Notes on Discussion of the Method

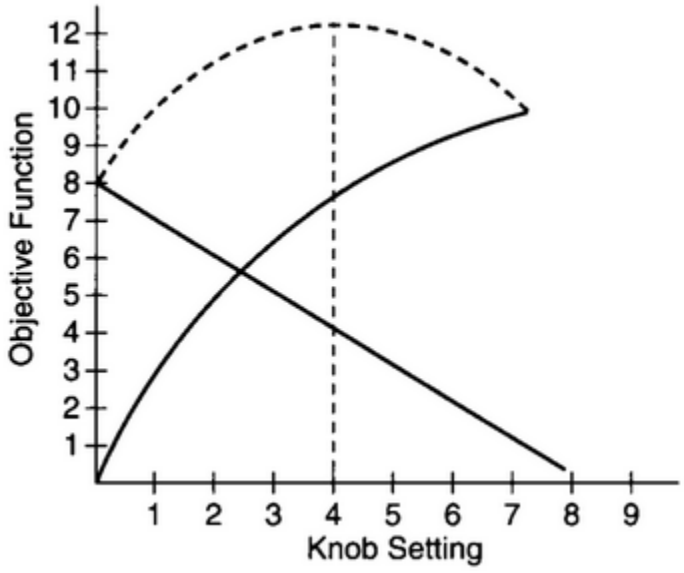
Discussion of the Method is a book near-perfectly written for postrationalists but for its publication date of 2003. As far as I can tell, it was mainly used as a resource for a class which the author (Billy Vaughn Koen) taught at the University of Texas at Austin. This is how I found out about the book – I was at a dinner talk with an alumnus from Koen's department; that alumnus listed Koen's class as the most impactful class he took during his time at the college.

First, who is Koen? People older than me may remember a website called YTMND – allegedly, a meme of him speaking daily affirmations called KOENMND was popular there. Aside from that, he's a chemical engineer from UT Austin with a doctorate in nuclear engineering. Before his retirement, he was a beloved professor and is clearly well-remembered among alumni.

Part of why I think of this book highly is both its structure and meter toward its end goal of convincing the reader of the engineering method. I would never claim to do this as well as the author – this is just a glowing review of the book and I urge anyone reading this to also read the book.

The first chapter of the book contains notes on the engineering method; some words of note are "best", "change", "uncertainty", and "resources".

First, "best": Engineers tend to pick the best solution for the situation, but what does "best" refer to? This depends. Different people have different objective functions, each with their own tradeoffs. Koen uses this graph as an example.



Next, "change": What engineers do is change a situation. Now, whether they can quantify the change of their solution is another question; nonetheless, this is their job.

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“Resources”: A change can only be made with resources. The availability of resources in a project may constrain it; a solution is only consistent with its resources, not the ideal.

“Uncertainty”: We cannot quantify the platonic ideal of a solution, the effects of a change, nor the true amount of resources we have available.

These are the basic concepts he presents to the engineer, which are commonly run into. I have worked on projects in which the best solution was disagreed on, whether due to constraints (is this the best thing that we need to spend our time on?), resources (is there equipment that a) works with process control software and b) can interface, and convert digital and analog signals?) and change (to what extent should a pre-existing system be modified?). All of this comes daily.

How do we deal with this? In the second chapter, he defines the engineering method as “the use of heuristics to cause the best change in a poorly understood situation within the available resources.”

What is a heuristic? It is itself one given that there are no good definitions of it. Koen settles on “anything that provides a plausible aid toward a solution but is fallible in a final analysis.” It is left to the reader as to why this is also a heuristic. To recognize on in the wild, one can check for the following:

1. does not guarantee a solution.
2. can contradict another heuristic.
3. reduces search time for a solution.
4. depends on context, not absolute standard.

There is a set theory expression of this that he goes into detail about. I will not. Two examples he gives which I love are:

1. allocate resources to the weakest link.
2. solve problems by successive approximation.

Are there times when these conflict? Absolutely! The weak link may change as the solution changes over successive approximation. If one thinks of a problem as a set of sine waves which oscillate between ideality and non-ideality, local minima may, at different times, have different weak links.

Another heuristic is the state of the art (sota). One is a product of their times and what constitutes good engineering in 1921 may not be that in 2024. Engineers are judged by the engineers of their times. At one point, the New York City metro was the sota; now it seems a bit dingy in comparison to other international cities.

Finally, engineers’ goals, heuristics, and sota are not the same as society’s. Oftentimes a design is a compromise with society in unforeseen ways. Societies

may want silly things such as highways through a downtown area. Engineers must not only negotiate among themselves but also the public at large.

The final heuristic is:

1. to know the best heuristic is to use the best heuristic.

The third chapter discusses some of the heuristics commonly used by engineers. There are two issues with heuristics. First, if all is heuristic, it is disconcerting to accept any engineer at their word; would you trust a car which was designed via time-saving shortcut? Second, what are heuristics compared to? When we look at a solution, are we supposed to compare it to the ideal? If so, what is the ideal, and is there one? When Plato brought the world of forms into existence it must have contained the concept of a car. Given the existence of tradeoffs, there can be no ideal solution as each solution is the function of the problems and constraints it is built to solve. An engineering solution is simply the best given its function. Thus:

1. the engineering solution to a problem has no reality apart from the heuristics used to obtain it.
2. Everything in engineering is heuristic.

Koen then attempts to prove this by attacking induction. Given that philosophy cannot seem to decide on basic concepts such as cause and effect, it requires a further look. Given that it is not settled, the engineer must take induction as a heuristic. He proceeds to cover a number of heuristics – one that I find useful is for safety; that if one is designing a system that could harm people when failing or not failing, over-design it. Usually, it’s nice to have 1-2 additional safety systems in place. If the goal is to control, say, temperature, look at flow rate, reaction rate, and pressure as well to control temperature by proxy.

Another heuristic that rationalists may be found of – quantify or express all variables in numbers. QALYs (quality-adjusted life year) are one such attempt to flatten the rich experience of a human life into numbers.

“Always give an answer” – the role of an engineer is to give the best answer possible.

“Work at the margins of a solvable problem” – for there is no point in reinventing the wheel.

“Make small changes in the sota” – the state of the art is likely a local minimum and there is likely a more stable minimum. but the change between the two may cause harm.

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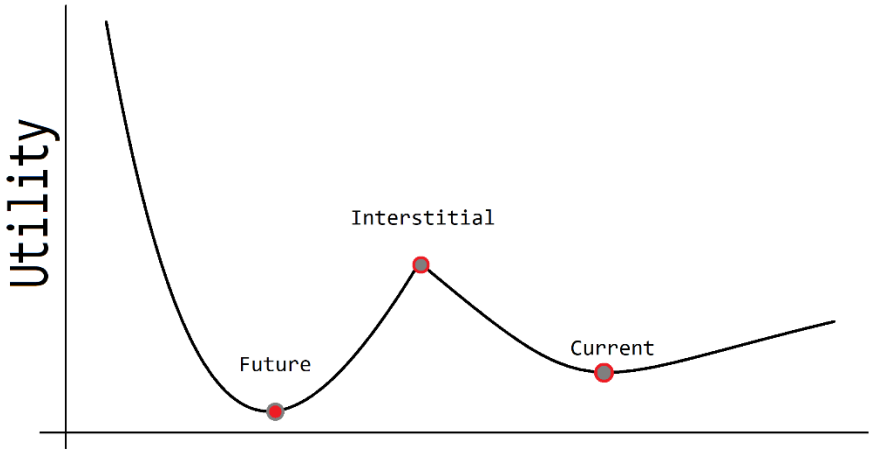
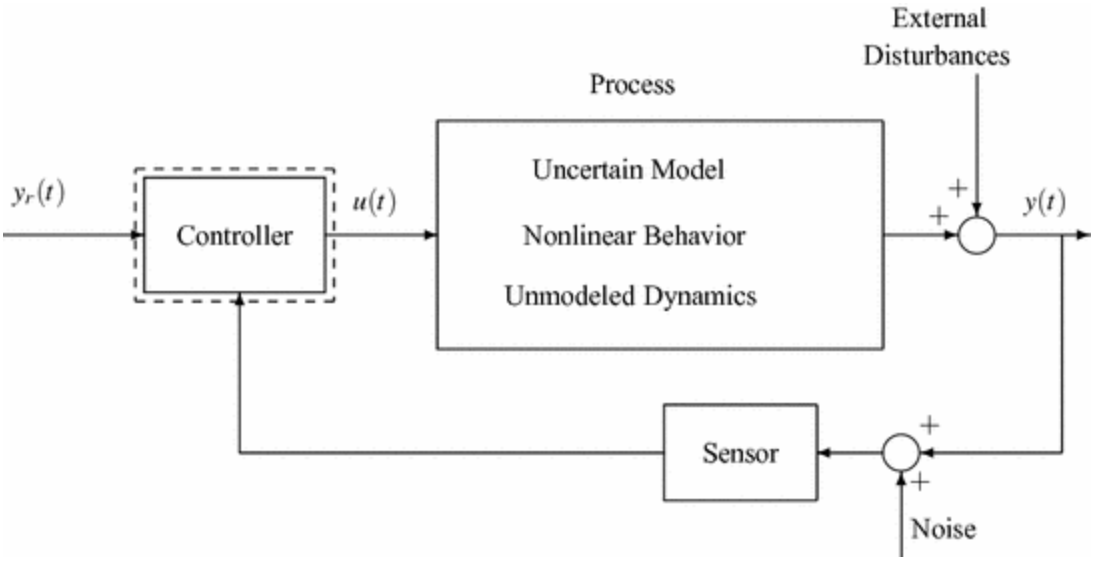


“Always give yourself a chance to retreat” – consider multiple designs, have a backup plan. This will cost more money and time.

“Use feedback to stabilize engineering design” – learn from your mistakes and carry on.



“Make the minimum decision” – each decision you make narrows the space of available further options.

“Break problems into manageable pieces” – a complex issue is oftentimes only soluble by looking at its parts.

An engineer who has had any experience can likely think of scenarios where they used these heuristics, consciously or not.

Now, Koen must consider alternatives to his definition in his prior requirement to use the sota. The first is that of Polya’s engineering morphology:

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1. understand the problem.
2. devise plan
3. carry out plan.
4. Look back to check solution.

What are the issues with this? A fixed structure such as the morphological list cannot capture the full range of engineering problems, changes, and solutions. Do engineers hold this list in their heads? Probably not. Though not an actual definition, this framework can be held in one's mind as a heuristic.

The second is the definition of engineering as an applied science. This cannot be true. Science generally points toward a greater truth, engineering the best solution. While not at odds, these vectors need not be identical. Generally, engineers do use science; thus, use science as a heuristic.

Another is engineering as trial and error. The issue in this definition is that engineers restrict their solution search space prior to design such that there is no brute-forcing as trial and error implies. Though this does serve as a heuristic for some problems.

If we look at the prior definitions of [best/change/uncertainty/resources] we may have an internal definition of engineering as problem solving. However, problems are not universal such that a universal engineering cannot be designed by problems alone. One feels most comfortable at 64F, another 75F. A thermostat at 74F is more of a problem for the warm-blooded. Furthermore, it is likely that any solution is not the only solution, but possibly the most practical – we only can do the feasible within the constraints of sota and time. Thus, this can be a heuristic – engineering is problem-solving, goal-directed, and need-fulfilling.

So, what uses these heuristics? Nature, for one, uses successive approximation, is capable of retreat, works within bounds, and so on. It is not that nature has a mind of its own but rather confirmation that these heuristics are near-absolute.

To return to Koen, his final definition of the engineering method is: "heuristic: the engineering method is the use of heuristics to cause the best change in a poorly understood situation within the available resources."

What else is a heuristic? Time is. Like induction, we cannot completely agree on what time is, let it be real, linear, etc. Rather, it is a heuristic we use via induction. Everything exists in reference to another time; it is not an independent quality. If time is such a heuristic, then those functions of time, such as change, are too. Change is ~dX/dt, after all. Best is also relative to the sota of the time; resources may vary over time; and uncertainty (hopefully) wanes over the course of a project. Thus, we can simply Koen's definition to "heuristic: use engineering heuristics"

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How do we know if this heuristic works? If the present world proves accurate the sota of past engineers, you will find that engineers typically reach their goals.

“Heuristic: use engineering heuristic” may not sit quite right. First, is the use of said heuristic not one in itself, and therefore fallible? If so, one must admit to some higher truth that the engineer may rely on instead of circular reasoning. The issue Koen runs into here is that all is heuristic. This seems like a difficult proposition, but the argument starts here:

1. Each domain has a set of self-evident heuristics.
2. each domain must fall under the set of all heuristics.

From what little I’ve taken from a completely separate domain (music theory), this seems accurate. We still take some rules in mind to simplify the search space for composition.

Language is another domain. When we speak, we are grasping at the meanings we wish to communicate rather than actually transmitting those meanings. The phrase “Sarah told Billy to walk to the pier” raises with it multiple connotative meanings depending on emphasis, and this is just in English. When translating Chinese to Latin, any connotations may be entirely lost.

Furthermore, language fails to describe the imperceptible. The colorblind may not be able to describe the difference between red and green; that still exists.

If not convinced, here are notes on this section of the book regarding language. I do not want to format this in an image editor.

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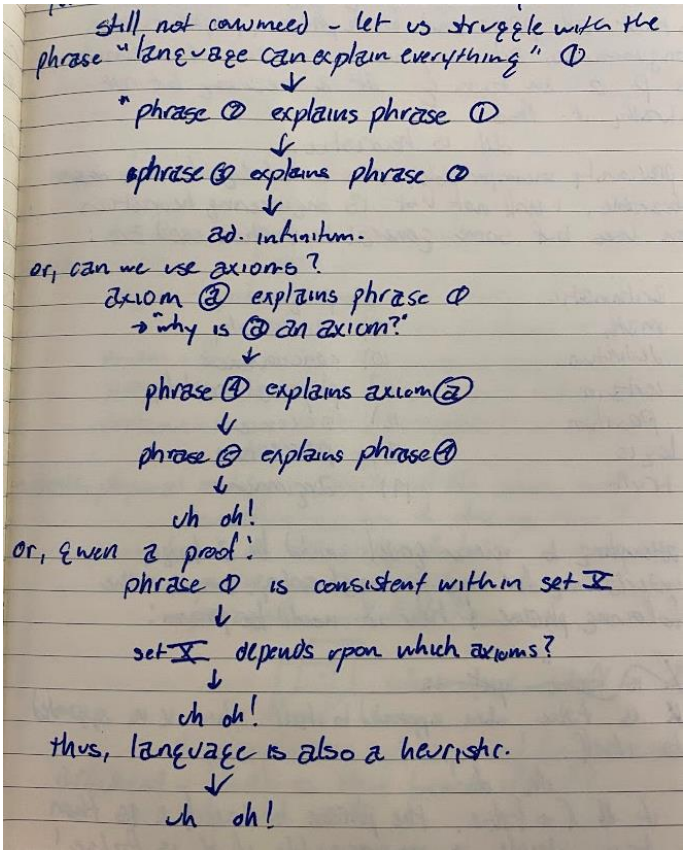

The issue with declaring language as a heuristic is that all prior and future phrases, prepositions, conjunctions, adverbs, nouns, etc., are also heuristics, all pointing at a meaning but not actually it. Thus, Koen resolves that all is heuristic.

Previously uncomfortable, this set of logic becomes nearly unbearable. I will not list in detail all 13 heuristics Koen mentions, but some are:

1. arithmetic
2. math
3. deduction
4. certain
5. position
6. logic
7. truth
8. progress
9. causality
10. consciousness
11. physical reality
12. science
13. perception
14. argument

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Some notes on these are that for the first, arithmetic, attempting to review Godel would be a huge undertaking which I do not want to do. For deduction, it falls to the same as induction. For position and certainty, see $\int \psi\psi^* d\tau$. For logic, the same as induction given the inconsistency of schools of thought. Truth falls to arithmetic's. Progress and causality fall to time. Consciousness to observation, as well as science and physical reality. For perception, sincerity of belief is not enough to prove (see synesthesia). And for argument –

Thus, all is heuristic.

"all" is a heuristic for what we point to with "all" is a set differentiated by what is held in people's minds.

"is" falls to language.

"heuristic" falls to unquantifiability.

We have not been reduced to moral relativism. We generally can agree on some subsets of beliefs that are internally self-consistent. We mat treat beliefs as frameworks that we may flit through via our own objective function – for now we cannot escape our minds. One must account for themselves.

And for logical inconsistencies, these may be dissolved as well:

[mind/body/dualism] are a set of heuristics that each work within their own thought-space.

Against relativism, we still evaluate individuals against the sota at the time of judgment. All is heuristic. That does not mean that we cannot use it.

Before intelligence,
mountains were mountains,
With intelligence,
mountains became mountains,
With the heuristic,
mountains became mountains, and
After the heuristic,
mountains became once again mountains.

In chapter five, […]

Where does this leave us, floating with our own tide adrift islands of logical consistency? Some orientation or compass is needed. Utopia fails as it is a dream rather than an instruction manual. It is not that we use our set of heuristics to change this world for a better one. Instead, we use a set of heuristics in alignment with others to work toward a better world.

The implications of this:

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Ideologies, heuristics, etc. are best viewed as internally consistent frameworks that one need not bind themselves to but rather flit between to fulfill their personal objective function; as we live in a world with minds aside from our own, it may be preferable to coordinate these with others as to achieve a better world by whatever means necessary.