How Is the Spirituality of Engineering Taught or Conveyed?*

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This paper expresses the experience of two campus chaplains at Delft University of Technology in The Netherlands. Their initial bewilderment changed into a better understanding of their parish, once they developed a tool to see and to explain the tacit spiritual dimensions of engineering. In short, they discovered a hidden but strong spirituality among engineers, which, once expressed, helped their students to understand their own motivation to become an engineer.

THE BEST-KEPT SECRET OF DELFT TECH

ONE OF THE MOST astonishing discoveries during my long career as a campus chaplain at Delft University of Technology is that this university produces engineers. We appear to produce engineers and nobody knows how. How we do this is one of the best-kept secrets of our university.

It is clear that many students come to Delft, which is exclusively a university of technology, with clear engineering dreams. They want to serve, they want to make beautiful things, they want to solve problems—so they declare in their laconic language.

One of the things Delft is really good at is repressing confessions of this kind. On the surface, the Delft spirit is a rather binary one, in which things are good or bad, true or false. But this language offers little room for complexities and subtleties. Feelings, dreams, aspirations are not in high esteem. So the naïve freshman soon learns what to answer when they ask him why he chose technology as a study and a profession. Our students easily learn to give the expected answer and say that at high school they were good at maths or that they want to become rich.

Moreover, the official program hardly contains anything about the typical ways of thinking of an engineer. The program of a course in physics at a general university like Leiden hardly distinguishes itself from the program of a course in applied physics in Delft.

But, nevertheless, Delft produces real engineers. That is really my astonishment. They arrive at eighteen and just seem like average young people newly graduated from high school. However repressive the cultural climate, they develop into true engineers. Our students have to give a public presentation of their skills at the end of their Master's training. The way they do this is a real engineer's way, so you won't hear from this 25-year-old engineer that he needs more research to be able to give a certain answer. Like an engineer, he will answer with what he thinks feasible within the actual state of knowledge. An engineer focuses on solutions. An engineer will assume personal responsibility for his answer. An engineer acts on the basis of trust. Trusting his own abilities, he operates in the interest of the public.

As we said before, there is hardly a clue in the so-called curriculum of the several Delft schools that engineers are being trained here. Nevertheless, there is an engineering culture. All Delft students consider themselves as genuine Delft when they meet students from other universities. And others deal with them accordingly. There are quite a few terms of abuse in the traditional inter-university intercourse, like 'bicycle fixer'.

Our students have a lot of characteristics in common, such as professional optimism, the self-confidence that problems are simply there to be solved. They have an active approach towards given problems. There is unmistakable warmth in their approach, which implies: you can have confidence in us.

Now, the question we want to discuss with you is: where do they get this professional character from? If it is not explicitly being taught during courses, where do they find access to this essential part of their future professional identity?

When you study their education, it becomes apparent that certain teachers play an important role. Not all of them, but quite a few, socialize with their students outside of classes. They have coffee together in the cafeteria, they join the group on excursions, and they sit down and have a drink at a bar. And there, they talk about the typical engineering approaches to certain problems. They might say, for instance, that science may not have a definite answer and that engineers always find a way to cope with uncertainties; some ten percent should be added to the outcome of a mathematical calculation or to a layer of concrete to be on the safe side. And, they claim, this has always been

proven the right thing to do, so why not stick to it. When you do it this way, you are not a bad engineer at all.

We have come to consider our university as a place of initiation for the tribe of engineers. Like the medical, the educational and the juridical professions, engineers constitute a tribe, with its own traditional set of values that are transmitted to the new members in a symbolic way during their initiation. Studying is a kind of initiation. The secret of Delft Tech is not kept intentionally. There is no code which prohibits the publication of this set of values. There is no freemason's conspiracy to keep secret things secret. There is just an inability to express in words what symbols can show in a much better way.

BICYCLE FIXERS

When I entered Delft University of Technology, this inability of engineers to express themselves puzzled me, too. I noticed this flaw in the engineer's mind, but I did not know how to respond to it. I could not understand it and, like many professionals from the symbolic and more theoretical sciences, I approached this phenomenon with a certain disdain. I climbed down the stairs from the library in my ivory tower right into the workshops of bicycle fixers, where, in the noise and chaos of constructing and building activities, I felt hopelessly dislocated. I did not have a clue what they were doing and what they were aroused by— no one could explain this to me in comprehensible words. These technical guys and girls were distant and inept at communication. At the same time, I was deeply impressed by the results of technology that was created by their skills and knowledge, and which was too complicated for me to understand.

Fortunately, as a chaplain, I was not only trained in expressing myself, but also in listening, in a broad sense. And this seemed to me the best approach to this problem of being dislocated in a new and unfamiliar context. Listening, observing, analyzing, describing the routines and traditions of this strange and odd tribe, like a genuine anthropologist, gave me the opportunity of getting to know them. And this investigation was worthwhile, because it not only made me understand their outlook on life and their preferences, but also gave me insight into the cultural transition that is influencing our societies, both in the East and the West.

In my education, words, concepts, and symbols were my tools. They were part of reality. For me, this verbal world was the first world; the rest, physical things, everyday life, were a mere shadow of this perpetual world, a realm I felt secure in because it had these everlasting qualities.

The world of technology was totally different from mine. At first, I considered this world as superficial, poor and empty, linked to local and short-term developments—a world not of spirit but of matter, vulnerable to damage and decay. However, through a thorough and long-term observation of the doings of engineers, I began to appreciate the deeper values of their training, experience and daily research.

In constructing and creating their products, mechanisms and procedures, engineers learn to use other means of communication and understanding. For them, the results of their work are a means of communication. They *are* communication, a form of professional dialogue, in which the qualities of a device are immediately apparent. They do not have to describe it, write down definitions, and find arguments to convince their colleagues. No, it is simple and obvious. You can *see*, with your own eyes, what they have constructed or designed. And their colleagues will test and verify it. Of course, they need to know some specific data, some operating facts, but, as always, the proof of the pudding is in the eating. The question asked by engineers is not *what is the idea behind it? what is the concept? where does this all stem from?* but *does it work?*

In this technological model of communication, two elements play an important role: the use of the senses and aesthetics. A device is tested, and passes when it works. Eyes are sharp observers, trained to spot irregularities. Ears are used too, and by listening attentively a good engineer can hear whether a machine is working properly. By hearing, feeling, smelling or even by tasting, an engineer is able to qualify the fabric of a device or construction. When a machine is operating according to their expectations, they will simply nod their heads and agree in one simple gesture. When they hesitate, they will shake their heads and look very disappointed.

Aesthetics is another means of communication by which engineers exchange their thoughts and emotions. When they consider a machine or device or even a newly found formula or procedure 'beautiful,' it means it receives their professional approval. The beauty of it is not defined. Engineers do not need many words to describe the beauty they see. To recognize beauty, to express that something is beautiful, is enough. It is a mere shibboleth, a password, a secret code, immediately understood by other engineers. And they will agree, nod their heads and say that they consider it beautiful as well and that they are all grateful and satisfied. When you, as an outsider, ask *what is the beauty of it?* they will identify you as a nonengineer. When they like you, they will try to articulate what they consider beautiful and good, but it is obvious that this exercise is not easy for them. Words are hard to find. And how can you describe accurately the feeling of lovely, wellwelded material. You need to have this feeling, otherwise you will fail to understand engineers.

The practice of engineering is not superficial, poor and empty, but is exceedingly rich in almost hidden means of communication, only obvious to those who are trained in this notable profession.

They know what to see, to hear, to feel, and to smell. The things they build, design and process, the results of their work, are their specific means of communication. By means of these, engineers express their thoughts, their hopes, their dreams. They are words, or even more accurately, *symbols* cast in iron, glass, concrete or plastic. A bridge, a new brand of road surface, a better sewage system, lighter and safer materials for building airplanes, are the statements by which they alter our ways of living, working and perhaps even thinking. Their influence on cultural change is immense, but that is exactly what they have always done. From early times, they have answered the needs of people not by building sentences, but by constructing machines or water managing systems, organizing storage and transport of goods and food supplies, offering cities the conditions to grow and make life good and comfortable.

TECHNOLOGY IS PART OF GOD'S COMPASSION FOR MANKIND

Someone who discovered and explained the tacit dimensions of technology is Lynn White Jr. Many of you must know him or know his works. He was one of the first students of a new branch in historiography, the history of technology. At first he was not respected among historians—he aroused very severe criticism and he felt misunderstood his whole life—but in the end he met with recognition and approval.

Being trained as a medieval historian myself, I was for a long time familiar with his works about the plow, the stirrup and the mill: the invention of the stirrup brought about the superiority of the Frankish cavalry in the eighth century, and the heavy wheeled plow with horse traction appeared in the long fields of Europe north of the Alps. In short, technology, with its inventive spirit, stood at the cradle of Western Europe. I will not go into details, as I suppose most of you are familiar with these stories. Lynn White's works were very appealing to me.

I rediscovered his views on the history of technology five year ago, when I enjoyed a sabbatical at Claremont School of Theology. By that time, I had become campus chaplain at Delft University of Technology. Once I was nosing through the open stacks that American libraries happily possess when the *Dictionary of the Middle Ages* caught my attention. In volume II of this dictionary, Lynn White contributed an article on Western Technology [1]. Here he repeated his famous topics, which were well known by then. The article was published in 1988, one year after his death, and may be considered as summarizing his life's work.

But he did more than just summarize. He engaged in a theological explanation of the meaning of this technology. In his day, this was not usual and it still is not. Historians, at least European historians, do not easily transgress the borderline between their discipline and that of theologians, maybe out of fear of being misunderstood as protagonists of a certain theology or church. Nevertheless, White was not deterred. Being the son of a Presbyterian minister may have influenced this attitude.

In this encyclopedic article, theology enters the domain of technology –and does so for the first time. I am not talking about religion, because religion has always been part of White's interpretative framework—the word 'religion' figures in one of his early titles. No, I'm talking about theology, about explicit religion. I am not aware of theology ever stooping to the level of technology before this time. Engineers lack words for their passion and theologians never offered them. This complexity intrigues me.

Early Cistercian and Norbertian monks were among the first engineers of Europe. The impact of their works is obvious. Cistercian monks used watermills to produce the paper for their scriptoria. The abbot of Middelburg chaired the water board of the Dutch province of Zealand. Such things are well known, but what did the people believe who drained the marshes, who developed the moors, who built the dykes, who reclaimed the wasteland of Europe?

Bernard of Clairvaux, father of this monastic movement, is a well-known writer whose mystic writings possess great beauty and astonishing depth. He is a spiritual leader of the new Western Europe that came into being after the year 1000. His saintly figure stands shining brightly against the dark ages from which he emerged. He was an uncompromising religious enthusiast. But what did the *fratres conversi*, the blue-collar monks of his order, believe? Can we safely assume they believed the same as Bernard did, just because he shared their hard labor from time to time?

White assumed the patient priestly task of finding words for their conviction, to give their soul a voice. After having remained implicit for many centuries, a theology of an engineer comes into existence. This is a quality of his work I have never heard praised.

He says very clearly that technological advance is an expression of God's love for his children. Benedictines and Cistercians tell us by their actions that the time- and labor-saving devices of technology help to save souls. In his rendering of their belief, technology is part of God's compassion for mankind.

As chaplains in Delft, we like to say that technology is spiritual, because it is human compassion cast in iron or concrete. Look for the designer of a product and ask what motivated him. Nine times out of ten he will answer that he believes passionately in his work. 'I'm a believer. Can't you tell from what I'm doing?' he says. From ancient times, engineers have performed theology, although their language is hard to understand

for an outsider. You may need a theologian to understand it.

THE HEIRS OF BERNARD OF CLAIRVAUX

We chaplains work among the believers and we are convinced that the time has come for them to be explicit about it. And engineers shall be explicit about it, not because we urge them, but because they are compelled to do so, driven by fundamental and significant changes in society.

In our anthropological approach, we presented engineers as being representatives of a tribe, and, to a certain extent, it can be said that they are all part of this particular and powerful tribe. They have their secret knowledge, their hidden ways of communication, initiation and professional conduct. They have a set of values they have to obey, although it is not written down. In our theological approach, we stated that engineers are living and working according to a widely shared belief system, making visible, in their products, the profound conviction that they are committed to defending the sacredness life. There was a time when the tribesmen received religious, almost divine, titles in honor of the technological miracles they performed. In 'The Golden Age of Engineering,' as Sam Florman calls the era between 1850 and 1950 in his book *The Existential Pleasures of Engineering*, engineers are praised by the inhabitants of booming nations and adorned with titles such as 'priests,' 'prophets,' and even 'saviors' and 'redeemers' [2].

After the Second World War, however, technology began to show its grim, dangerous and devastating side and the appreciation of the distinguished tribe of engineers vanished. These holy men, this caste of demigods, became the object of criticism and rejection. Instead of being looked upon as saviors and redeemers, they were cast as immoral and irresponsible polluters, inventing junk nobody asked for. And what did the tribe do? Disappointed, deeply affected by misunderstanding and aversion, the tribesmen withdrew from society, closing mind and soul to their compatriots, who were unable to appreciate and value their work. In their voluntary retreat they continued their work, silently bearing the contempt and distrust. In a way, this outcast tribe of engineers resembled their ancient forefathers, creating a modern monastic movement, safely screened from prying eyes in their labs and workshops, free to follow their own incentives and insights and still working passionately for the welfare of people.

But times have changed. In his book, *Another Modernity, A Different Rationality*, the American sociologist Scott Lash describes the irreversible transition which our societies are undergoing [3]. There is a change from 'simple' Kantian modernity into 'reflexive modernity.' In 'simple' modernity,

people come under the sway of pre-given rules, whether within the norms of modern institutions and organizations (like unions or political parties) or of the welfare state, church and family. In reflexive modernity, individuals must *find* the rules to use to encounter specific situations. In reflexive modernity, one can never quite know, never quite get a grasp on, objects of knowledge. One has to learn to live with risk, with ambivalence and contingency. One lives in, what Lash calls, not an 'empty,' but an 'aporetic' space. Rule-finding in *aporeia* is not supported by tradition. The traditional framework people lived in has broken down. We cannot restore this.

We live in an open and flexible society, in which we are no longer served by the rigid fencing-off we described above. What we need today is communication. During a private meeting we had with Scott Lash in London some time ago, Lash stated: 'Face-to-face communication is necessary for trust and recognition.' To him it is clear that, in life today, in the aporetic space we inhabit, we have to rely on communication. In communicating with each other we may *retrieve* traditional elements, forms of life, to use them as guidelines. Engineering is a profession containing many powerful and inspirational traditions that may serve us today.

This means that, for engineers too, the days of comfortable autonomy are over and done with. Engineers can no longer hide in the realms of science and focus solely on the development of new technologies. As mediators between science and the world they live in, engineers have the task of finding ways to sustain and develop life in a balanced and adequate way by controlling *and* explaining the complicated processes in nature and human existence.

They are being enticed out of the dark void of obscurity they are hiding in, challenged to manage this perpetual and vulnerable transition our society is in, forced to open mind and soul to professionals of other disciplines, and to the public they claim to serve. In our urban, highly organized, high-tech societies, we have to share the information professionals offer us, we have to deal with the answers they try to give to problems we are confronted with, and we ask them to account for the solutions they provide. For our world has become so complicated that we are no longer able to give a single simple answer to a problem. In our time, many answers are given, on many levels, or different answers in different contexts, and, in order to come up with a good and sensible and appropriate answer, professionals in one field are compelled to negotiate with professionals in another.

Professionals have to supply the necessary trust people need in life. And, from their point of view, professionals need trust from the public in order to perform their duties. To receive trust in our society, professionals, engineers as well, have to live up to these requirements.

It is clear to us that, to survive in this aporetic space, we do not need a new type of engineer—we

need an open and communicative engineer who is able to share with us, face-to-face, his or her ancient inspiration and commitment. In this way we can regain the trust we need in today's life. Do the heirs of Bernard of Clairvaux have a new mission here?

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Ton Meijknecht was born in 1944. The Catholic bishop of Rotterdam appointed him Campus Chaplain at Delft University of Technology in 1975. He received his academic training at the Catholic University of Nijmegen (M.A.) at the Catholic Theological Seminary of Amsterdam (B.Div.), at the University of Amsterdam (M.Div.) and at Leiden University (Ph.D.). In 1997 he spent a sabbatical at the Center for Process Studies at Claremont (CA). In 2003, on another sabbatical, he crossed the US twice in order to speak with many colleagues and friends. Since the early 1980s he has specialized in the relationship between technology and the reflexive tradition of faith, ethics and philosophy. He became more and more convinced that this relationship could only be developed in close cooperation with engineers. At the same time he discovered tacit moral dimensions within the engineering profession, a deep urge to serve mankind. This made him look for new ways of offering pastoral presence among technology students. In the 1980s he started holding conferences about faith and technology on a local level. In the 1990s he gave these conferences a more international character. Since 1996, this work has continued to expand in cooperation with Hans van Drongelen. He has written two books on this subject, both in Dutch: *Saint Prometheus* and *The Engineer's Journey* (with Hans van Drongelen).

Hans van Drongelen was born in 1955. In 1991 he was appointed as Calvinist Campus Chaplain at Delft University of Technology. He got his degree as a Master in Divinity at the Vrije Universiteit Amsterdam in 1989. He attended Summer University at the Hebrew University in Jerusalem in 1980, where he studied Contextuality in Biblical Theology. At the Vrije Universiteit he specialized in Missiology. Supported by theories from the domain of Cultural Psychology, he concentrated on Spirituality, analyzing the conditions and human needs for a spiritual life in a secular society. After leaving University he attended to a Hospital Ministry in Amsterdam, focusing on pastoral care in a technological and highly structured context. In organizing symposia at the University of Technology at Delft, his major concern is realized, which is bringing to light the spirituality of human activity in the field of engineering. In this way, Missiology receives a new understanding, retrieving spiritual values in a technological and secular context, giving students a new perspective on their professional life and future. The publication *The Engineer's Journey* (in Dutch), written in collaboration with his Catholic colleague Ton Meijknecht, underlines his conviction that spirituality (religion) is in no sense outdated in western society. In the new millennium, they have both explored the tacit dimensions of professional spirituality (see www.ismagic.nl).