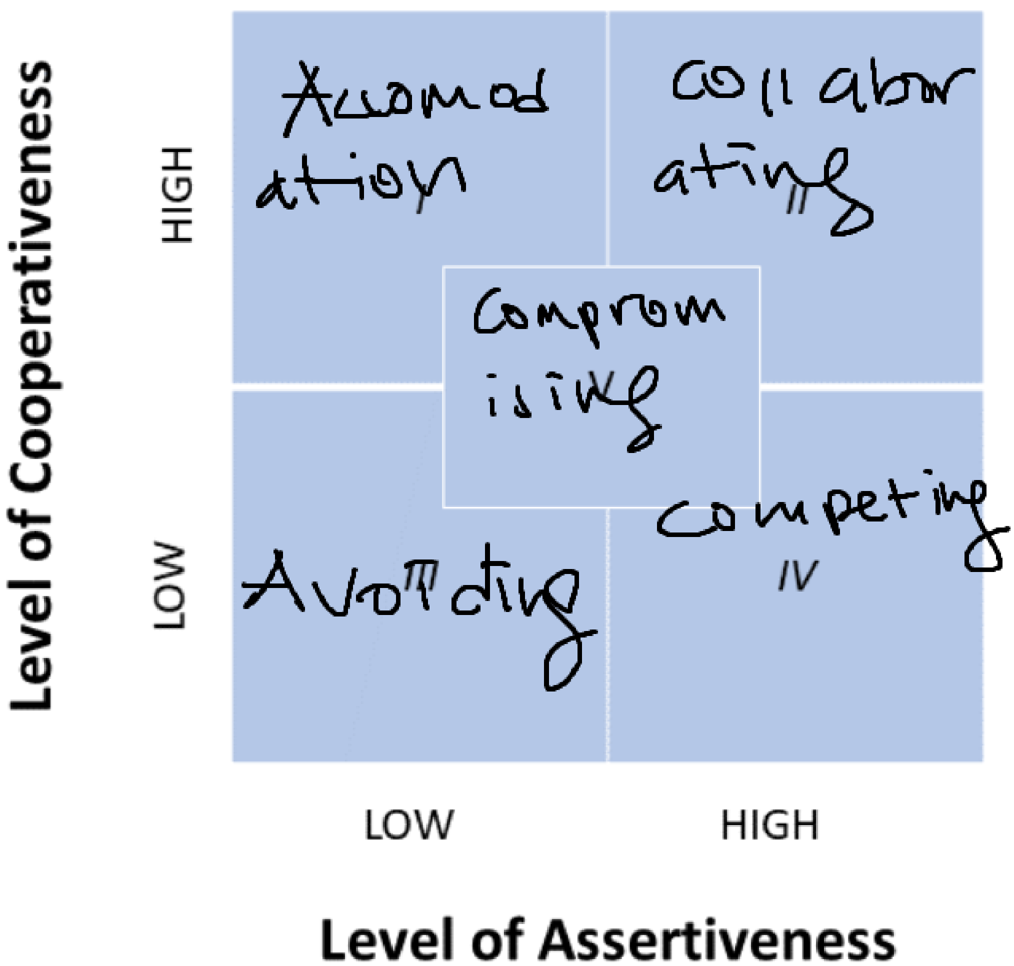
3x3 Feedback Model

Sender	Message	Receiver
Clear consistent, unambiguous speech and body language	**Concrete** descriptive, specific, and non-judgmental; focuses on receiver	**Clear** consistent, unambiguous speech and body language
Courteous polite and respectful tone, language, and body language	**Complete** includes observations, impacts, and suggestions for improvement	**Courteous** polite and respectful tone, language, and body language
Considerate consider receiver when choosing time and method of feedback	**Considerate** is empathetic and relevant to the receiver	**Complete** acknowledge the feedback; ask for clarification

Conflict Management

- Assertiveness: degree to which you seek to meet *your* goals
- Cooperation: degree to which you seek to meet *other parties* goals

- 5 Strategies:
    - Competing: firmly stand to get what you want, even if other party does not get what they want
    - Accommodating: other party gets what they want even if you do not
    - Avoiding: ignore the conflict or remove yourself from the situation
    - Compromising: meet in the middle. Give and get
    - Collaborating: take time to work with other party to seek out a solution where you both meet your goals



Elevator Pitch

- Audience:
    - Who are you pitching to and what do they need to know
- Purpose:

    ○ Why are you pitching this idea
- Context:
    ○ Under what circumstances are you pitching this idea
- Very short (less than a minute)
- Three stages:
    1) What is the problem?
    2) What is your solution?
    3) Explain why your solution is important to the audience (why should they care)

Module 5: The Claw

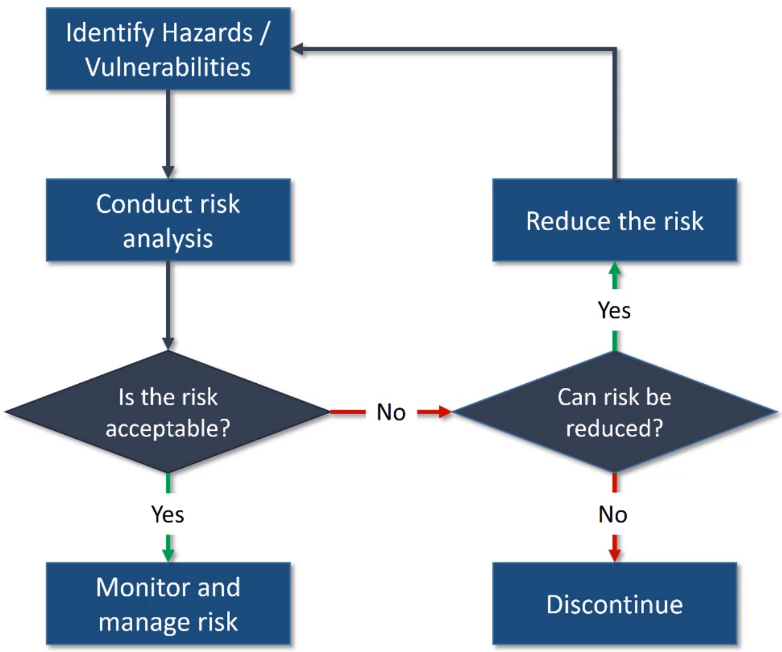
Risk

- Risk = (severity)x(likelihood)
- Hazard: capacity of equipment, material or processes with potential to cause harm
- Risk: possibility of harm from hazards, risk arises from hazard
- Risk can be mitigated but is never zero
- most relevant reason for analyzing risks: it helps focus our attention on different sources and categories of risk, increasing the chances we identify all key risks

Likelihood

Almost certain	5	5	10	15	20	25
Likely	4	4	8	12	16	20
Possible	3	3	6	9	12	15
Unlikely	2	2	4	6	8	10
Rare	1	1	2	3	4	5
		1	2	3	4	5
		Negligible	Minor	Moderate	Major	Catastrophic

Severity



Project Risk

- Project Risk = possibility of unfavourable project outcome
- Vulnerability: potential decisions, project management, information, changing conditions to yield negative results
  - Arise from how teams weigh costs/benefits, how thorough team is in information gathering, managing time and resources

Managing Risk

- Avoid: change what you are doing to remove the risk
- Mitigate: minimize the likelihood or severity of risk
- Transfer: pass the risk onto someone else
  - Insurance
- Accept: for minor risk or strategic risks, you are willing to live with the consequences of an incident

Risk Categories and Sources

- Risk sources:
  - External: outside of teams control

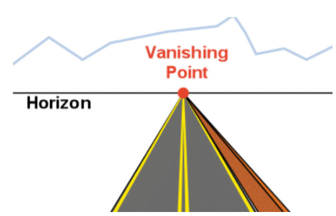
○ Strategic: possibility of greater reward
○ Preventable: within teams ability to mitigate/control

- Risk categories:
  - Safety: health/welfare of people/environment
  - Technical: design/manufacturing that prevents device from working as intended
  - Project Management: complete on time and within budget or how you prepare for the competition
  - Operational: decision making/organization/operation of device
  - Other: economical, political

Designing an Experiment

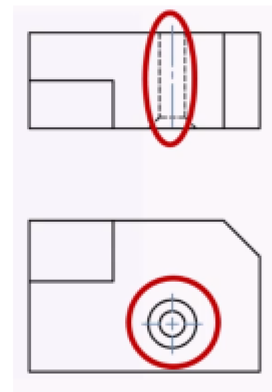
1. What risk are you investigating?	• What is the risk you have identified as the one you are trying to reduce?
2. What are you attempting to measure?	• What ***metric*** informs your greatest risk? • E.g. time, weight, number of successful lifts (?), etc. • Are you evaluating that metric directly or indirectly (e.g. if I change *x*, what happens to *y*)?
3. How can you measure your metric?	• What types and how many measurements are needed? • What tools will you need? • What is your experiment procedure?
4. How will you analyze and interpret the results?	• What procedures, tools, or techniques will you use to analyze your data? • How will you present the results (e.g. graph, table, statistically analyze it)? • How will you know if you can trust the results? • Are they ***reliable*** (retests give the same results)? • Are they ***valid*** (they measure the phenomenon you intended)? • What conclusions can you draw from the results?
5. How do your results apply to your project?	• How can you use or implement your results for your project? • What are the limitations of your experiments? • Do they suggest any follow-up testing is needed?

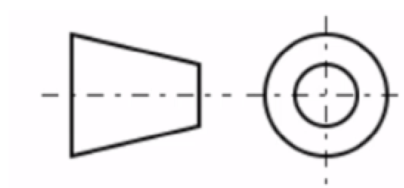
Engineering Drawings

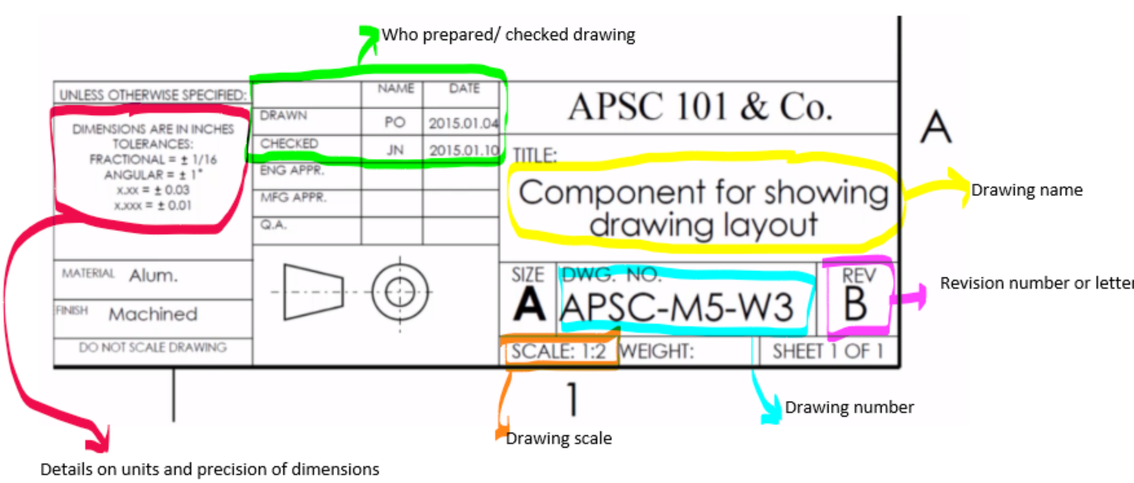


- Perspective drawings:
  - Realistic drawing
  - All parallel lines converge at a ‘vanishing point’
- Isometric View:
  - Oblique view from one corner
  - Diagonal or 3D image
  - Vertical lines are vertical

    - The x-y axis makes a 30 degree angle from horizontal
    - Equal distances on object are equal on page
    - Parallel lines on object are parallel on drawing
    - Enclosing box: does not have to be an exact cube
    - Circles on the object appear as ellipses on the page

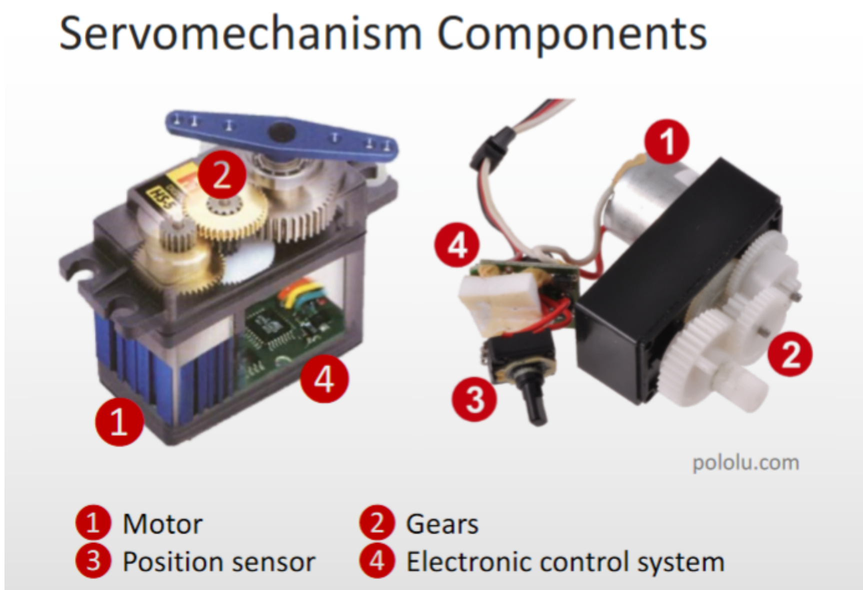


- Orthographic View:
    - Set of at least 3 side views of a drawing
        - Top, front, one of the ends
    - Hidden lines are drawn as dashed lines
    - Centremarks: crosshairs
    - Centrelines: ------ -- ------
- Third Angle Projection
    - Type of orthographic projection
    - Top, front, right hand views
    - 
        - North American symbol for third angle
- Title Block contains:
    - Drawing name
    - Drawing number
    - Revision number/letter
    - Drawing scale
    - Who drew and checked it
    - Units and dimensions

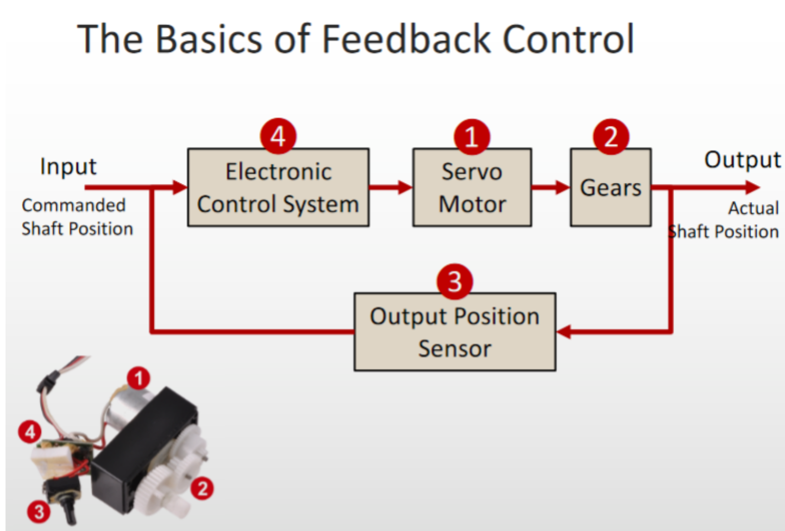


- Dimensions
    - Cannot have redundant dimensions
        - Choice of which measurements to include is based on which are most critical to get right
    - Try to dimension visible parts only
    - Ø indicates diameter
    - Do not place dimensions inside an object
    - Extension lines may cross, dimension lines may not
    - Place dimensions between views if possible

Servo Parts and Control

- Servo Parts
    - 

    - *servo arm doesn't rotate 360 degrees

- Servo Control 

- **Output Position Sensor** measures the angle of the output shaft and send a signal back to the Electronic Control System
- **Gears** increase torque

Module 7: Van Anda 2.0 (RWH)

Spreadsheets (Excel)

- $ means that the cell does not change when you copy formulas
- R^2 value is called coefficient of determination
- IF test:
    - =IF (logical_test, [value_if_true], [value_if_false])

Target Design Specifications and Satisfaction

Target Design Specs:

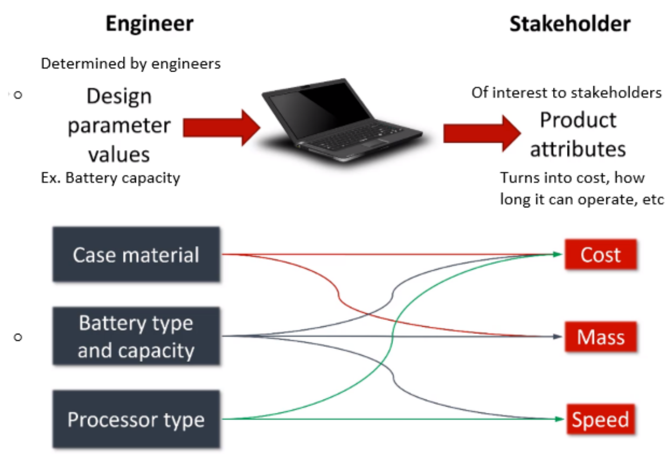
- Come from needs
- Consist of requirements and evaluation criteria

Design Parameter Values:

- Thought of as inputs
- Created by design engineers
- Consists of materials used and other decisions made by the engineer
- Can impact multiple attributes

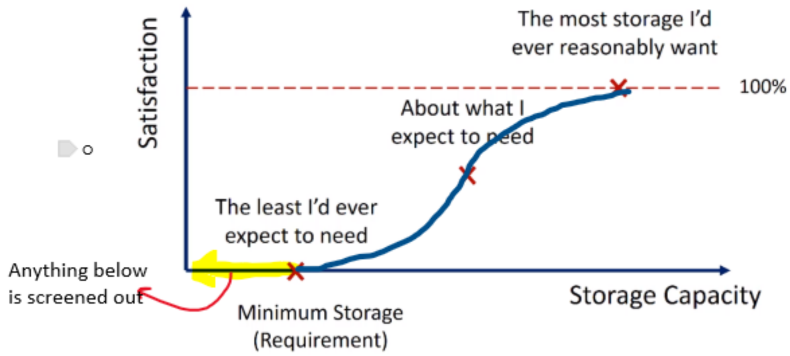
Product Attributes:

- Thought of as outputs from design parameters
- Evaluated by consumers
- Can be things such as speed, cost, durability, etc.



Satisfaction Curves:

- Represent evaluation criteria (EC), but also show requirement
- Quantify performance for single EC-curves are generated w/o looking at other attributes
- Satisfaction plateaus when the EC reaches the 'most I'd ever want' stage
- Curve steepest at point of expected needs-small changes here are noticed
- Where do these curves come from?
    - Understanding market, research, stakeholder consultation/observation
- Total satisfaction is the weighted sum of all the curves



Prototypes for Design Decisions

- Virtual Prototypes:
  - Computers are a common method of virtual prototypes
    - Computer modelling: flexible (see and make changes easily), powerful (modern), numerical (we can approximate equations that we can not easily solve on paper)
  - Pros: inexpensive, fast, efficient
  - Cons: rely on approximations, need to understand limitations, results need to be interpreted carefully
- Physical Prototypes:
  - Pros: controlled environment, able to isolate variables
  - Cons: very different from real world, must know how to convert results to large scale, integrate results from individual components into the full system

Fluid Flow Physics

Definitions:

- Water pressure: $p = \rho g h$(N/m^2)
- Flow Rate: $Q = A_{nozzle} v$
- Pressure from pipe friction: $p = f\frac{l\rho v^2}{2d}$
- Pressure from restrictions: $p = K\frac{\rho v^2}{2}$
- Pressure from filter: $p = C_f v$

Equations and relationships:

- Flow rate out: $Q_{out} = A_{nozzle}\sqrt{2gh} = A_{nozzle}\sqrt{\frac{2p}{\rho}}$
- Velocity out: $v_{out} = \sqrt{\frac{2p}{\rho}} = \sqrt{2gh}$ (h=height of water)

- Pressure of pump: $p_{pump} = \rho g h + f\frac{l\rho v^2}{2d} + K\frac{\rho v^2}{2} + C_f v$
- Energy: $E_{water} = p_{pump} V_{catchment}$
- Fluid always moves from high pressure to low pressure systems

Question 6 1 / 1 pts

For the instant the boy is filling the balloon with air, blowing from his lungs, rank the following from highest pressure (top) to lowest pressure (bottom).

Correct!	1 Highest pressure	The boy's lungs
Correct!	2	The boy's mouth
Correct!	3	The balloon
Correct!	4	The atmosphere

Flow moves from high pressure to low pressure. Flow originates from his lungs (highest pressure), moves through his mouth (slightly lower pressure), and into the balloon (lower pressure still). Atmospheric pressure is lowest, since we know flow would leave the balloon if not sealed.

-

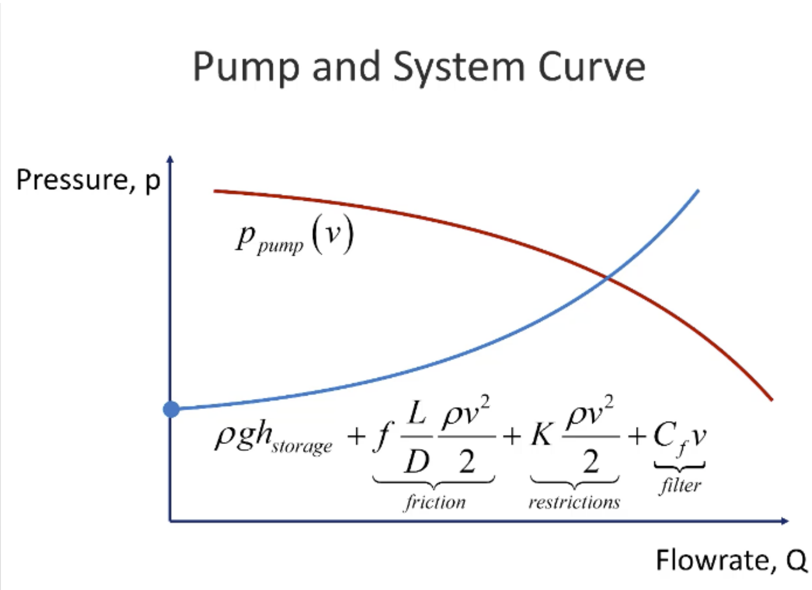
System Curves

System Curves (Catchment to storage)

- The y intercept - the amount of pressure the system requires to raise the water by the storage tank height

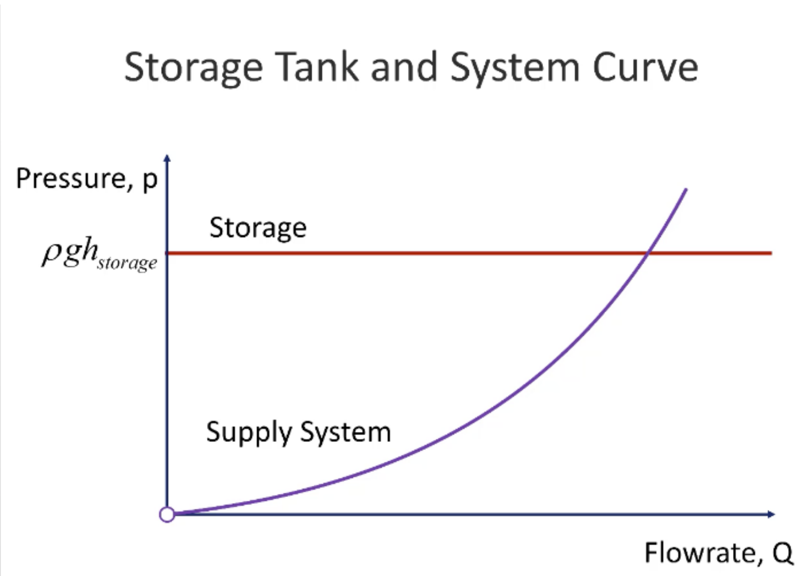
- How to increase flow rate from catchment to storage tank?
    - decrease elevation of storage (lowers system curve)
    - reduce losses (system curve is less steep)
    - better pump (system curve moves up)
    - increase pipe diameter (lowers friction)

House to Storage



Storage to House

- Moving down supply system curve → reducing pressure loss



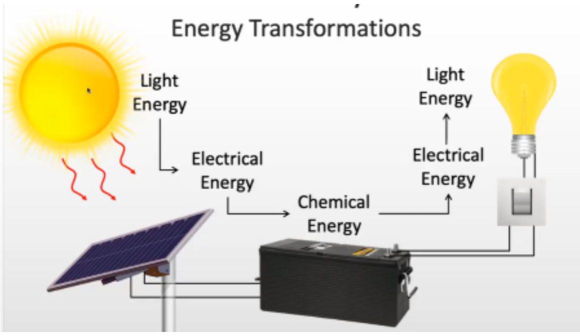
Filtration

- 200um filter-sand, dust, pollen
- 5um-silt, suspended solids
- 1um filter-some pathogens, fine particles **(our system MUST have 1um Filter)**

Disinfection

- Non-chemical (UV) **(our system MUST have UV filter) (UV comes after filters)**
  - Pros: no chemical residue, effective at killing most pathogens
  - Cons: requires clean water/low turbidity, requires electrical power
- Chemical (Chlorine)
  - Pros: kills most pathogens, well developed technology
  - Cons: requires residence time and hazardous chemicals
- Chemical (Ozone)
  - Pros: kills most pathogens, ozone is produced on sight
  - Cons: expensive, power required

Solar Power System



- Pros: no local emissions, silent, no fuel transport
- [Energy stored in the system] = [energy coming into the system] - [energy going out of the system]
- Energy is lost to heat-decreases efficiency

Project Details

Water Collection:
- Water collected (volume)=(rain (meter))x(catchment area)
- More water stored in tank leads to higher pressures

Flow Lines and Purification:
- Filtration could occur on the inflow or outflow line
- Bag filters must come before UV filter
- UV filter only works if the water is not cloudy
- UV filters have a max operating flow rate
- Chlorine/Ozone filters come before UV?

Energy Supply:
- Energy sources of diesel or solar power
- Solar panels contribute to emissions in production

Bias

- Teams benefit from diversity

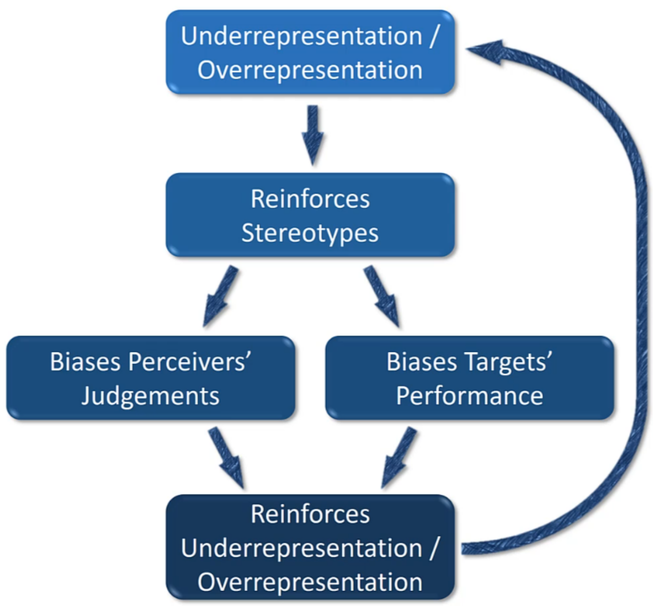
    - More creative solutions, strong relationships improve individual and team performance
- Diversity is also beneficial in leadership

Explicit Associations
- Beliefs and attitudes about a group that people consciously report

Implicit Associations
- Culturally learned associations that can shape perceptions outside of conscious awareness and control

- Everyone has both explicit and implicit bias
    - It is possible to change it and decrease your bias
- Biases shape how we see others and how we see ourselves (stereotype threat)
- Understanding biases helps us prevent them

Bias Framework

- 

Workplace Environments & Teamwork

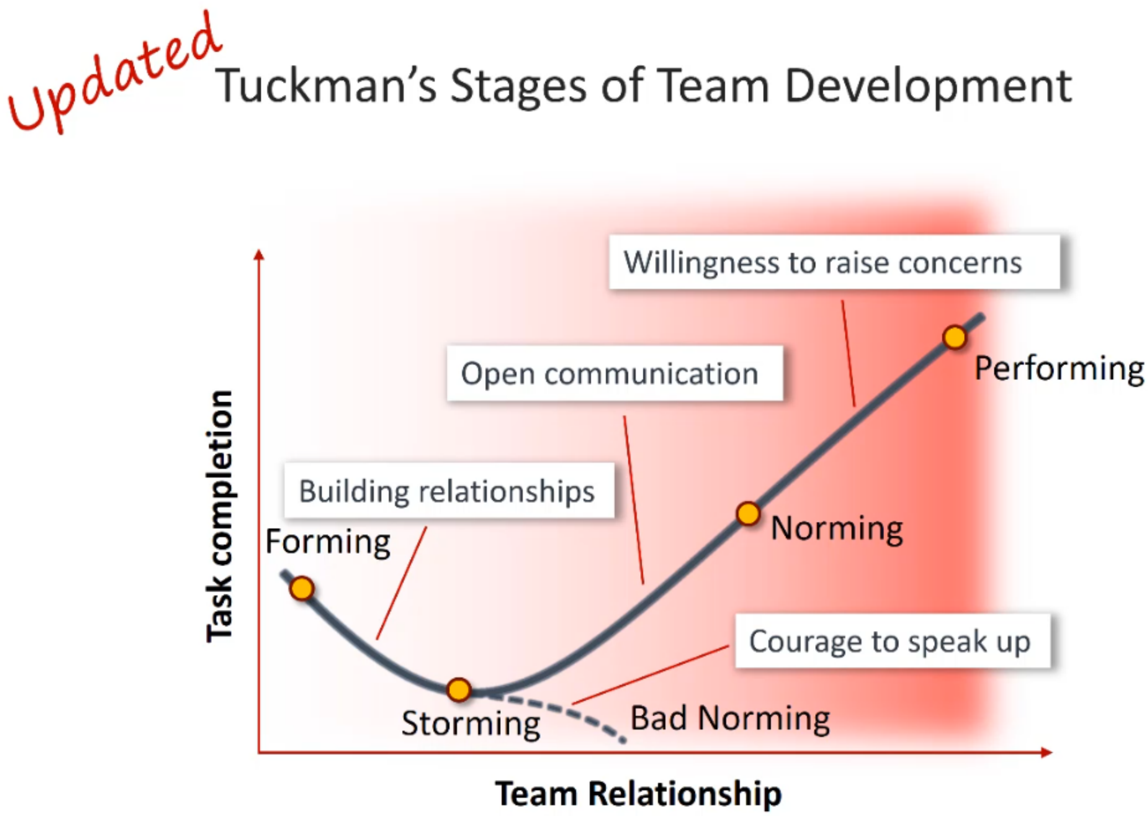
Traits of effective teams:
- Dependability-work done on time and of high standard
- Structure and clarity- clear goals, roles, and plans
- Meaning-personally important work
- Impact-members feel their work matters
- Psychological safety (most important)- members feel safe to take risks and be vulnerable
    - Bias and stereotype threat undermine this

Ability of the team members is NOT one of the traits

<u>Tuckman's stages of Team development</u>

- Forming (everyone is polite and no one wants to argue)
  - Strengths of team not fully utilized in forming
- Storming (everyone is arguing and as a result tasks are not being completed)
- Norming (roles are formed and people know what they are supposed to do)
  - Bad norming (team member constantly not showing up to team quizzes)
- Performing (team is operating efficiently and there is openness and trust is established)
- Original model did not have "bad norming"

- Bias and stereotype threat undermine psychological safety on a team
  - Prevents relationship growth



Academic Integrity VERY DIFFICULT

Answer to Q1 – Academic Integrity Pledge – It’s tough, but you can probably definitely click no for this one.
Q2 is rough too but also click no