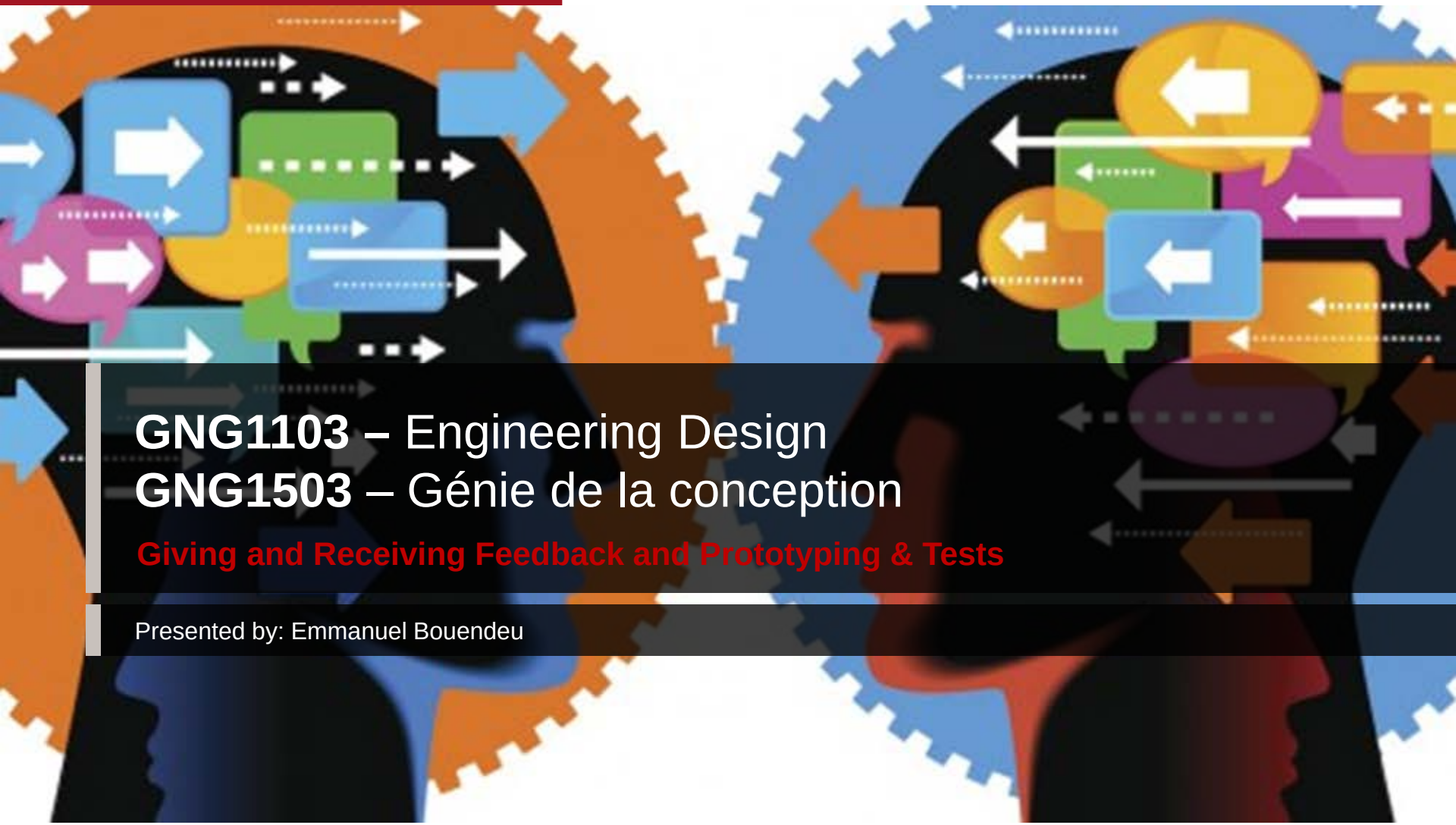


GNG1103 – Engineering Design
GNG1503 – Génie de la conception

Giving and Receiving Feedback and Prototyping & Tests

Presented by: Emmanuel Bouendeu

http://vacancycentre.com/wp-content/uploads/2015/03/feedback-career-tips-working-in-malta-620x280.jpg

Agenda

- Reminders
- **Review Questions**
- **Feedback Control System & Personal Feedback**
  - Giving & Receiving Feedback
- **Prototyping & Testing**
  - Definition & Attributes of a Good Prototype
  - Prototyping Objectives
  - Types of Prototypes & Fidelity
  - Importance of Testing & Testing Plan

Reminders

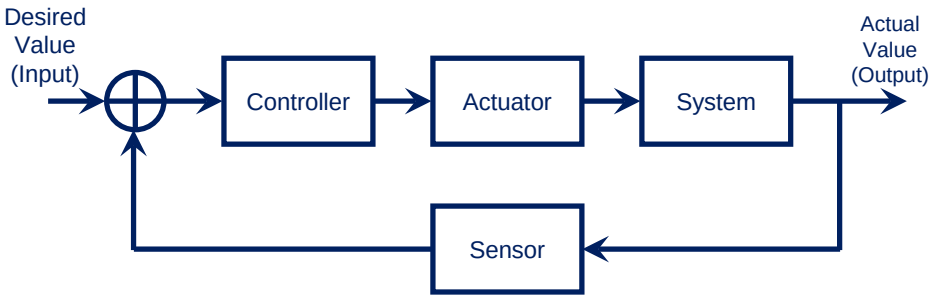
- **Lab 6** (SolidWorks), Bring a mouse: This week
- **Project Plan** (Week 4,**6**,8,10): Weekly review & update
- **Client Meet 2** (Sketches & Questions): Feb. 11, 12 & 14
- **Mid-term exam** 75 minutes (Lecture 1 to 11): **Feb 12.**
- **Project Deliverable E** (Project schedule & Cost): Feb. 16
- **Peer Feedback & Team Dynamics 1**: Feb. 16
- What is your summary of **Lecture 10**?
  - Engineering design analysis & Importance
  - General principle of engineering analysis
  - Tools used for engineering design analysis
  - Considerations for components and material choice

Review Questions

1. How **important is a personal feedback**? What are the **attributes of an effective personal feedback**?
2. Give two examples of productive feedback and two non-productive ones.
3. What is the **importance of prototyping** and **testing** in engineering design?
4. In the table below, indicate whether the statement is true or false.

#	**Statement**	**True/False**
1	A neutral description of a behavior is always irrefutable.	
2	Prototypes can be classified along two dimensions.	
3	The attributes of a **good prototype** are fidelity, cost, iteration cycle time and signal-to-noise ratio.	
4	Comprehensive analytical prototyping is generally not feasible in engineering design.	
5	Before any testing, an adequate testing plan is essential as it can help to save time and money.	

Personal Feedback



- We have seen a basic feedback control system before (e.g. thermostat example or the embedded control lab.)
  - Some part of the output of the system is 'fed back' to a decision point, where it is compared with an unchanging desired value
  - The difference between the actual system output (actual value) and the desired value is then processed to "fine-tune" the system output
- Personal feedback can be viewed as a feedback system
  - We want to adjust our actions or behaviour (outputs) to have a desired result (e.g. working well in a team environment)
  - BUT… personal feedback is "filtered" through the observations and opinions of other people

Image from: http://blog.alexdevero.com

Personal Feedback – The "Human" Factor

- Main difference between feedback control systems and personal feedback is that people are involved
  - People are not always logical
  - People's observations are not always accurate or even correct
  - People's emotions can cloud their ability to give feedback (and also their ability to receive it!)
- Personal feedback is needed both to correct poor behaviours and to enhance or re-enforce good behaviours
  - We give each other feedback *all the time*, but not always in an explicit manner (e.g. "body language").

⇨ Explicit Personal feedback (and how to both give and receive it) is a skill which can be learned and practiced

Not All Personal Feedback is "Productive"

- Feedback can be positive or negative, but ***both*** types of feedback can be useful in modifying our behaviour
- Here are a few examples of how to give feedback:

Hockey Canada PSA Relax, It's Just a game Golf - YouTube

Hockey Canada PSA - It's Just a game - Grocery - YouTube

Hockey Canada PSA - Relax, It's Just a game - Hide n' Seek - YouTube

- There is a basic way of giving feedback, which will maximize the chance that it will be 'productive' feedback and actively considered by the receiver

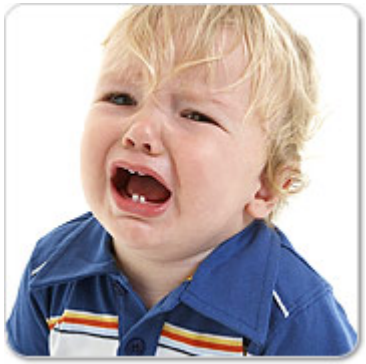
Productive Personal Feedback Recipe – "When you do X, it makes me feel Y"

- Give personal feedback using neutral terms describing the behaviour and its effect on you
  - Avoid using emotionally-loaded descriptions (e.g. atrocious, terrible, appalling, horrific, mean, spiteful)
  - The behaviour should be described precisely and ***without*** your judgement or opinion… that comes afterwards, when describing the effects
  - The person receiving feedback can't quibble with your description of how ***you*** feel either, since ***you*** are the world-leading, foremost subject matter expert here!

Why Give Feedback this Way?

- A neutral description of a specific behaviour is hard to dispute, **provided it is accurate**
  - Receiver may not be aware that he/she was doing something or was doing something a certain way
  - This can be shown (e.g., with a video camera) but is unlikely to be contested, especially if corroboration with other observers is possible

Why Give Feedback this way?



- Describing the effects of a behaviour on *yourself* (i.e., when *you* are the feedback giver) is *not* really contestable
  - Only *you* know how *you* feel about something!
  - This feeling may **not** be a rational one or maybe not even a justifiable one, but it remains how you feel, nonetheless!
  - Don't infer knowledge of the feedback receiver's personality (this is ***not*** your area of expertise!)
  - While the receiver is now *aware* of how their behaviour affects you, they may ***not*** choose to change anything at all about their behaviour!

Elements of Productive Feedback

- Feedback should be as specific and actionable as possible
- Feedback should not be given for other people
- Feedback should be timely
  - The details of events fade fast in people's memory
- Feedback should be given at the right time (i.e. when the receiver is receptive)
  - If somebody is very angry, it is probably not a good time to give them feedback (e.g. "You mad, bro.?")

Image: https://i.ytimg.com/vi/U2HNZiVWaZc/maxresdefault.jpg

Examples

Describe behaviour
in neutral terms and its
effects on you

- Specific & Actionable
- Timely
- Given at the right time
- Speak for yourself

- *"You are a very moody person"*
- *"You are truly thoughtless"*
- *"I feel like you aren't listening to me, when you turn up the music when I am speaking to you"*
- *"You say weird things"*
- *"Your voice makes me feel like I am being patronized when you are giving me feedback"*
- *"When you were talking to me in Loblaws last year, you were mumbling"*
- *(After the event, when alone with the person) "When you blew up in that meeting just now, I found it hard to listen to what you were saying"*

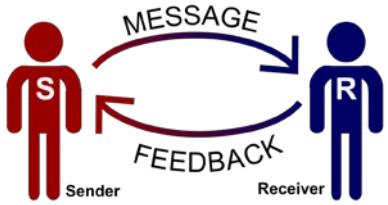
More Examples

Describe behaviour
in neutral terms and its
effects on you

- Specific & Actionable
- Timely
- Given at the right time
- Speak for yourself

- *"When you interrupted me just now, it made me feel like what I was saying was not important to you"*
- *"People hate it when you are so loud"*
- *"I really liked the way that you did X just now, especially the Y aspect of it"*
- *"You are so angry right now, but that's probably the least of your many issues. Are you mad, bro?"*
- *"Lots of people don't understand you"*
- *"You are mean"*
- *"You behaved aggressively with that shop clerk"*
- *Last month, you were always talking too much*

Receiving Feedback



- There is a good way to *receive* feedback too!
- As the receiver, you don't have to agree with what has been said to you, but you should **acknowledge** it (i.e. provide feedback!)
  - Do this by re-phrasing, *in your own words*, what you think you've been told
- The giver of the feedback should be satisfied that ***you*** understand *what he/she has said* to you
  - If the feedback was difficult to receive for you, then it might well have been hard for them to give too (e.g., the next example!) so keep your emotions in check

Practice Giving and Receiving Feedback!

- Find a partner and decide who is going to start as the feedback giver and who is going to be the receiver (you will get a chance to play both roles!).

1. Assume that the person next to you smells bad and you suspect that the person is not wearing any deodorant. Assume that you have noticed this before too. Discuss the conditions under which you would give them feedback about this 'problem' and then give them some feedback, assuming that these conditions are met.

2. Switch roles and repeat the exercise, instead now assuming that the person next to you is repeatedly playing annoying and distracting videos with their smart phone, while you are trying to listen to the totally fascinating GNG1103 lectures.

- *Remember* the format for giving feedback:
  - "***When you do X, it makes me feel like Y***"

Prototyping

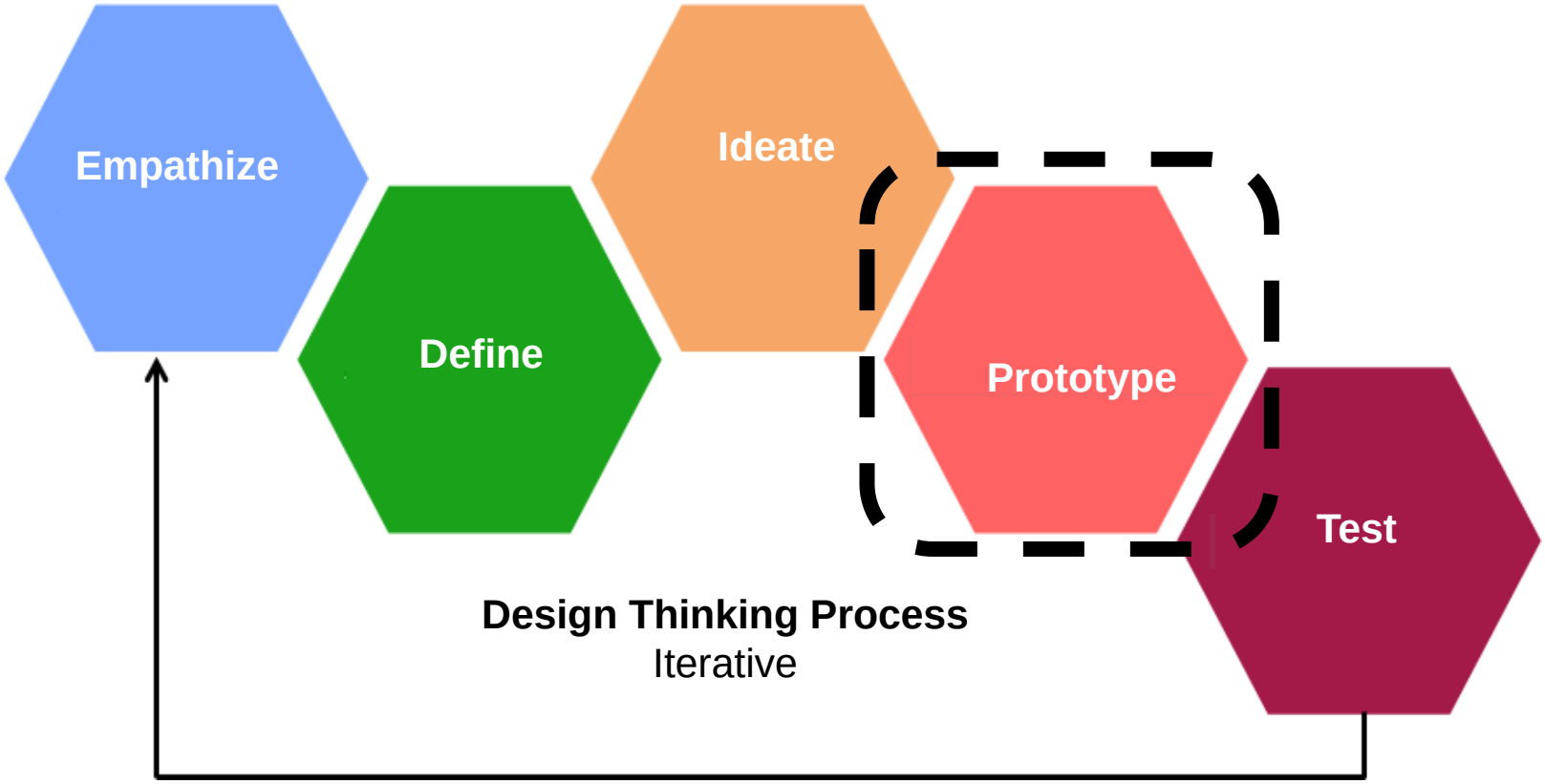


Image from: http://dschool.stanford.edu

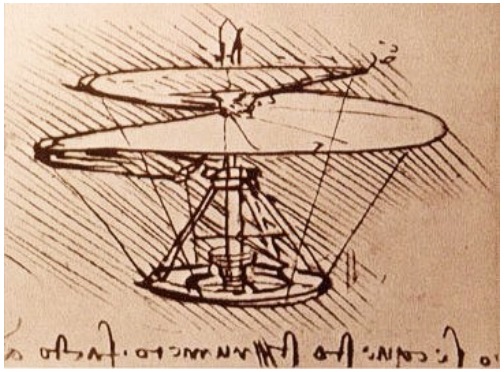
What is a Prototype?

- A prototype is a representation of part or all of a design concept to learn something 'useful'

http://www.scoopcar.com/images/ford/Ford-Evos-2013-Concept-05.jpg

Prototypes can be 'useful' for:

- Learning more about or Understanding a problem better (e.g. a sketch or drawing can be viewed as a kind of prototype for communication purposes)
- Communication or getting feedback from users (e.g. in the "Design Thinking" gift-giving exercise)
- Reducing the risk associated with a *particular* aspect ("focused" prototype) of a design
- Measuring performance often of the *overall* functionality ("comprehensive" prototype) of the design as with 'concept' cars



https://commons.wikimedia.org/wiki/File:Leonardo_da_Vinci_helicopter.jpg

What Makes a Good Prototype?

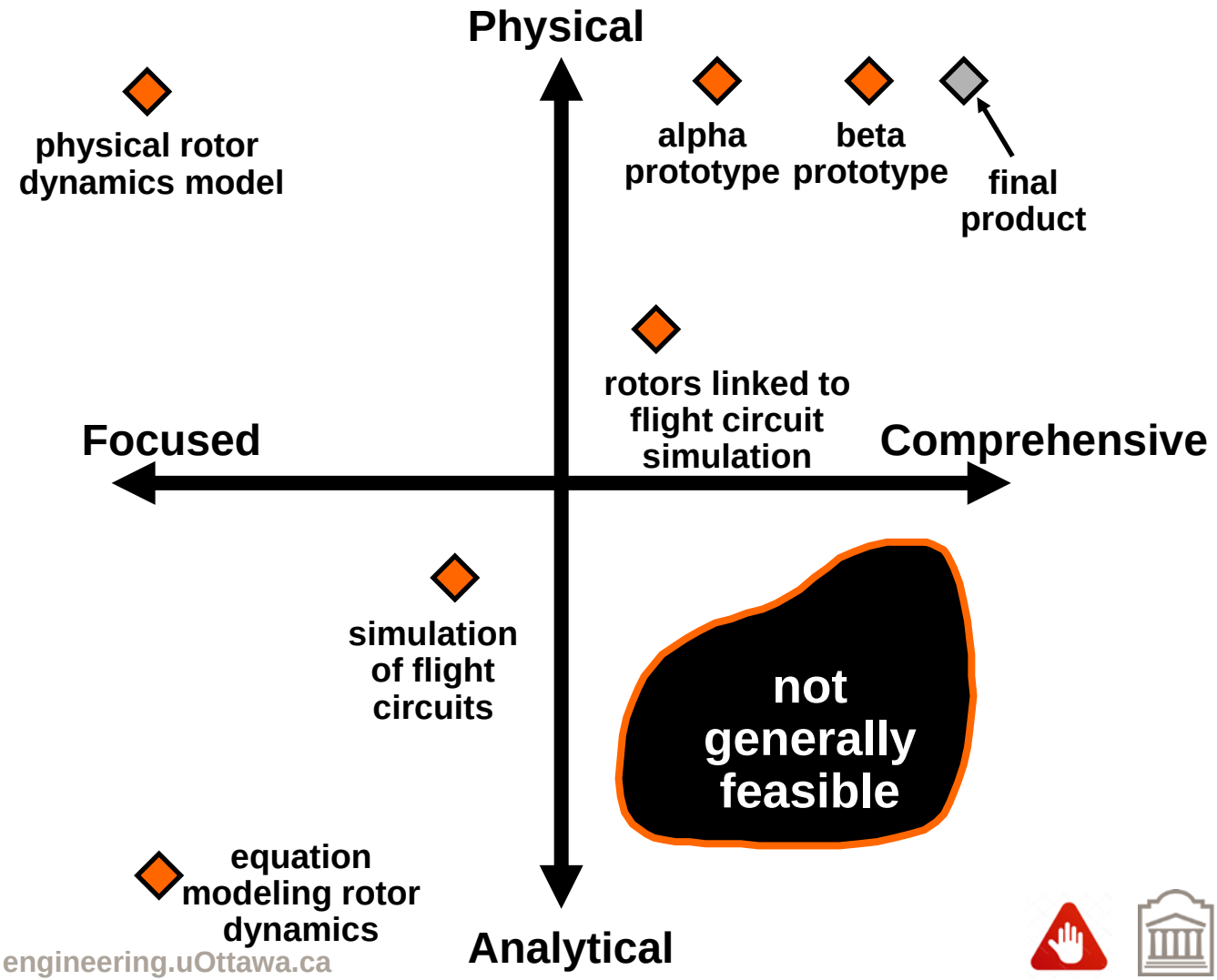
- Fidelity: Degree to which the prototype testing represents the final product/ process/ service under real conditions. Prototypes can be of high, medium and low fidelity.
- Cost: Total cost of designing, building, testing
- Iteration time: Time from designing to when analyzed results are available to plan another iteration
- Signal to noise ratio (SNR): Extent to which the variable of interest is obscured by experimental noise

Prototyping Objectives

- Reduce uncertainty
  - Having a defined purpose means that this is more likely!
- Different Types of prototypes
- Must plan the timing of prototype cycles
  - Early, simpler models can be used to validate initial concepts
  - Relatively few comprehensive models are really necessary (e.g. maybe just for integration testing)
  - Must plan some time to execute and then also to learn from any prototyping cycles

Different Types of Prototyping

Prototypes can be classified along two dimensions



Comprehensive or Focused?

Image from: http://blog.dailydoog.com

- **Focused** prototypes:
  - Implementation of one or a few attributes of the product
  - Answers specific questions about the product design
  - Generally several are required (e.g. stud finder control prototypes)

http://www.collectspace.com/images/news-030916a.jpg

- **Comprehensive** prototypes:
  - Implementation of many or all product attributes
  - Offers opportunities for rigorous testing
  - Often best for milestones (e.g. significant team progress deliverable) and integration (multiple sub-systems are being combined for the first time)

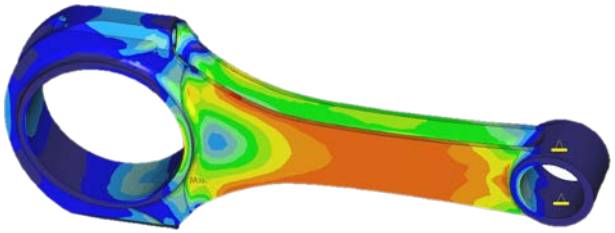
Image from: http://blog.dailydoog.com

Analytical or Physical?

Image from: http://www.deavita.com

- Physical
  - Tangible **approximation** of the product

    Q: How much detail is 'enough'?
  - May exhibit unmodelled behavior
  - Some behavior may be an artifact of the approximation
  - Often best for communication



- Analytical
  - Mathematical model of the product
  - Explicitly modeled phenomena (behavior not always anticipated!)
  - Behavior may be artifacts of the analytical method
  - Often allows more experimental freedom than physical models
  - Often cheaper and easier to modify

Example: Analytical or Physical?

- ***Volkswagen Golf 6 prototyping***
- Virtual crash test: http://youtu.be/ffV3jjsw52g
- Physical crash test: http://youtu.be/x0dnyPzgNNU

Prototype Fidelity

- In general, a prototype uses a simplified version of the final object, raising questions about fidelity (i.e. "trueness"). A prototype fidelity can be high, medium or low.
- Value of a model for testing:
  - Reduces the investment in time and money
  - Allows control of specific design aspects
  - Simplifies analysis tasks

  Example: Aircraft designers prototype a possible aircraft design with a scale model of the design in a wind tunnel. In wind tunnel tests, the models usually don't include internal designs such as cabins (expensive and irrelevant).
- Simulations can also be used to complement physical prototypes being tested
  - Fidelity question is still important and depends on the approximation or simplifying assumptions that are being made

Course Attendance: Registration

- Use your smartphone or laptop to **register/notify** your attendance in this lecture
- Allow **geo location** in the attendance site
- Accept **cookies** from third parties applications
- Log in using only your **Uottawa** account at the link below

  https://attendance.azarm.ca/attendancerecord/gng1103f

- Your attendance must be registered only **during the lecture** and at the **time specified by the professor**
- You can also use the **QR code** below, to register quickly

Testing

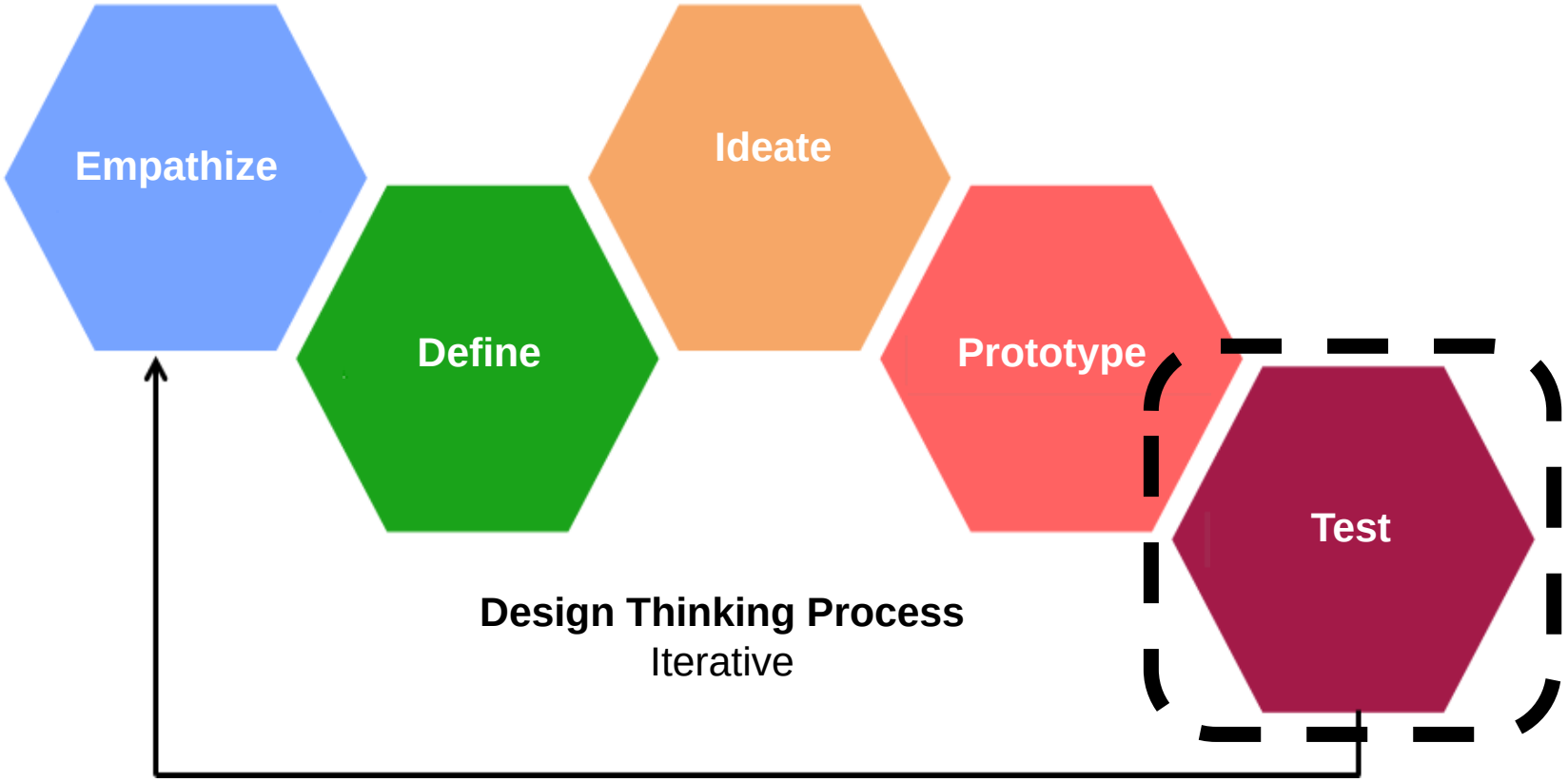


Image from: http://dschool.stanford.edu

Testing

- After prototypes have been created, they must be tested!
- By definition, prototypes are the first of their kind

⇒ They should be used for testing, testing and more testing!

Q: How does testing work and what are the benefits of doing it?

Benefits of Testing

- Avoid critical problems down the line:
  - Design flaws
  - Ease-of-use issues
- Helps ensure proper functionality
- Should help ensure that the user can figure out how to make it work too!
- Proper testing plan can save time and save money

Benefits of Testing Concepts

- Go / No-go decisions
- Deciding on what market to be in
- Selecting among alternative concepts
- Confirming concept selection decision
- Benchmarking (comparing performance)
- Soliciting or generating improvement ideas
- Forecasting demand
- Verifying assumptions and simplifications (analysis)
- Verifying if the product is ready to launch

Test Planning Steps

1. Define the **purpose** of the test

   Q: **What** are you trying to figure out or learn from your prototype?

2. Choose a specific design concept (or part of a concept)
   - Target **measurable** attributes

3. Choose a testing *method*

   Examples: analytical simulation, physical prototype test, etc.

4. Perform the test

5. ***Measure*** the important attributes, ***observe*** and ***record*** the results carefully

6. Interpret the results (i.e. are they applicable?) and document your conclusions, reviewing them with others

Ski Hill Case study – Prototype I

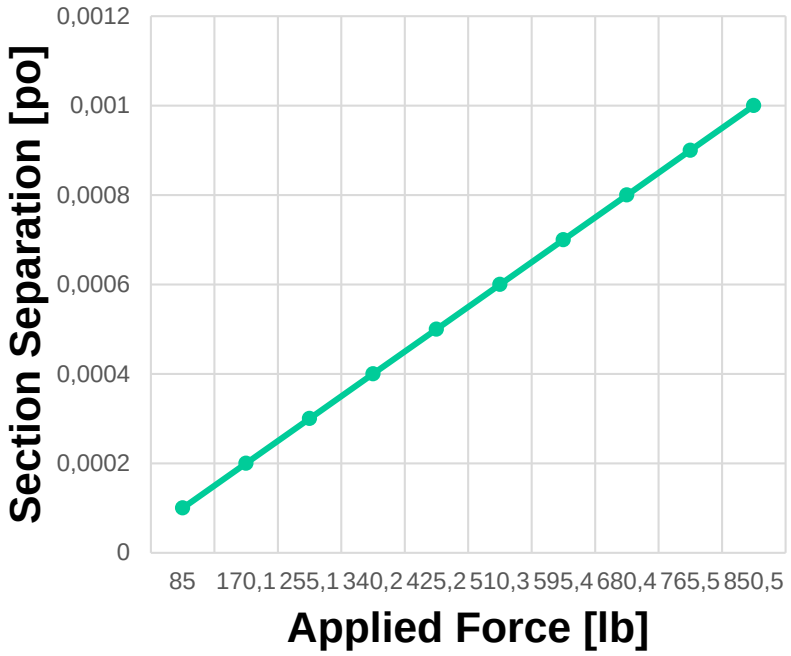
- **Objective**: Testing the tub mating performance when using different sections (low fidelity focused prototype)

Potential Separation (Variable Applied Force)

Section Separation (in)	*Applied Force (lb)*
0.0001	85.0
0.0002	170.1
0.0003	255.1
0.0004	340.2
0.0005	425.2
0.0006	510.3
0.0007	595.4
0.0008	680.4
0.0009	765.5
0.001	850.5

Module 05, Table 3

The dependence between the applied force and the section separation is linear



Ski Hill Case study – Prototype II

- **Objective**: Testing the storage mechanism, in the undeployed state (low fidelity focused prototype)

Ski Hill Case study – Prototype III

- **Objective**: Testing basic Deployed size and Handling of a Subject (low fidelity focused prototype)

Ski Hill Case study – Prototype IV

- **Objective**: Testing effects of vertical depth on brake force (low/ medium fidelity focused prototype)

Module 05, Figure 12

Depth and Brake Force Results

	Static Test	Slow Test	Fast Test
Depth (in)	Force (lb)	Force (lb)	Force (lb)
0	14.56	15.25	16
0	14.13	16	15.43
0.5	22	24	25
0.5	20	24	25
2	29	31	32
2	54	3	36
3.5	Exceeded Limit	47	43
3.5	Exceeded Limit	41	44

Module 05, Table 4

Ski Hill Case Study – Prototype IV

- **Objective**: Testing the brake force with controlled braking angle (low/ medium fidelity focused prototype)

Module 05, Figure 13

How Much Testing is *Enough*?

- Continue to create prototypes and test using them, iteratively, until:
  - You run out of time
  - You run out money
  - You run out of energy! ……..
  - You are satisfied with the results (i.e. you have achieved all of your objectives)

Q: Other stopping criteria?

Image from: https://www.tumblr.com/search/p:%20energizer%20bunny

Summary

- **Giving and Receiving feedback** can be done "productively"
  - Use basic format of describing the behaviour (in neutral terms) and its effect on you
  - Make sure your feedback is: specific, actionable, timely (for the event and for the receiver) and that you just speak for yourself
- **Prototypes** let you learn something or communicate something and they can be:
  - Focused or comprehensive
  - Physical or analytical
- When using prototypes, a test plan is essential
  - Define the testing objectives, prototype format and then observe, measure and record the results carefully, interpreting all results

Extra Time?

Exercise: Creating a Test Plan

- Using the workbook document in BrightSpace, in your project groups, create a test plan to create a 'focused' prototype and the associated test plan for that prototype for your GNG1103 project, replacing the italicized text in the document with your own
- Do this for:
  - The most critical aspect of your project or an important aspect with the most uncertainty (i.e. important enough and uncertain enough that the work is warranted)
  - The riskiest or the most important subsystem or both
  - Another part of your project that would benefit from prototyping for another reason