

The Five Saints of Electrical Engineering*

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Spirituality is essential in the training of engineers. Engineers have always had a religious calling—it was their task to save the world from downfall—and they still have this feeling. But it is a feeling that is hard to express. Articulating it is not an integral part of the training. High time for a coming out!

Keywords: Revealing the professional tradition of an engineer as a tradition of compassion.

INTRODUCTION

BEHIND HIGH TREES alongside a canal of the old fortified city of Delft stands a building with pinnacles and stepped gables in the style of north-German brick Gothic. Five stained-glass windows with stately figures hang above the main entrance door of oak. On the corners stand towers with winding stairs carved out of natural stone.

Yet this is not a convent. The five stained-glass figures are not celestial saints, but the personified works of mercy. They are images of the blessings that we have electricity to thank for: power, movement, warmth, light and sound. The building is an old building of the Delft University of Technology. One hundred years ago, in 1905, the building was inaugurated to house the then brand-new subject of electrical engineering. The new dons seek the cloak of respectability. Engineers dedicate their labors to God.

Now the building is in a dilapidated state. The stained-glass windows with the five symbolic figures were moved to the new location in 1969. The spacious hallways are deserted and bare. A pair of pigeons live in a lecture room with Gothic arches and windows. Anti-squat students now occupy what were once four large spaces that may have served as lab rooms or as classrooms.

Electrical engineering has no trade history. In contrast with other subjects such as civil engineering, this branch of science did not go through an intuitive phase. In the early Middle Ages monks dug out ditches and erected dikes. That was their holy task. Electrical engineering cannot boast such a past. It could only develop once knowledge had become science. Thus the urge of electrical engineers of a century ago to voice their religious task was all the stronger.

This building is a fragment of European history, a chunk of our identity. Nobody knows why it has been neglected. People just forgot about it. This happened sometime in the 1960s. And yet, take the

time to stand in front of that old building and sense its meaning. Better still: find your way in and wander through the stripped rooms. It will make your heart glow with pride. Even in its deserted and rejected state, the building still radiates its calling. It is as if the building sighs: 'Engineer, know thy past!'

AN ENGINEER DRIVEN BY HER TRADITION OF COMPASSION

Maaïke Stevens, 25, an industrial design engineering student, lives as a student and a guard in this old building, in one of the large rooms at the front, with a view of the canal. She works on her graduate project, a design for an exhibition on the notion of time. This in itself is already rather exceptional, a budding engineer concerning herself with the notion of time. Isn't that a bit too abstract for an industrial design engineering student? Aren't students in this faculty concerned with concrete matters like the shape of products, the push buttons, the computer screens and the accompanying manuals? Are the numerous market research projects they graduate on not abstract enough? Time seems to be a subject more suited to students of philosophy or science. She has called her exhibition design 'Lost in Time'. But what is this title intended to express?

Her intentions are revealed on the day she presents her graduation project to her supervisor, her tutors, family and friends. What is also revealed is the type of engineer that we are dealing with. She applied for an exemption from the obligation to graduate in one of the rooms of the Faculty of Industrial Design Engineering, and has invited everybody to the old building of the School for Electrical Engineering at Kanaalweg, where she will present her project in one of the old lecture rooms. Maaïke has structured her presentation in such a way that the entrance to the building serves as an introduction to her theme. Along a line of red tape she has laid in the forgotten hallways of the building, the guests are led to the lecture room by

* Accepted 14 December 2005.

means of a winding staircase of stone. In front of the narrow entrance to the winding stairs is a small table with an open book by Tonke Dragt on it. Her presentation makes clear that this book inspired her to choose this project. She received the book from her parents as a twelve-year-old and it has made a deep impression on her. It is the story of a little boy who one day discovers behind the door of the bathroom a winding staircase to a different world. It has become the starting-point of her journey through the time zones.

Supported by visualizations projected on to a white screen, she introduces her design for a traveling exhibition on time, a silvery, glittering cupola consisting of rings, which the visitor of abstract time can enter via the outermost ring in structured time zones. These zones are the cultural usages of time, which she calls 'beacons', and in which we can recognize the Christian, the Islamic, the Jewish, the Buddhist and the Aboriginal approach to time, each with their own view on— and interaction with—time.

One striking aspect of the presentation was that Maaïke did not lose herself in technicalities, but kept focusing on the aspect of the experience of time of people in the diverse cultural time zones. Few engineers have the talent to clarify the deeper motives behind their work and functioning. They are hardly conscious of the long tradition in which their predecessors strove to improve the quality of life on the grounds of mercy and their conviction that suffering and death are not determined by inescapable fate. Especially in our times, engineers come across as practical, well-trained individuals who are capable of great achievements, thanks to their tremendous computing powers and ingenuity, but who seem barely aware of the (traditional) framework of their trade. Engineers are highly dexterous and able, but, in one way or another, are also 'Lost in Time'.

What is so special about Maaïke's project is that she can link the designing process of the engineer to the phenomenon of time. Even by connecting her project to an early reading experience, she shows that she is sensitive to the strong influence of time and experience on her thinking and functioning as an engineer. Using the old faculty building as a stage for her presentation, she stresses how contemporary design is connected with these old traditions in which the works of mercy are anchored. Maaïke is a fine example of an engineer who is not in the least lost in time. Her supervisor and her tutors too recognized her special contribution, and she graduated *cum laude*.

THE MENTAL DINNER PARTY

In order to delve into this repressed question about lost identity, we from MoTiv at Delft University of Technology regularly organize 'Mental Dinner Parties'. These proceed as follows. In a room in the building of MoTiv there is a table

with a number of chairs around it. It is six o'clock in the evening and the table is laid. Students enter. Two of them have cooked a meal. There is a moment of silence or prayer and the company starts eating. When the initial hunger is stilled, we pose the crucial question: Can you explain why you have all come to Delft, why you have chosen a career in engineering? The conversation commences. After a fortnight the group returns, two different people have cooked the meal, and we start in the same manner; the same question is posed. This continues for quite some time, maybe for as long as a year. In the beginning the group consists of four or five people. Every time a newcomer joins us. Some think 'This isn't going anywhere; I've got better things to do' and they drop out. Others take their place.

In the end, the group consists of about fifteen individuals, who turn out to have learned quite a lot. They have learned to trust their own feelings. They have learned to trust others. They have developed a common language with which they can express and understand their feelings, and understand the feelings of others. They have explored unknown territories and were comfortable there, and at the end of that year the setting changes. The room is no longer the cozy room in MoTiv, but a large hall somewhere on the university campus. Gathered there are not only these fifteen students, but also about one hundred people. The students have invited their friends, their roommates, their fellow students and their sports friends. In the center of the hall is a table with five chairs. Two chairs are occupied by students from the group, one by an experienced engineer with an advanced career. A philosopher who is not intimidated by technology takes a fourth chair. The fifth chair is assigned to the panel chairman. The initial question has evolved into: Why do I want to become an engineer? This question is first discussed among the panel and at a certain moment the audience is invited to participate in the discussion. That which was initially private discussion becomes public. The common language used to express vulnerable feelings and motives, developed behind closed doors, is made public and put to the test.

YOU CAN'T PUT YOUR FINGER ON IT

Participants in these meals and their public extension experience something here that attracts them and that they cannot grasp. And that is what intrigues them. The food that is being served there makes them hunger for more and that keeps them captivated in the double meaning: that they sense that there is more, but they cannot grasp what that is.

Mahla Alizadeh Dehavi from Iran translates this longing. She is looking forward to the new year. She wants to participate in the next symposium then, and develop an insight into the way students

from other disciplines think about questions of responsibility: 'A Mental Dinner Party is held every other week one year in advance of a symposium. There, you have the opportunity to talk with fellow students from other disciplines and to debate matters such as personal responsibility. I find this very appealing. On a regular basis experienced people are invited to join a meeting and you can debate such matters with them. A number of these questions you take to the symposium. I'm quite looking forward to that.'

Two students who participated in the last round, Jelle ten Hoeve and Arjen Kruithof, also know that feeling of being captivated. Like Mahla, they are enthusiastic. 'The intimate atmosphere during dinner makes for deep and personal conversation in the group, and newcomers are immediately involved.'

But there is also a feeling of frustration. Jelle said: 'I found out, after a great night with a wonderful debate, that I couldn't explain to my flatmates why this was such a special evening. One night, there was an adviser to the Minister of Traffic there. He spoke very well on how raising dikes could quickly evolve into a political matter. He had to give the minister a recommendation the minister did not want to hear. That was difficult, of course. It was interesting to talk about that with him. But it is hard to explain what made that discussion so captivating.' Arjen shares this experience: 'Even more curious is the fact that I can point out what went wrong if an evening turns out to be less successful. For instance, by indicating that the conversation was too hypothetical or impersonal. At a successful evening the atmosphere is good and everybody continually stimulates each other, and you end up feeling you have developed your thinking. But I couldn't put my finger on what made it so successful.'

REVEALING WHO YOU ARE AS AN ENGINEER

Even if you cannot put your finger on how something works, it can still exude an appealing—even an alluring—force. In a way, you could call it erotic. There is an irresistible attraction in something you cannot define, but which irrefutably influences you. Is it because of the force, the inner power, that is released by it? We ourselves, the organizers of the Mental Dinner Parties, notice how much energy it takes to follow the conversations and how much energy flows back to us from these gatherings in the form of enthusiasm, vitality, drive, pleasure.

The fact that something special emanates from the Mental Dinner Parties is expressed in the loyalty of the participants. It takes no effort at all to get the participating students together every other week: we do not keep an attendance sheet, there is no need for pressure in the division of tasks, we do not have to announce sanctions

against disorderly behavior, and everything proceeds harmoniously. Conflicts are scarce, and, if they do arise, they are solved almost naturally within the group. There is no need to intervene. Apparently, something like a (temporal) spiritual community arises that knows unwritten rules.

For us, the spiritual force and meaning of the Mental Dinner Party have become clear and we discover how many of the personal qualities of the participants are revealed by it. In this sense there is no danger of creating uniform model students; participants are challenged to identify, familiarize themselves with and develop their inner qualities, of which they may scarcely be aware, if at all.

We think that by this approach participants develop sensitivity, not only for what others say, think and feel, but also for what is going on inside themselves.

And although we want to prevent ourselves from making causal connections (we have the feeling that this would frustrate the forces we work with), we can conclude that this sensitivity, developing within the participants, creates a connection, not only with people who were strangers to each other, or with the eventual goal of organizing a public debate, but above all with the essential traditions which brought forth the engineer—they plug into an invisible, mostly forgotten, professional spirituality which, however, has by no means left our world.

This creates a greater and more profound self-knowledge, from which they can profit. They feel self-assured and confirmed in their choice of technology and the profession of engineer. They dare take choices and venture upon steps in their professional career. They have the courage of their convictions. In other words, we see them blossom into independent individuals who set to work with conviction and creativity—engineers, above all, who certainly will not feel lost in our time.

UNSUNG HEROES

The ability to think in the long term, to think in different perspectives, and perseverance in the face of setbacks and frustration are what characterize an engineer. His professional joy arises from his ability to extend the axis of what already exists. The development of this aspect of his profession, too, belongs in his training. Either an engineer is spiritual or he is not.

The history of water treatment in Chicago is exemplary for the importance of this attitude. The city has always drawn its water from Michigan Lake. At the same time, the slaughterhouses and tanneries dumped the remains of the cattle with a carefree flourish via the Chicago River into the lake. In some parts of the lake the crust on the lake was so thick that birds could walk over it.

The turning point came in 1885. During a heavy rainstorm, severely polluted water floated via the intake into the water supply. The polluter received

back his contaminated materials. A huge outbreak of typhoid fever that took the lives of thousands of citizens was the result. Fear and indignation held sway in the city. This must never be allowed to happen again. The city council took the decision to move the course of the river to the south, away from the lake. The Chicago River flowed from then on into the Mississippi.

As is often the case, this solution, too, resulted in another problem. The cities along the Mississippi complained because now they were saddled with the pollution. Around 1920, Chicago built its first water treatment plant. This was the first step on a road that led to the Deep Tunnel Project in 1985. This is a tunnel with a diameter of six meters which collects sewerage during heavy rainfall, so that it does not flood into Michigan Lake to pollute its surface waters. There is a reservoir that can contain the sewerage temporarily. From there it is treated and pumped back into the river. The project radiates confidence.

Technology and Murphy's Law go hand in hand, but it does not give in to the accompanying discouragement: one just goes at it again with a fresh heart. Four generations of civil engineers have already been involved with this work. If a given solution does not work, or if a new and unforeseen problem arises, they just keep on searching until they have found a new solution. In this way, engineering is often a matter of action and reaction, a work of continuous and balanced management. Engineers need to have stamina and a profound connection with their assignment.

And this is where the elusive notion of the identity of the engineer comes to the fore. Apart from the identity of the individual, there is the identity of the professional group. A member of the group knows within himself what this is. The other members know this also from each other. And the public, too, entertains certain expectations of the professional group. A trademark of engineers is that they put public safety above anything else. Nobody is disappointed or upset when a manager puts the interest of his company above everything else. That is what is generally to be expected. But everybody expects an engineer to have public interest in mind when he makes a pronouncement. An engineer has obligations that he would not have if he held a different occupation: he is bound to the moral ideal of his professional group.

When you visit the engine room of the Deep Tunnel Project in Chicago, one hundred meters below the ground, you develop an eye for the special task and commitment of generations of engineers who have given their best efforts and knowledge to this project. At the foot of the elevator shaft you find a 20-meter high hall which houses two enormous pumps and has room for a third one. You can see the tubes through which the water flows. One of the tubes is in use as long as a third pump is not operational yet. That tube is sealed off and sticks into the

room. If the seal breaks, the room and the elevator shaft will be flooded within three minutes. Then you would have to make a dash for it, up 100 meters of stairs, the raging water at your heels. Engineering deals with superhuman powers, with unimaginable risks. That evokes a sense of awe, a sort of fear mixed with admiration. To know such forces, and to calculate them, that is the work of engineers. In addition, they have to know the margins of uncertainty. The civilian may assume that these calculations are correct. And that evokes a grateful feeling that there are people who are willing to take on responsibility for this risky water-engineering project. They are heroes who defy the fangs of this subterranean snake in order to guarantee healthy water for us all. And who commit themselves to these works for many generations, so that they remain reliable through time.

They are invisible heroes who just do their job every day—*unsung heroes*. Especially these days, the engineer's lot is to remain unknown. He is an unsung hero who goes through life unnoticed, and who all the while does these essential things with great determination and trustworthiness. This is the case with the majority of engineers. And it is this that we want to highlight; we want to praise the heroic aspect of being an engineer in this way.

CONCLUSION

Where do you create such heroes? Where do you teach them to persevere when the going gets tough? To silently perform their vital tasks, hidden from the public eye? Where do they learn to respect both the powers of nature, and the possibilities to use those powers for the benefit of all?

The answer to these questions is simple. They learn their trade at the polytechnics and universities. But will they master it completely there? Will there be focus on the aforementioned indispensable aspects of their professionalism? We are not so sure about that. That which constitutes the core of being an engineer is not dealt with in any program of study. Of course, a spark is certainly ignited, and even ignited often. Engineers learn from each other; students learn how to find this inner balance from their experienced lecturers. However, our question is whether it is more than just coincidence if students pick up on this.

We state adamantly that engineers do not develop their love for their trade. Often, lecturers or colleagues fail to reach out to them. They themselves are often unable to ignite the spark that inspired their predecessors, the engineers of the Golden Age of technology between 1850 and 1950.

We assert that the program only aims to deliver half an engineer and does not manage to permeate his whole body and soul. The program focuses on his usefulness, but not on his inspiration. Spirituality is indispensable in the training of engineers.

(Translated by Jules Guldenmund.)

In April 2002 the MoTiv-symposium 'Engineering Is Magic', presented in November 2002 at the TU Delft, received The European Award for Research in Science & Technology, granted by the CTNS (The Center for Theology and the Natural

Sciences, Berkeley). MoTiv received this award for its innovations in the field of science and religion, combining interdisciplinary scholarly activity with a strong interest in the educational outcome.

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