Dr. David Ullman’s Quotes

Design Aphorisms appear throughout The Mechanical Design Process

Aphorisms are terse statements of the truth. Over 75 aphorisms appear in The Mechanical Design Process. You can use them to make your point, inspire others, or just to add something clever or inspiring to your environment.

Suggest your favorite pithy engineering truths for inclusion in the list. If accepted for addition, you will be given attribution and sent a free copy of The Mechanical Design Process Case Studies.

**Chapter 1: Introduction to the Mechanical Design Process**

* The design process not only gives birth to a product but is also responsible for its life and death.
* Design problems have many satisfactory solutions but no clear best solution.
* A design paradox: The more you learn, the less freedom you have to use what you know.
* Human beings don’t have a pollution problem; they have a design problem (The Upcycle, W. McDonough and M. Braungart,2013). (also, in chapter11. OOPS)
* You are responsible for the impact of your products on others.
* Constraints are often opportunities in disguise.
* Everything is uncertain
* Better, faster, cheaper – choose two.
* The results of most design methods can be thrown away. Their value is in the process followed and knowledge gained.
* Mechanical design progresses from function to form, yet ugly products seldom work right and don’t sell well.
* Complexity grows faster than you can understand it.
* Question every feature: Can I eliminate you?
* You can’t tell a differential equation to stay off the grass.
* It's better to make half a product than a half-assed product. From “Getting Real”.
* Perfect is the enemy of good enough.
* Less bad is not good.
* If I were given one hour to save the planet, I would spend 59 minutes defining the problem and one minute resolving it”. Albert Einstein

**Chapter 2: Understanding Mechanical Design**

* Designers cost little, their impact on product cost, great.
* Product cost is committed early in the design process and spent late in the process.
* Fail early; fail often; repeat. (Chris Bouwmeester)
* Function determines form and form, in turn, enables function.
* A skilled designer speaks many languages.
* Most design problems are redesign problems since they are based on prior, similar solutions. Conversely, most design problems are original as they contain something new that makes prior solutions inadequate.

**Chapter 3: Designers and Design Teams**

* All design and decision-making are governed by human cognitive capabilities.
* Designers cost little, their impact on product cost, great.
* If you try to think about what you are doing while you are doing it, you stop doing it. If you don’t reflect on what you just did, you are doomed to repeat it.
* The odds are greatly against you being immensely smarter than everyone else. John R. Page Rules of Engineering
* A team is a group of people in search of a common understanding.

**Chapter 4: The Design Process**

* Quality cannot be manufactured or inspected into a product; it must be designed into it.
* Design is a process not just building hardware.—Tim Carver, OSU student, 2000
* Developing of a concept into a product without prior effort on the earlier phases of the design process is like building a house with no foundation.

**Chapter 5: Project Definition**

* Design is the technical and social evolution of information punctuated by decision-making.
* If you do not know where you are going, you cannot know when you get there (modernized from “Our plans miscarry because they have no aim. When a man does not know what harbor, he is making for, no wind is the right wind” Lucius Annaeus Seneca (4 B.C. – A.D. 65)
* Design is an iterative process. The necessary number of iterations is one more than the number you currently have done. This is true at any point in time. John R. Page, Rules of Engineering
* A task that only describes an activity is done when you run out of time.
* Everything takes twice as long.
* A plan is a “work breakdown structure” because without one the Work remaining will grow until you have a Breakdown unless you enforce some Structure on it. John R. Page, Rules of Engineering.
* A plan is only valid until you start working on it.

**Chapter 6: Product Definition**

* All design problems are poorly defined.
* Your decisions, good or bad, affect everyone downstream.
* You only think you know what the customers want.
* One man’s treasure is another’s trash. Both will judge your work.
* To steal from one person is plagiarism, to be influenced by many is good design.
* Find the target before you empty your quiver.

**Chapter 7: Concept Generation**

* If you generate one idea, it is probably a poor one. If you generate twenty ideas, you may have a good one.
* Or, alternatively
* He who spends too much time developing a single concept realizes only that concept.
* Most of your best ideas wind up being useless in the final design. Learn to live with the disappointment and take joy in the successes.
* Function happens primarily at interfaces.
* To steal ideas from one person is plagiarism; to steal from many is good design.
* Try to not reinvent the wheel .
* Patents give you bragging rights and license to litigate.
* Follow the KISS rule: Keep it simple, stupid.

**Chapter 8: Concept Evaluation and Selection**

* If the horse is dead, get off.
* It’s hard to make a good product out of a poor concept.
* Risk is uncertainty falling on you.
* The problem with designing something completely foolproof is to underestimate the ingenuity of a complete fool. Douglas Adams
* All decisions are based on incomplete, inconsistent, and conflicting information.
* The odds are greatly against your being immensely more knowledgeable than everyone else.

**Chapter 9: Product Generation**

* Complexity occurs primarily at interfaces.
* Determine how constrained a component needs to be, and constrain it exactly that amount – no more, nor no less.
* Components grow primarily from interfaces.
* Triangulate! Unless you have a very good reason not to.
* Forces flow like water. Failures occur mainly in the rapids.
* Design perfection is achieved not when there is nothing more to add, but rather when there is nothing more to take away. Antoine de Saint-Exupéry
* When in doubt, make it stout, out of things you know about.

**Chapter 10: Product Evaluation for Performance and the Effects of Variation**

* Every feature added brings with it new intended functionality. It is unintended functionality that can hurt you.
* Evaluation always requires a clear head and twice the time you estimated.
* Know how to control what you can, make your product insensitive to what you cannot and be wise enough to know the difference.
* An inaccurate model is inaccurate no matter how small the variation.
* Nothing is deterministic, everything uncertain.
* Hand fitting parts is fun when making a prototype, a disaster on the assembly line.
* You can’t BS hardware.
* Costs generally increase exponentially with tighter tolerances.
* She who does not design a robust product will be cursed with unhappy customers.
* A robust design is insensitive to noise. Noise is what the designer cannot control or chooses not to control.

**Chapter 11: Design for Cost, Manufacture, Assembly, and Other Measures**

* Eighty percent of the cost is incurred by twenty percent of the components.
* Product cost goes down exponentially with increased production volume
* If you don’t have experience with a manufacturing process you want to use, be sure you consult someone who has— before you commit to using it.
* Design for assembly is important only if assembly is a significant part of the product cost.
* A single part costs nothing to assemble. M. M. Andreassen
* Every fastener adds costs and reduces strength.
* Make it fail where you want. Design in mechanical fuses.
* You are responsible for the resources used in your products.

**Chapter 12: Wrapping up the Design Process and Supporting the Product**

* Documentation is like the poor crust on a good pie, you must eat it to clean your plate.
* Only a perfect product will never change and there is no such thing as a perfect product.

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