MENG 293

Project Management and Social Responsibility

Lecture Notes (2016)

1. Introduction

1.01 Sustainability

Sustainability is an important design consideration.

Since 1972 when the Club of Rome met and created their now famous and telling 'The Limits to Growth' report <link> the world has gradually come to see, more and more clearly, the problems we face. They are the problems of species success: over-population <link> , over-consumption <link>, over-waste production <link>, and environmental degradation <link>, to name but a few.

Is it worth working to correct these problems? Well, that question leads to some much larger questions. On a personal and human level, one might ask: what is the true point of anything anyway? Why should anyone really care? What, after all, is the meaning of life <link>? Does having more stuff really make people happier and more satisfied? <link><link><link>.

It is interesting to consider that everything physical will eventually end up as garbage. That is EVERYTHING. Your shoes, that bus you took this morning, the building you are in right now … everything. The more that is produced the more garbage there will be. The trouble with throwing things 'away' is that there is no 'away' anymore. 'Away' is right here – you live, more and more, in close proximity to everyone's garbage.

Where do these soon-to-be-garbage objects come from? The answer to this is simple. We produce them, of course. We buy them, use them, discard them. Even worse, we as THE designers, are the ones responsible for the production of objects that will end up filling up our landfills, polluting the waters and altering the skies. We are the ones. The ones who can transform this world into something better or speed its decline.

The consequences of failing to change our sightedness from the short view to the infinite are profound. We are the ones with the control, resources, and influence. Knowing that fact makes me want to say … DON'T MESS IT UP!

As people involved in engineering, we have a special responsibility when it comes to shaping the details that make up the future. Almost every object we interact with in this world has been designed, altered or been influenced by people. The "people" I refer to here are, of course, us. We are the designers and the creators. Every object has been created by people like you. You are the ones who make the choices that will influence every stage of a manufactured object's life: design, marketing, use, and disposal.

- Materials and Methods Selection: Choosing one material or another, one manufacturing, packaging, transportation, marketing method or another can have a huge impact on the user experience and the environmental impact a manufactured object has.
- Poor Design or Bad Marketing: Created a very short product life cycle enables the product to enter the landfill years sooner than it might otherwise. Additionally, when a product is a flop other successful products must be made to fill the gap left by the failure and, as always happens, the successful product will eventually go out of service and enter the landfill. One product failure has a double impact on resource use and a large environmental impact.
- Bad or Dangerous User Experience: Bad design hurts people – those shoes that always give you blisters, keyboards that lead to carpal tunnel syndrome, vehicle controls that make it hard to do the right thing prior to an accident, lead additives in plastics used to make kids toys that create brain damage, folding Ping-Pong tables that cut people's fingers off, candies that, as they melt, produce razor sharp edges in your mouth that cut your tongue, etc., etc.

Good product design means thinking of everything. Good engineering means thinking of everything. When is the best time to start producing great designs?
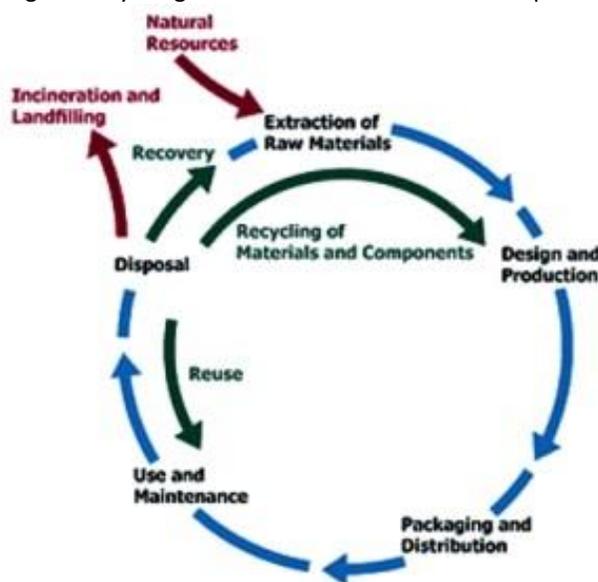
As always, the best time is Now.

2.   Design & Sustainability

Once the light has started to dawn and you begin looking at the common objects around you as things that *people created* rather than gifts from an unknown place, you will be ready to start doing what designer do. Their main task is to "think of everything". Don't get too worried about this. It is you and your fellow designers who define how big the boundaries of your design might be. You get to define what "everything" is, within the context of your design. As time goes by "everything" will get bigger and bigger. Your designs will get better and better.

2.01   Core Design Processes

At the core of design are a number of important processes that everyone uses. Each design or design group has a different perspective on these core elements but if you closely examine what any designer does, they are all there. They are:
- Integration;
- Design Rule;
- A Design Process; and,
- Creativity.

(a) integration

When you create something new you draw together knowledge, experience, and observations that you have spent much time accumulating. To create even the simplest things requires the integration of a great deal of information.

Think about it. To re-design even such a thing as the lowly paperclip requires a wide array of facts, knowledge, and observation. You will need to observe how the client wants to use the new paperclip (perhaps … holding sheets of Filo Pastry together so they can make the rather wonderful Baklava <link>. If you have never tried it … do so. It is out of this world!).

How strong are these ultra-thin sheets of pastry? How many sheets will need to be held together by the new FiloClip®? What should you make the FiloClip out of? How big should it be? Should the wire surface of the clip be ribbed, the way older paper clip versions are? How big are the hands of the users of the FiloClip? How strong are those hands? How many times a day will each pair of hands need to clip filo pastry in the way they will need to? Will the new clips get wet? Need to be reused? Interact with other equipment or machines? Have a specific coefficient of friction? Have a certain spring constant? How will you make these clips? Will a new machine need to be designed to bend them into their shape or will you mold them from plastic or maybe, if you are clever, you can make the clips from some sort of pastry so they can be attached but do not need to be removed … hmmm … now that IS ingenious!

Lots of information needs to Integrated to form even the most straightforward design.

The more information you and/or your design team have at your fingertips the more design freedom you will have.

Once you graduate as Mechanical Engineering Type, you will be very familiar with a few areas of esoteric knowledge that most others do not possess. While working for a living you will be asked to integrate this knowledge to form a wide variety of designs. Specifically, these areas are:

- **Materials**: make something out of something - metals, plastics, wood, composites, bio-matter, etc., etc.;
- **Fluids**: water (cooling, drinking, floating), fuels (gas, liquid), air (fly, breath);
- **Heat**: keep it cool, get it hot, melt it, minimize fuel use, maximize control;
- **Control**: get everything coordinated and have it do what you want, every time it runs; and,
- **Communication**: tell others what your design is, how it will work, how to operate it, tell automated machines what to do to make it.

As you might suspect, in the years to come, you will learn much more. Gradually you will see our life's accumulated knowledge synthesised into your beautiful designs and, as a natural consequence, your worldview will become much, much broader.

(b) rules of design

Over the years I have developed six rules to help me through the design and implementation process.

They did not all come at once. In fact, I think my first rule occurred to me when I was an engineering student in Toronto in 1979. The other rules followed year

after year with rule three occurring to me while I was teaching and formulating (that order) an engineering ethics class in Victoria, BC, Canada in 2010. Rule three really is a major motivator and has had a major impact on my work as a designer.

Here are the rules:
1. If it works, it's right.
2. If it looks good, it's right.
3. If it does no harm, it's right.
4. Don't fall in love with your designs. Love hurts.
5. The client always pays ... for everything. That's their job.
6. A design is never done. You just run out of time.

1. If it Works, It's Right
Function. That's what this rule is about. Like folk art, product design has the goal of producing something that somehow has a use or function. In other articles, I'll be focusing on what 'function' is, but for now, let me just say that that it is multi-faceted. For example, a pencil has the obvious top-level function of making marks on a page. It also has the function of interacting with your hand so you can maintain a degree of control over its operation. These are both functions. They are both equally important but not equally obvious. If one made a pencil out of graphite Jello (Orange is my favorite) it might make marks on a page but you would have a great deal of trouble maintaining control of it as you held it your hand. That would be a fail!

2. If it Looks Good, It's Right.
Form. How something appears influences how you feel about using it. Choosing to use something ugly or beautiful, sleek or angular says something about you. After all, you chose to use that particular device. I walk the streets sometimes marveling at what people are wearing - some fantastic some atrocious. These people I am watching woke this morning and had to make an effort and choose to wear what they have on. Someone is atrocious by choice! It's a statement. The same thing is true in product design. If you choose a Jello Pencil it says something about what you are thinking about, how you view the world and how you want others to regard you.

3. If It Does No Harm, It's Right.
Have 'no harm' come from your life's efforts. There are all sorts of ways that a design and the physical object that emerges from it can help the world and better society and the people within it. Conversely, there are a great number of

ways a design can be harmful. In many ways, the idea of a design doing GOOD and, alternatively, doing BAD, is one of my primary areas of focus.

A design that does GOOD is one that helps people, society, and the environment. This sounds grand but it isn't really meant that way. It is a simple thing.

Does a new Tea Cup do GOOD? Well, yes, in one way at least. By enabling a person to enjoy a wonderful cup of tea, most certainly it does some form of good. It makes the user happy. What could be more important than that? Bringing joy. Success! On a larger scale, does the Tea Cup help society? Does it help the environment? Goodness. When looking at a simple Tea Cup, it's hard to say.

It is easier perhaps, to invert the question: Does the Tea Cup, at some level DO HARM? That is, I think, often easier to visualize and articulate. If the Tea Cup were made from a radioactive metal (Uranium for example) one could quite rightly say it represents a serious hazard at many levels: the user would eventually die from cancer by using it or even storing it at the back of the kitchen cupboard along with all those other unused 'gift' tea cups that have accumulated there over the years. The radioactive cup would also become toxic waste of the most serious kind when thrown away. The Tea Cup is most definitely BAD! Not only it toxic but it would cost way too much to make and transport. The company who took it on as a product would undoubtedly suffer financially from their ill-considered choices. The radioactive Tea Cup is a BAD idea. It does not pass rule 3 - it most certainly does harm.

Oddly, the radioactive Tea Cup is still BAD even though it may bring the user joy. Joy, that is, for the short remainder of the user's short life. Joy it would seem takes a back seat to harm.

In future pages and posts, I'll be talking much more about the myriad ways a design can 'Do Harm' and how to correct a design so that it ultimately becomes one that DOES NO HARM. This conversation will involve the idea of making objects that:
- Are useful and safe to the user (really rules 1 & 2);
- Are environmentally sustainable; and,
- Are profitable for the company.

These are the three cornerstone ideas around the concept of 'does no harm'. For a design to be right it has to pass this rule in all three categories.

Our world is built one design and one product at a time. If ALL designers and producers chose to make each new product conform to rule 3 from now on, after just ONE product life-cycle, everything in the world would be different: users would be happier, EVERYTHING around you would be environmentally sustainable and companies would more profitable. A tall order? Not really. It's simply about the choices you make at the drawing table. The choices designers make. The choices you make every minute of every day as you work for a living. Follow rule 3.

4. Don't Fall in Love with Your Designs. Love Hurts.

Love. So you are working in a team and you all kick out ideas. Your ideas are the best. Naturally, they are. You love your ideas. Why? Because they are yours and, yes they are, they are the best. By far. One day you have an amazing idea. Way better than the others ones you have had. You nurture it. Develop it. Keep it close. At the next design review meeting, you take the plunge. You tell your team about that incredible idea. The one you have come to love and cherish above all others. When they hear it, an odd thing happens. Your teammates, the people who you have grown to know and trust, look at you and shrug. Some look away. Some stronger souls say to you, in that diplomatic way you have heard before directed toward others, "that's a ... (cough) ... 'interesting' idea". Then they move on. THEY MOVE ON! They have rejected your idea. They have rejected YOU! They have spurned YOU. How can you trust them ever again? HOW! Whaaaaaaaaaaa. Whaa. Whaa.

Ya, you get it. Love is love. You can, and will, be rejected and each time, if you are in love, it will hurt.

Designs are NOT people. Don't get confused and mix them up by this subtle point. Not all love is the same.

Designs and ideas are like water, they flow by endlessly. You just have to be practiced and flexible enough to keep re-creating until you find a set of ideas and designs that conform to rules 1, 2 & 3, and also are accepted by your team. Don't fall in love ... with your designs. People, yes. Your designs, no.

5. The Client Always Pays ... for Everything. That's Their Job.

Money. Money is the lubricant that keeps a project moving along. It is one of the unfortunate realities of professional life that without the availability of cash a project just won't be all that successful. The client has a number of important roles to play and one of these is to provide the money to make it happen. In exchange, you do whatever it is you need to do to successfully get your part of the project done on time, with a reasonable level of quality. The client may be your boss, your mom, a friend or a real private entity. Payment may be money (boss, private entity), cookies (your mom) or beer (a friend) ... plus actual

money for gas, hotel, food, air travel, internet usage, the taking on of extra staff to help achieve a deadline, plus lots of coffees at that amazing coffee place around the corner. They are amazing ... and the client pays for those coffee's too (you just don't invoice it that way).

6. A Design is Never Done. You just Run Out of Time.
Shortness of Time. Bummer - you delivered the design package to the client last Friday. It was pretty good but there were still a few little things that could have been done differently and better. There was just not quite enough time to do it completely and to do it absolutely right. Ah well, you say ... On to the next project.

Time is the one resource that truly has hard and fast limits. If you run out of time, you run out of time. You can't get any more. The sooner you accept this the better. The other thing that you need to accept is that no matter the job you are doing, the number of things that need to be done to take care of everything perfectly is INFINITE. Your to-do list is forever long. You don't have forever and nor does your limited team. You will not get it completely finished before it has to be delivered. You simply won't. Accept this fact and know that your client will never notice. You, however, will remember forever.
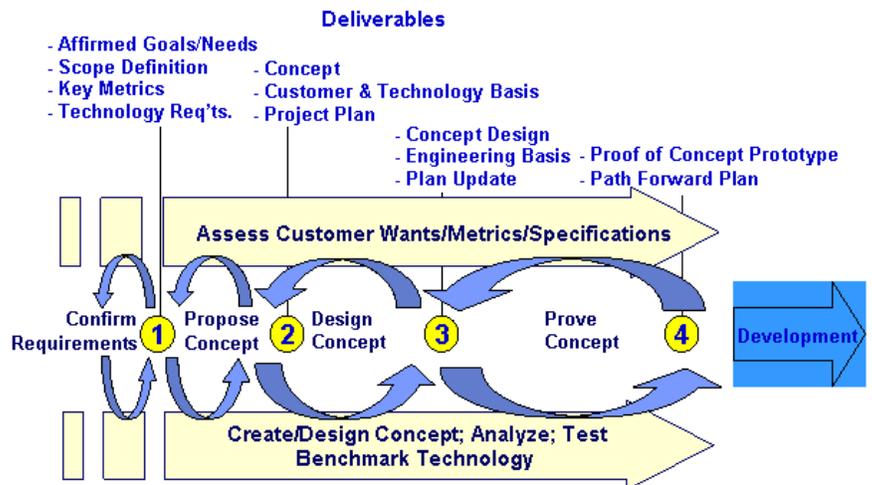
How do you deal with this irritating fact of life? Easy. Do the important things and, if you have time (ha!) do the rest.

(c) design process

1. <u>Determine a need or want.</u>
   This might come from you or your client.

2. <u>State the need or want in the most general way possible.</u>
   Don't be afraid to deeply examine and maybe even totally revamp the original idea and concept.
   (Work with the client on 1 & 2 and then go away and have a good think. Come to your own conclusions and then present your thoughts to your client. To be successful at this point you need to become a people-person ... for a while.)

Project Phases

Deliverables
- Affirmed Goals/Needs
- Scope Definition
- Key Metrics
- Technology Req'ts.
  - Concept
  - Customer & Technology Basis
  - Project Plan
    - Concept Design
    - Engineering Basis
    - Plan Update
      - Proof of Concept Prototype
      - Path Forward Plan

Assess Customer Wants/Metrics/Specifications

Confirm Requirements ① Propose Concept ② Design Concept ③ Prove Concept ④ Development

Create/Design Concept; Analyze; Test Benchmark Technology

3. <u>Think up at least 10 concrete solutions.</u>
    Do this in a non-judgemental way. Let your creativity run wild. "Crazy" ideas are great – they set you free. Doing this with a group is more fun and you will come up with many more solutions, faster.
    (This is the creative step. You have to think differently here. Become an artist for a time.)

4. <u>Evaluate your solutions.</u>
    Will they work? Do they conform to the laws of physics? Will the costs be low enough? Let the best ideas float to the top and keep one or two for a more detailed analysis.
    (Don't make it personal. You will be working with your team for a long time. Don't fall in love with your idea – love hurts. Be logical, rational, non-emotional for now.)

5. <u>Analyze your solutions.</u>
    *   Apply mathematics and a variety of engineering equations, standards and norms to determine if your design will, in fact, work.
    *   You will use analysis to predict the design's performance (predict the future before it really happens!)

    Based on your analysis you will likely re-design and re-analyze part or all of your design many, many times before you are done.
    (This is what you learn to do in school.
    Do it well – you are predicting the future after all.)

    UNCERTAINTY / PATTERNS / INSIGHTS   CLARITY / FOCUS

    RESEARCH   CONCEPT / PROTOTYPE   DESIGN

6. <u>Build one and try it.</u>
    Does it physically work? Can it be built? Are there any interesting surprises? Does the physical model give you or your client any ideas? Make sure you budget to build at least two prototypes of a new device.
    (You learn this in school too, but a good deal of it comes from life experience. Fabulous communication and people skills are important here.)

7. <u>Re-design for manufacturing.</u>
    There is a big difference between the way things are designed for a one-off build, versus a manufacturing build, where a million are made. Often a team of manufacturing engineers is employed here to help out.
    (Control yourself – it can only get cheaper.)