



## Reconstructing and Deconstructing Engineering Education: Tools to Interpret Engineering Philosophies

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**Heideggerian Constructs and the Engineer: Tools to Forward  
Engineering Philosophies**

## Abstract

With the recent deluge of attempts at forming a more coherent and aligned philosophy of engineering education, a demand for an application of traditional continental methods should be apparent. Even the definition of the field itself is available for scrutiny, and within that framework, a number of interesting paradigms can be discussed. This paper intends to apply approaches from Heidegger's works on metaphysics compared to modern engineering education philosophies. These approaches include interpretations of commonly used words, the intentionality of various constructs within the field, and to whom these constructs affect.

The main core of this discussion on Heidegger revolves around the lesser-expanded constructs of *false thinking* and *Bodenständigkeit* or autochthony – sometimes called *groundedness*. These two constructs can be readily applied to the enterprise of engineering education to better situate the engineer in the world and to discuss his place relative to his role in society, his job, his colleagues, and related institutions. While there are many tools to evaluate engineering thinking and even emergent ones to evaluate divergent and creative thought, tools to evaluate the *lack* of thinking or *thoughtlessness* are not pervasive. Heidegger's philosophy provides reflections to better understand false thinking, grounded thought, and potentially a construct for delimiting thought or *thoughtlessness* – three constructs from which our modern technological literature could benefit.

Lastly, of key importance to the future of the field of philosophy of engineering education is its self-expression, not to be confused with the often-used term *agency*. In one sense, engineering education can be expressed from the vantage point of engineers and educators and their respective communities, and the community efforts must be addressed to fully understand the definition of engineering education. It should be understood that the lens used to study both engineering and education in terms of a philosophy such as Heidegger's is fundamentally a lens of abstraction focused on the self, thus can be of key importance to our community. After discussing several components of Heidegger's philosophy, his constructs are tied to recent publications.

## Introduction

A few years ago, I began a journey to align what I saw were emergent philosophies with engineering education with traditional Western philosophies and constructs.<sup>[1]</sup> Since that time, much seems to have occurred in the world of engineering philosophy within our community, but the call for furthering engineering philosophy still exists.<sup>[2-4]</sup> The purpose of this work is multi-fold: first, to further expand on concepts previously addressed within the context of Heidegger; two, to provide a scaffolding towards operationalizing some constructs potentially useful for the modern engineer and engineering student; and three, to integrate some modern works on engineering philosophy within our community and hopefully successfully integrate them with the framework I will construct.

## Why Choose Heidegger and Why Now?

Within liberal education, there has been a historical struggle to define the engineering enterprise.<sup>[5-8]</sup> Gasset's work has traditionally been taught in education courses as a standard outlook on the subject, whereby he divides engineers from scientists into categories of the disciplines that can be taught and the ones that cannot. His main assertion is that scientists cannot be developed in the same way that engineers can within an academic institution. The reasoning is lengthy, but the crux of his argument is that engineering and the technical trades exploit physical laws of the universe, which is in his mind far easier than developing new physical laws or interpretations of physical laws.

The interpretation of why the modern engineer is viewed the way he is has been discussed in multiple venues, but the work of Bix takes a philosophical approach. He argues that during and after World War Two, the genesis of the *engineer as product* became paramount. One way he supports this is through the development of the modern engineering pathway – a precursor to the often discussed *pipeline* problem in today's engineering colleges. Colleges and universities shortened the length of their degrees, identified shortages in local defense industries and filled them, and provided specialized courses to retrain engineers for the war and post-war industrial efforts. Similarly, the engineering enterprise contained in Seeley's interpretation of the Wickenden report has a comparable assertion.<sup>[7, 9]</sup> One of Seeley's main critiques of American engineering in particular is that it had become little concerned with student self-realization or self-assessment as opposed to the specialized and more theoretical nature of European engineering.

Heidegger's works span a number of important topics, but one he addresses throughout his career is how the meaning of words is interpreted by human beings. Usually his efforts on the subject are summarized into the question of *being*. One method whereby he constructs and explores the concept of being is through *Dasein* – a construct meant to engage the philosophical community with the notion that humanity is at a nexus of *object* and *subject*. When the engineer in our American institutions has been treated only as a byproduct for a specific purpose – one that cannot even construct new physical laws but only manipulate them – the engineer existence comes into question.

While previously I concerned myself with the notion of expanding the construct of the engineer's *place* in society, I am more focused on expanding upon a few of Heidegger's philosophies here. Although I still feel that the question of *how we prepare engineers to think philosophically* is a high priority for our field, the current state of affairs indicates that perhaps papers on highly specialized philosophies may help forward the discussion more so than grand summaries of multiple views. I focus mostly upon the nature of Heidegger's notion of thought, thoughtlessness, and where they take man in his relationship to technology.

The reason for a much smaller focus as opposed to previous works must be stated here. First, in my conversations with colleagues and attendance of major lectures over the past few years, I have noticed some glaring misconceptions concerning certain philosophers. In order to ameliorate the net contention of certain misunderstandings, it behooves us in this community to

help bridge the gap between core texts and current literature. Second, in order to have a more lively debate in the community, selecting a few choice concepts from a major philosopher can actually be more generative of deep philosophical conversations than presenting a smattering of forty thinkers and hoping colleagues decipher a tome.

### An Invitation to Heidegger – Two Quips

I would like to provide two short stories as an introduction to Heidegger pulled from my lectures to engineers and liberal arts majors. The first, slightly more technical, provides a link to my previous work and keeps the concept of *Dasein* fresh in the literature. The second, I include because the armchair philosopher and the first year student alike can easily access it.

While lecturing on Husserl, I start with his own situationalization of philosophy, whereby he manages within two pages to perfectly state his purpose as a philosopher and why he may address a set of problems previously unaddressed.<sup>[10]</sup> As I stated in a previous work, Husserl breaks down the development of modern philosophy into four parts: the *logos* construction of the Socratic era; the Cartesian revolution; the transcendental movement of Kant; and an emerging *phenomenological* revolution, in which Husserl participates. In order to understand Heidegger, one must understand the role Husserl had in framing the philosophy he forwarded. Arguably the largest shift in philosophical thought in Husserl's categories lies between Kant and himself. Husserl uses Kant as the proverbial house of cards throughout his writings, but not when directly addressing the nature of object and subject. Husserl carefully defines that *subjectivity* according to Kant leads the human creature immediately to the development of his mind and eventually to knowledge. In other words, the only way a human being can fully experience life is to know life, and the only way to know is to engage and embrace one's *subjectivity*.

Heidegger begins to borrow and dismantle various pieces of Husserl's reconstruction of the philosophy of history through his early and middle career trajectory. Most notably, the development of *Dasein* can be seen as an attempt to replace or iterate what Husserl had begun by taking on, albeit at times disingenuously, Kant's *subjectivity*. Whereas in Husserl's digression on object/subject, the human being is left free to determine the nature and the degree to which reality or more succinctly, his constructed reality is *objective*, Heidegger takes this a step further and claims that in the development of the *Dasein* construct, the human being is both object and subject.<sup>[11]</sup> Sometimes, this phrased in lectures as the human being is at the *nexus* of object and subject, but throughout Heidegger's literature, I have not found such explicit wording, and one must tread carefully when expanding Heidegger's words.

I have also taught the philosophies of Heidegger within numerous course frameworks throughout the years, including mathematics, logic, and various engineering course modules as a guest lecturer. Often times, I start with a funny digression containing pictures of other famous thinkers and philosophers to illustrate a point. At the top is Aristotle with the quote, "What does it mean to be a good person?" Below him, Descartes, "What does it mean to be?" Below him, Nietzsche, "What does it mean?" Further down, Bertrand Russell, "What does 'it' mean?" Further, C.S. Lewis, "What does it?" At the end the rapper Lil' Jon's picture is displayed and it extolls his tag line of "WHAT?" After displaying these pictures, I often times hand draw a sketch

of Heidegger between Bertrand Russell and C.S. Lewis with the phrase, “What does ‘is’ mean?” (As an aside, I’ve also referenced that Heidegger stole this now-famous line from Bill Clinton in the 1990s). Of course, Heidegger isn’t limited to asking the question of what does ‘is’ mean, but he is probably most famous for posing and reposing the question, “What does ‘to be’ mean?” throughout his works.

### The Capacity and Nature of Thought

Let us start with some constructs within Heidegger’s discourse on thinking that can apply to today’s students and faculty within engineering. Also, as a warning, we will be starting at the *end* of Heidegger’s career and with one of his more accessible eras of thought. One particular line of thinking within his works is man’s capacity for thought given a present or ongoing malaise. By that, Heidegger means a number of possible states, as he spent his career trying to better define and redefine the constructs we use to think about our daily lives. For instance, it may be easy for one to say that he or she *lacks thought* within the framework of *not thinking*. Certainly, within the realm of the Cartesian movement, this would be the case. The period of philosophy following Descartes, and Hegel noted this on multiple occasions in his lectures on modern Western philosophy, could have been interpreted as conjecturing that *lack of thought* and *thoughtlessness* are equivalent, or even nested forms, or perhaps hold some sort of functional relationship relative to each other.

Heidegger takes the time to elaborate on *thinking* through the active dialogue in his *Discourse*,<sup>[12]</sup> specifically with regards to a thought exercise involving listening to music. His philosophy says that *capacity of thought* goes beyond being active and present in the moment of action. In fact, the constructs of *reflection* and *thinking* are not to be assumed to occur in active participants of any activity, no matter how involved we may think they are or are not given the nature of the exercise. This can be disturbing to some faculty, as anecdotally all teachers worry about the efficacy of a lecture format, or an active learning exercise. The question in qualitative research, of course, is how does one measure the efficacy of a pure lecture format without resulting to quantitative means? Surely, the design researchers among us would have no qualms observing students from multiple angles, recording every word spoken and to whom it was spoke, and building some sort of multi-tiered categorization of the activities in which students partook at any given second.<sup>[13]</sup>

So while we have acquiesced in many ways, in Heidegger’s view, to a state of being that places a lower tier value on thought itself, we have to ask *where is he intending on taking us?* Heidegger begins to redefine, as he is so known to do, the concept of thought within a few examples in his writings. He gives a few examples that build on one another. The first, we have already discussed – that of the participant in a supposedly-active environment. His first conjecture is that rational and active thought is *assumed* based on some sort of structured context. He states that we have a tendency to increase our belief that the nature of the context will directly effect the active thinking about the context, or any presence of active thinking within that context related or unrelated to the context itself. Second, he digresses into another caveat of *false thinking*, that of the individual believing he is thinking within context in which one would assume to be thinking. The *assumption* of thinking and *false thinking* seem to be

separate entities to Heidegger, and he does not explicitly unpack them within his writing. The assumption of thought usually relates to the general relation of a being who can think but is not in a given environment. *False thinking* is usually endemic to an individual believing he is thinking given a context.

Heidegger warns us of being lulled into false thinking conundrums with a context by assuming we are thinking when in reality we are going through the motions of thinking on a subject. To him, the many distractions in our daily lives are simply that – distractions – and they do not augment our ability to actively think about our lives. Even worse, Heidegger contends that the motions of daily life that distract us are doubly damaging because we claim and use them as examples of how we *actually are* thinking. These *distractions* may not seem like distractions at all to us. In fact, distractions can be the same thing that we are actively living and should be actively thinking about in Heidegger's philosophy. Where we cross the threshold of inactive thinking and have relinquished control of our thinking is another extremely important space for Heidegger to navigate and explore.

One phrase differing from *distraction* that Heidegger uses in his later works is *commemoration*. He tends to cite examples that take place within services where our thoughts should be focused on one particular thing, hence the word fits. He does state this in various ways, but *commemoration* in my opinion may be the most effective term in English. This is a placeholder for the distractions in everyday life that allow us to give up our rational thought instead of augmenting it. For example, when we convene for church or at a memorial, we should be at the apex of our thoughts within that context. The process of commemoration in today's world has served as a context to allow us to fool ourselves into believing we are rationally and actively thinking when in reality we are not. Now, does this mean that the commemoration is doing the *thinking for us*? Heidegger is surprisingly silent on that point. *Do we think with (the) commemorations?*

The third example he yields to us within this digression is the debate between rationalizing our thoughtlessness and where this thoughtlessness leads. He answers that the first is a *process*. Example – within a remembrance affair or gathering for a departed loved one or colleague, it is clear that we spent hours (if not years) around this individual, becoming better acquainted, etc. We should, logically, be at the apex of our learning about him and thinking about him during such an event. Heidegger makes the case that in today's society, humans beings are not at that apex of thought; moreover, they are not at that apex because they have implicitly diminished it, used the context as a distraction, and otherwise embarked on a process of thoughtlessness. Whether the process of rationalizing thoughtless is explicit or implicit does not seem to matter much to Heidegger, but that it is being rationalized is paramount. Next, where thoughtlessness and its rationalization lead to Heidegger is more disturbing. He believes that modern man builds entire industries and cultures upon such a thoughtlessness, or as he puts it, *thinking of a different kind*.

The Relationship Between Self Determination, Thought, and Technology

A second of Heidegger's large thoughts in his mid to later years revolve around self-determination or *assertion*, thought, and technology.<sup>[14]</sup> While I have already discussed the genesis of his ideas on thought, I will turn to technology as he wrote throughout the dawn of the nuclear age. Although he does not directly link the two, the notion of acquiescing to superior technology and thoughtlessness takes a high place in Heidegger's philosophy – and certainly the technological critique he has come at a much needed time in our own community.

Heidegger divides thought into two camps: meditative and calculative. Calculative thinking involves the sort of specialized thinking that involves planning, research, and organizational abilities – always in reference to some known quantities or conditions. Of key importance to calculative thinking is the inability to stop expanding outward without meditative thought. The aforementioned quagmire of thoughtlessness, rationalization of thoughtlessness, distractions, and all related issues, directly map to meditative thought. Meditative thought in Heidegger's world comes in multiple forms, for instance: active thoughtlessness; the traditional transcendental meditation; and self-guided. Active thoughtlessness comes when a human being decides to take a path that leads him away from thinking. In one way, it can be construed that Heidegger means to malign meditative thought through this example, but it is quite the opposite. While the dangers of meditative thought abound and can lull a human into disengaging with his thoughtlessness that is exactly the power of meditative thought.

In this sense, Heidegger proposes multiple thought exercises to show the worth of a seemingly evanescent type of thought. He conjectures that although the meditative thinker may be floating above the world, a person engaged in such thinking does not do so in a vacuum, in other words, meditative thinking does not arise on its own. The more traditional meditative form is one that requires extreme concentration and practice to achieve, and according to Heidegger can require greater effort than calculative thought. Where Heidegger decides to dash meditative thinking against a rock is in his discussion of how this sort of thinking is a self-guided system. Heidegger's philosophy assumes that human beings are *thinking* creatures. So even though meditative thought may require practice and honing, it is the *nature* of human beings to engage in such thought.

The construction of the relationship of man's thinking to technology comes through the use of *Bodenständigkeit*, one of Heidegger's lesser studied technical terms. Through German, it can be defined as both *groundedness* and *autochtony*, and is quite unpopular of a line of thinking to study in technological philosophy.<sup>[15]</sup> Heidegger proposes that the *rootedness* of man, through the malignment of his thinking, has actually been shaken to its foundations. He further proposes that in order to test this lemma, we as philosophers ask: what characterizes this age?; and what is happening in our age? The question of scarcity of basic necessities replaced by the management of technology is the linchpin argument here. Building on the breakdown of calculative and meditative thinking, the development of technology can appear to a thinking human as explicitly and implicitly beyond his thought capacity. In other words, the advance of ever more developed technologies has outstripped humankind's ability to not only think, but given him myriad new distractions to rationalize thoughtlessness. As this new technology becomes ever pervasive,



Heidegger would argue that we surround ourselves with items that allow us to continuously engage in thoughtless behaviour.

Taking this to its logical conclusion, with the loss of properly managed meditative thinking, a human in today's modern world can use calculative thought as more than simply a crux, but as a means to interpret both the world and the transcendent.<sup>[16]</sup> This existential turn of events in human thinking actually runs contrary to the entire set of phenomenological philosophies through Heidegger and, in fact, poses a problem for older ones as well. For instance, if humans have indeed rationalized that calculative thought is the sole means of engaging the world, or as Jaspers and others define it, the "The World," then what does this tell us of the way the same humans engage the Transcendent? (Here, the transcendent is that which is both beyond ourselves and is beyond The World, akin to traversing Socrates' daemons).

### Linking to Recent Works

I would like to take these constructs from Heidegger and apply them in the context of recent works within our community. Starting with the work of Gravander, we can apply the divide between the philosophy of engineering and philosophy of science.<sup>[17]</sup> While Gasset's seminal work has defined the line in the sand between a scientist and the more technical professions, the debate on developing a philosophy of engineering continues. Gravander gives a number of examples in his recent work to divide a philosophy of engineering from a philosophy of science. Foremost, although mentioned as an aside within his work, a philosophy of engineering is not a philosophy of technology. To these ends, it is important to understand the intentions of Heidegger's works when applied to an engineering sphere. Heidegger had a number of applications for his ideas on thought at the time they were written, and one would be remiss to eliminate the engineering bent from them simply because he used the word *technology* instead of engineering.

The divide between the ideal notions contained in science and the functions of reality in Gravander's discussion can be viewed through Heidegger's lens in multiple ways. First, Gravander conjectures that engineering seeks *solutions* at its core and, more precisely, *optimal solutions*, with the caveat that there are *always* multiple solutions depending on conditions. Science, being artificially constructed or at least assuming that it can describe some *ideal* version of the world, produces *theoretical constructs*. From a Heideggerian interpretation, both ways of viewing the world contain potential pitfalls, shortcomings, or ways for the human negotiating them to convince himself that he is in control of the scientific endeavour. At first, one may be tempted to categorize the *enterprise* of engineering and science into one that contains massive distractions by the nature of their existing. For instance, the structure of universities, laboratories, industrial complexes, and even the clutter basement or garage of an armchair practitioner, can contain reinforce *thoughtlessness*. Another example, is that the process of either science or engineering, both of which being built upon previous works, in itself could engender human practitioners only concerned with furthering a particular line of work and not actively thinking while undertaking such work.

The divide between focusing solely on the *application* and *solution* may contain an interesting opening for interpretation here. These two types of endeavours must, by their definitions, contain calculative and meditative thought. Both of them require a *special thinking*, to quote Heidegger, and although seemingly narrow or myopic in nature, this thinking can contain elements of thinking and distraction. We would be careful to propose here that the process of finding the optimal solution or application may actually be meditative and much more expansive than one would think in the scientific realm, for the following reasons. First, engineering solutions as defined in Gravander and elsewhere can be iterative. If the solution really is never an *ultimate* solution, then the human solving it has to be actively thinking and navigating that terrain. Second, they can be duplicitous, divergent, or otherwise, given the nature of the problem and the information at hand. The fact that the solution is not singular, grounds the human being as there is no single right answer. In other words, the potential for the engineering *process* to be calculative and engendering thoughtlessness may actually be attenuated by the open nature of engineering solutions.

Here the recent work by Bassett and Krupczak may be of help.<sup>[18]</sup> In order to more clearly understand how Heideggerian constructs can be applied to a philosophy of engineering, we must more carefully describe the relationship of engineering to science. Within this work, they invoke the proximity to the creation of artifacts to elaborate differences between science and engineering. Here we find a stumbling block in the previous conjecture that ascribed a more thoughtful and meditative mode to the engineer. Bassett and Krupczak invoke the concept of *plans*, which like the communicative enterprise of science, allow one individual to pick up where another stopped – hopefully improving the design if not completing it or bringing it into the world by manufacturing. The nature of planning itself and the ability to transmit and communicate them can be considered a massive exercise in thoughtlessness, outstripping any critique against science as being representative of such problems. In fact, the nature to which plans are redundant, that is to say the nature to which the humans involved in the development of such plans can be replaced, could mean engineering as a whole is a byproduct of thoughtlessness!

## Conclusion

While far from a complete treatment of Heidegger's construction of thought, the modalities presented enable the reader to undertake a more exacting look at his works, hopefully without fear of his legendary opaqueness of prose! I stopped far from the overall goal of working on an operationalization of Heidegger's works within the framework of engineering education, and I feel that would be far beyond the scope of this paper. The concepts of thoughtlessness, calculated and meditative thought, and redefining the enterprise of engineering within a greater philosophical context are all useful while our community grapples with establishing a proper engineering philosophy. I am especially positive on the recent publications undertaking the defining of engineering and how it differs from science, and feel that modern continental philosophy holds a key part in guiding our community. While not within the scope of this paper, I would encourage those within the community to ponder the further question of the nature of *Bodenständigkeit* in engineering philosophy, and how to properly situate it. Only recently have

philosophers of technology undertaken the task of delving deep into the construct of rootedness in Heidegger's construction, and so the area is ripe for developments.

## References

1. Ricco, G. *Three Deadly Venoms: Phenomenology, Existentialism, and Philosophical Constructs to Expand Engineering Education Research Methodologies and Philosophy*. in *American Society for Engineering Education*. 2011. Vancouver.
2. *Philosophical Perspectives on engineering and Technological Literacy*, ed. J. Heywood and A. Cheville. 2014, Glasnevin, Dublin: Clondalkin Group.
3. Goldman, S.L., *Why we need a philosophy of engineering: a work in progress*. *Interdisciplinary Science Reviews*, 2004. **29**(2): p. 163-176.
4. McCarthy, N., *What use is philosophy of engineering?* *Interdisciplinary Science Reviews*, 2007. **32**(4): p. 320-325.
5. Ortega y Gasset, J., *Mission of the university*, ed. H.L. Nostrand. 1944, Princeton: Princeton, Princeton university press.
6. Bix, A.S., *Engineering National Defense: Teaching Technical Education at Land-Grant Institutions During World War II*, in *Engineering in a Land Grant Context: The Past, Present, and Future of an Idea*. 2005, Purdue University Press: West Lafayette. p. 105-133.
7. Seeley, B.E., *The Other Re-Engineering of Engineering Education, 1900-1965*. *Journal of Engineering Education*, 1999. **88**(3): p. 285-295.
8. Smith, K.A., *Successful Attributes for the Engineer of 2020*, P. University, Editor. 2008: West Lafayette, Indiana.
9. Wickenden, W., *Report of the Investigation of Engineering Education: 1923-1929*. Society for the Promotion of Engineering Education, 1930. **1**: p. 1-12.
10. Husserl, E., *Phenomenology and the Crisis of Philosophy*. 1964, New Haven, CT: harper and Row Publishers, Inc.
11. Heidegger, M., *An Introduction to Metaphysics*. 1959, London: Yale University Press.
12. Heidegger, M., *A Discourse on Thinking*. 1966, New York City: Harper and Row, Publishers.
13. Atman, C.J., et al., *Engineering design processes: A comparison of students and expert practitioners*. *Journal of Engineering Education*, 2007. **96**(4): p. 359-379.
14. Heidegger, M., *The Self-Assertion of the German University*. *Review of Metaphysics*, 1985. **38**(3): p. 467-480.
15. Metcalf, R., *Rethinking 'Bodenständigkeit' in the Technological Age*. *Research in Phenomenology*, 2012. **42**(1): p. 49-66.
16. Schrag, O., *Existence, Existenz, and Transcendence*. 1971, Pittsburg, PA: Duquesne University Press.
17. Gravander, J., *Philosophy of Engineering as Propaedeutic for the Philosophy of Engineering Education I*, in *Philosophical Perspectives on engineering and Technological Literacy*, J. Heywood and A. Cheville, Editors. 2014, Clondalkin Group: Glasnevin, Dublin.
18. Bassett, G. and J. Krupczak, *Abstract Thought in Engineering and Science Theory and Design*, in *Philosophical Perspectives on engineering and Technological Literacy*, J. Heywood and A. Cheville, Editors. 2014, Clondalkin Group: Glasnevin, Dublin.