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Conceptual Foundations of CSCW: From Marx to Wittgenstein

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## Conceptual Foundations of CSCW: From Marx to Wittgenstein

Kjeld Schmidt

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#### 1 Introduction

My co-author, Kjeld Schmidt, is a leading figure in organizational analysis, theory of practice and technology, and Computer Supported Cooperative Work (CSCW). Volker Wulf and his department at Siegen University gave me the opportunity to interview Schmidt in Copenhagen on October 4, 2018. Almost five years later, I am proud to present an edited transcript of that interview in the sequel to this introduction.

I had prepared my interview with little knowledge of CSCW, though with an educational background in engineering, computer science, and logic. My initial training in engineering had made me quite skeptical of the alleged foundations of computer science, and my skepticism had only grown by the time I met Schmidt in person. However, Schmidt's own quest for conceptual clarity was first and foremost connected to CSCW itself, and less so to my computability theoretic concerns. The reader should therefore bear in mind that we both approached the conversation from different, yet complementary, angles.

My skepticism towards computer science "foundations" probably started with my PhD research on the semi-automatic construction of energy-efficient code and the formal verification thereof (2000-2006). Like an Englishman in Newy York, I was a "computer scientist" in a building packed with electrical engineers. I was versed in machine-independent programming, they were experts in machine-level programming and hardware. The virtual world was mine (I reasoned top-down), yet the real world was theirs (they worked bottom-up). While my co-supervisor was a theoretical computer scientist and advocate of logic programming, my supervisor was a control theorist and electrical engineer. They did not speak the same language (they never have). In a word, my sociological experience as a PhD student was incredible. Coming to my interview with Schmidt, electrical engineers would, and computer scientists typically would not champion the following statement:

Model is a better term than representation. Indeed, the model or the map is not reality and mathematics is often deemed to be reality.

These words from Schmidt re-appear later, in the transcript of our conversation. They are reminiscent of the writings of Michael A. Jackson,<sup>1</sup> Dave Parnas,<sup>2</sup> Edward A. Lee,<sup>3</sup> and other specialists in requirements engineering and cyber-physical systems. Some of the aforementioned critics strongly disagree with the tenets underlying computer science. For example, theoretical computer scientists are trained to believe that well-defined program texts can fully replace the human practice under investigation.<sup>4</sup> But, as Schmidt clarifies, it is questionable whether practice and symbolism go categorically hand in hand to begin with:

These models that we build and find useful, they are local and temporary closures. This means that if they are appropriated (as Volker Wulf would put it), they become part of our practice. But they don't replace the practice.

To be even more to the point, it is not uncommon for computing theorists to express difficulty in comprehending a Schmidt-like or neo-Wittgensteinian statement *an sich*, let alone to argue against it. For the bigger picture in this regard, I refer to my recent think piece in the Annals of the History of Computing.<sup>5</sup> All this to convey my incentive to interview Kjeld Schmidt back in 2018. As a historian, I wanted to know where his inspirations came from. And since his writings already pointed to Karl Marx and Ludwig Wittgenstein, I started from there. Likewise, Schmidt's overall research concerns the transformation of work with the introduction of modern computers. So, again, the interview begins there. But the intellectually rewarding insights come later, with Schmidt's "local and temporary closures" and the plain wrong assumption (which, as Schmidt indicates, prevails in the literature) that "observable, mutual awareness is somehow a generic ability of humans," namely that "we can understand it generally, as a universal competence and we can then design for."

Those career academics who know, deep down, that they are lost in a logical labyrinth, can use my conversation with Schmidt as a way out of the intellectual impasse. The academic has the liberty to run his (or her) race downhill towards a

<sup>&</sup>lt;sup>1</sup> Michael A. Jackson, Edgar G. Daylight, *Formalism and Intuition in Software Development*, Lonely Scholar Conversations Series, 2015.

<sup>&</sup>lt;sup>2</sup> See my intellectual engagement with Dave Parnas in: Edgar G. Daylight, "The Halting Problem and Security's Language Theoretic Approach: Praise and Criticism from a Technical Historian", *Computability*, Vol. 10, No. 2, pp. 141-158, 2021.

<sup>&</sup>lt;sup>3</sup> Edward A. Lee, *Plato and the Nerd: the Creative Partnership of Humans and Technology*, MIT Press, 2017.

<sup>&</sup>lt;sup>4</sup> The theoretician's tenet goes thus: A universal Turing machine captures the essence of all natural and artificial forms of intelligence that will ever have inhabited our galaxy. See my London talk, which is joint work with Erhard Schüttpelz: "The Turing Machine as a Boundary Object: Sorting Out American Science and European Engineering", 11<sup>th</sup> British Wittgensteinian Society Conference: Wittgenstein and AI, London, 29-31 July 2022; recording available here: https://www.youtube.com/watch?v=Fssz-LbRcTI

<sup>&</sup>lt;sup>5</sup> Edgar G. Daylight, "Addressing the Question "What is a Program Text?" via Turing Scholarship", *IEEE Annals of the History of Computing*, Vol. 43, No. 4, pp. 87-91, 2021.

drastic increase in mathematical symbolism, or to carry himself uphill towards conceptual clarity.

## 2 Raw Transcript of Interview with Kjeld Schmidt: Thursday, 4 October 2018

- Daylight: You were born in 1945, right after the war?
- Schmidt: The war was still raging in the Pacific. I was born in Esbjerg on the North Sea coast. It was the only large town, really, in that part of Denmark. The rest were just big villages. My family was working class. I don't really know my father's family. I think they were working class ... I believe my grandfather on my father's side had a hauling company: horse-drawn carriages, etc. On my mother's side, my family came from the northernmost Frisian Island called Fanø. They were seafarers in intercontinental shipping. For some reason she fell in love with some poor sod from the countryside and had seven kids — after which he hanged himself. And then she was fighting on her own, to raise all those children. At the same time, my grandmother organized the newspaper delivery workers in the town. So that was a struggling, social democratic family. My father worked initially as a truck driver and later, for most of his life, had various jobs on the harbor, in the fish industry. My mother too for several years. So, ordinary lower working class.
- Daylight: Do you have brothers or sisters?
- Schmidt: I have two brothers of which the eldest has died years ago. The other one still exists, and he is not a social democrat at all. I grew up in this industrial town, mainly fish industry. I had all kinds of ailments as a child. I couldn't play football because my left eye is blind. So, what else to do than read books? I did try playing football, but then I got concussions because the ball just hit my head. I was reading books instead.

Daylight: In the 1950s?

Schmidt: Yes. And building rockets, making them fly. I was interested in chemistry and natural sciences in general.

Daylight: After school you went to work?

Schmidt: I went to gymnasium, as the first one in the family. I was not really political at all;
I was interested in rocketry. You know, 1957, Sputnik. But in 1962, we had the Cuban Missile crisis. And that was a wake-up call. I began to read up on politics. The Cold War, its origins, I started reading Marx, Nietzsche, and Sartre. It took a year and then I was a socialist. This is the early 1960s.

Daylight: Did you share these interests with other people?

- Schmidt: There were a couple of guys, a circle of young socialists of 16, 17 or 18 years old. Reading and discussing Marx. Lots of discussion, lots of beer too.
- Daylight: You were a computer programmer in 1965.

- Schmidt: I got a job at IBM, which included training from scratch. I worked there for some years. But around 1968, politics became a major concern of mine. I began writing in magazines about strike movements and their background. I was doing sociology without being a sociologist. I had enrolled, first, in philosophy in Copenhagen, in 1964, but I stopped that after a year. Later, in 1967, I enrolled in history but skipped that after a year. I think I enrolled in sociology as well, but I can't recall at the moment. But I did write about social events extensively. In 1968 I also got in touch with a publisher who wanted to publish some Marx and I suggested that they should publish an abridged Danish version of Marx's *Grundrisse* from 1857/58. I got the assignment to edit and translate it, resulting in a publication in early 1970.
- Daylight: As a computer programmer in 1965, what did you program in?
- Schmidt: IBM called it Autocode. It was an assembly language. And later I learned COBOL and FORTRAN. I learned FORTRAN because there were some subroutines in what was mainly a COBOL program that couldn't be expressed in COBOL, so I had to do them in FORTRAN and include them as subroutines.
- Daylight: How would you explain your fascination with Marx to a very general audience?
- Schmidt: I was from the very beginning reading Marx because I was especially interested in his description of work and the transformation of work with the introduction of machinery. I saw that as crucially important. And then there was a book about the work of programmers that had been translated into Danish. Here you had wage workers building machines of a new kind, on an hourly wage. Not as engineers but from a completely different background, and also building automata. I found that very interesting and had been reading about it. Then I saw this job advertisement from IBM. They were looking for young people with good skills in mathematics who would like to be trained as programmers and then be hired.
- Daylight: They weren't looking for, say, sociologists?
- Schmidt: No. In fact, my grades in mathematics were appalling. In 1963/64 I couldn't care less, for I was reading about politics and Marx all the time. But I could explain my poor grades and they gave me a psycho-technical test; that is, all kinds of logic problems. Apparently I excelled in that test, and I got the job. And made a lot of money for my age.
- Daylight: What attracted you intellectually to Marx? Of course, I have the inclination to say it is because of your family background.
- Schmidt: That is why, at two levels. First of all, this was a time of political turmoil. Liberalism had failed. The whole notion of mutually assured destruction as a way to ensure peace had been shown to be highly dangerous for humankind. The established way of doing this had turned out to be absolutely crazy. At a more personal level, I had seen my father and mother coming home from work with the humiliations that they had to suffer. My father went unemployed for a year. I was born on the left. As a curious young man, I always wanted to be able to explain what I had experienced and what I thought, my opinions. I wanted to have my opinions with some warranty. Are there people you met in the 1970s who became life-long friends?

Schmidt: Not really. Well, my wife, Irene. We met in the early 1970s. But then she was married to another guy who happened to be my cousin. At the time, I was separated from my then-wife but we moved in together again. But at some point Irene divorced her husband, and when we met again in political circles, the infatuation was still there. It was a 7-year period of being in love without having the opportunity to live it out. In 1977 we joined up, with all our various kids. She was a crane driver in the shipyards, for a dozen years. Then she took a degree in History and Social Science and has after that been working for two decades in the trade union for industrial workers.

Daylight: You taught courses from 1972 to 1985, right?

- Schmidt: Yes, I taught History and Social Science at Roskilde University. I was employed as a Social Scientist. First as an Assistant Professor and then, from 1974 onward, Associate Professor.
- Daylight: Were people like Fernando Corbato, Douglas Engelbart, John McCarthy already on your radar screen in the 1970s?
- Schmidt: Not at all. I was interested, as in the mid-1960's, in automation, in applied computing, because of the microprocessor. That became a big thing in the early 1980s. I then decided to read up on it. Reading literature from engineering conferences and what else I could get my hands on: robotics, information systems,

In the 1970s I had been reading Marx and theories of imperialism on the sideline. And theories of the socialist states, which I gave up on. Because in order to do that in a scholarly manner, I had to learn Russian and all the Slavic languages. I said "No, life is too short for that." But at the same time, we had these beginning transformations of working conditions in the introduction of CNC machines, robotics in workplaces. I began to look systematically into that, very intensively, in fact.

- Daylight: Was there a climate of humans being replaced by machines? Or was there something else that triggered you?
- Schmidt: Yes, but I didn't believe that from the beginning. I found that weak. There was a discussion and I found it primitive. I didn't engage in it at all. No, it was the transformation of work [which triggered me] and the relationship of workers in the production process. The transfer of certain aspects of skill to the implement. Marx describes that [in *Capital*], in chapter 13 on machinery. I found this is happening on a far larger scale now than previously. Marx described all the kinds of textile machinery but primarily the cotton industry. Metal industries and most other industries were not affected by machinery at all. Marx sometimes talked about it as if they were machines but they were not machines by his own definition. They were just power tools. A hand-held tool is not a machine, just a power tool, because there is no transfer of skill. It just augments the muscle mass of the human operator.
- Daylight: What does Marx describe about the cotton industry?

- Schmidt: The transfer of skill from the spinner to the automatic spinning machine, for example. These were very expensive machines to build: the control mechanism and the power mechanism are identical. It's like a gear shift in a car. The power transfer and the control mechanisms are identical. These two conceptually different functions are performed by the same mechanism. Marx actually did have a notion of separation of these functions, which I found quite amazing. There is perhaps talk of that already in Babbage, whom Marx had read very carefully. With the computer you have a universal control mechanism that can be programmed to emulate any kind of 'physical' machine. So the power transfer (electrical motor and wires) is separated from the control mechanism. That created a technical platform for large scale automation; that is, automation penetrating all walks of life. My talk here about Marx versus automation is really about something that I did 10 years ago. In the 1980s I was just focusing on the role of computers in this transformation of work.
- Daylight: You use neutral terminology when describing some of Marx's ideas and your appropriations thereof. Are you willing to agree or disagree with the position that we shouldn't automate too much?
- Schmidt: That was not my concern. I'm in favor of automation. What can be done by robots is not worthy of humans. That's below human dignity.
- Daylight: Some things are not automatable. Take Artificial Intelligence for example and the Lighthill report in particular, which was in the 1970s.
- Schmidt: I began to read a lot about that: expert systems, AI, Prolog, ... I'm in favor of the advancement of technology. My concern was the conditions under which the jobs are designed, the unemployment benefits, education, re-education. I later became very skeptical of AI, but that's simply because I find it conceptually unfounded. Their claims are unfounded, but as a set of techniques it is interesting.

I was always concerned with the place of workers (humans) in the work process in general. Since new technologies enter work places and penetrate jobs that had so far been unaffected by any kind of machinery, I found that extremely important and still do. What kinds of skills will be replaced, which kinds of jobs will change, and how will this affect cooperative work?

Daylight: How did you express your concerns, your ideas? In research publications?

Schmidt: I was merely reading up on it until 1985. I wrote a report about it in Danish, with some colleagues, while we were still employed at Roskilde University. But then I saw another job advertisement for people with a social science background. This was an ESPRIT project on office automation. It was called "functional analysis of office requirements." The idea was to develop a methodology for analyzing administrative settings with a view to introducing computer systems for workflow systems and so on. This was very much inspired by the office automation work at Xerox at the time. So this was a European attempt to catch up (with the USA). They had been using computer scientists to do the work for at least a year when I was hired. They had thrown up their hands because they did not know how to do it. I

applied and got the job. (This led to a big pay rise, I had five kids [to feed].). I got out of Roskilde University, because it was in shambles. I could now use what I had been reading. I could understand the AI arguments. I started reading up on the literature on office automation.

- Daylight: Can you give a specific example?
- Schmidt: I had to introduce some distinctions, based very much on Marx. Distinctions between the workplace as a setting (an input/output function) and as a relationship between humans, tools, working conditions and so on. Knowledge domains as a concept came later. Then I did a very brief field run in a UK regional planning authority. It was just one day. I wrote up a report in which I describe their ways of working that the rest of the project found very illuminating. Trying to understand the work process, the division of labor, the different knowledge domains, the professional skills involved, and how they managed to do the job. What I actually proposed is now called a "geographical information system" consisting of multiple layers of representations.

With geology at the bottom, then archeological remains, ... If you apply for a building permit in any civilized country, then they will look into the subsoil: Are there any toxic wastes, archeological remains and so on that we need to take care of before we start building houses? All these representations need to be taken into account and are connected by location: latitude and longitude. I suggested that, they had all that in common. I didn't invent it, but they were reasoning that way. Later I got involved with engineering workstations. Studying the work of engineers. How they might use the new, upcoming workstations that were coming on to the market. I believe they were 25.000 dollars each.

- Daylight: What about mathematical research communities? You did some work on that as well.
- Schmidt: There were some mathematicians that managed to get funding for a European project called EuroMath. To build an information systems and repository for the European mathematical community, and especially a repository for preprints. Something like what later became Arxive. This was before the Internet became widespread.

Daylight: I'm still trying to lay my finger on the tasks that were assigned to you.

Schmidt: I did the requirements analysis. In 1985 I was employed in this computer science research lab, privately owned. This was in the suburbs, so my family and I could stay in Copenhagen. What I found out was that ... First of all, European mathematicians did not just work locally, they were part of a global community. Secondly, mathematics is not one community, it consists of thousands of very small research areas of about, on average, 30-35 people who know each other. They don't need a repository of preprints because they receive them by mail in brown envelopes. So I really argued that this was overkill. Then they also wanted to do something like TeX.

But then they had this silly idea that computers should be able to automatically

derive the meaning of a mathematical formula expressed in TeX. I had to point out "No, you can't, because a superscript can mean anything in mathematics. It could be an exponential function, a matrix function, ..." The sociologist in me would be the one who says "How do mathematicians actually go about doing their work? What kind of interpretations of texts are involved here?" Texts are read in context, from a particular perspective. They don't have meaning in and of themselves. At that time I began reading articles by Lucy Suchman. I read those with great interest. Suchman around 1985.

- Daylight: Suchman around 1985
- Schmidt: I read Simon before Suchman. His *Sciences of the Artificial*; that was important in my approach, too. Looking at work as a function, and then looking at the context as the landscape. Simon says the key to understanding the route an ant takes over the beach is the structure of the beach. That kind of materialistic talk was crucial. Of course I did not find his general problem solver convincing.

Daylight: Wittgenstein?

Schmidt: Not yet. Wittgenstein came later.

Daylight: Dreyfus?

- Schmidt: He came later. I was convinced by his argument. That the philosophical claims were hoaxes. That was mid-1980s.
- Daylight: Were you in the 1980s looking for an analytical framework or did this come later, too?
- Schmidt: What I was developing was a framework for understanding how different machine technologies would affect different kinds of cooperative work arrangements.

These various field work assignments (full time research work) were all cooperative work settings. The regional authority, the engineering, the mathematics, the portfolio management. They were all about cooperative work with people with different skills. They entered into cooperative work for different reasons, and machinery would have different effects because of that. People engaged in cooperative work for the simple reason that the limitations of the human body and the human mind (how much can you learn in time?), so you need more people to be on the same kind of task. I think I called it augmented cognitive work. You augment the capacity of individuals by working together. Lifting a stone together is the old example. But people also worked together because it takes a long time to acquire a skill. And different tools require different kinds of skill, and these skills have to be developed.

This is the Babbage argument. In order to have different skills involved in a production process, you need people from different backgrounds, different kinds of education and training. That was the kind of sociological analysis of skills and the reasons why people engage in cooperative work, sort of continuing and supplementing what Marx had been writing. He only wrote about the elementary augmentation, and the cooperation among workers with different skills. I added the skills involved in intellectual work. I wrote that in 1988.

If you take a civil service. There you have people with the same educational background (from law or economics). They are involved in handling the same case because you need more than one pair of eyes to give a nonbiased appreciation of the case. A kind of systematic bias discount, I used those terms from Simon and March. Simon the sociologist, not Simon the cognitive psychologist

I wrote a paper about that. If you take the different skills involved in cooperative work, if you then introduce machines, this may change completely. At the engineering workplaces where I went to do field work, I people told me that technical draftsmen were being replaced now that they had introduced CAD. Because now engineers would be able to do the drawings immediately by themselves, provided proper training. I've seen this also in administration organizations with text processing, where the typing pool was replaced by principals using the keyboard themselves.

Daylight: Did Heidegger have an influence on you?

Schmidt: No, I read some of it. Heidegger mystifies technology and techniques, systematically and deliberately.

- Daylight: Compared to, say, the USA, I take it that Scandinavian countries have a different mindset about cooperation between humans and machines. Did you notice a different way of looking at automation across countries and continents?
- Schmidt: Here I'm just an amateur, speaking as a politically interested citizen. Trade unions in Scandinavia engage more openly with new technologies than, for instance, in the UK --- to the extent that the UK still has trade unions, not to mention the USA.

In Denmark there were mixed feelings in the early 1980s, but eventually trade unions said "If we get engaged in it, we can get rid of some boring tasks," tasks that involve monotonously repeated operations that are mind-dumbing and ruin the human body. Marx already said strong things about that kind of work: being skilled in only doing three kinds of operations for the rest of your life.

My wife has been very active in engaging with these technologies. Introducing these technologies as a lever for transferring decision power to the shop floor. To allow workers on the shop floor to have a more varied working day. To be able to make local decisions, without having to ask the shop foreman all the time. To be able to do some planning work as a group.

Daylight: This is typically Scandinavian, is it not?

Schmidt: Yes. It has a background in the Anglo-American socio-technical movement and the industrial democracy movement in Great Britain. It started there. It didn't end there, they've forgotten about it. To a large extent it also died out in Scandinavia when China entered the world market. The interest in increasing productivity in Denmark cooled down, they would rather make money by increasing flexibility by moving production to Eastern Europe and East Asia.

#### Daylight: [Where does the Three Mile Island incident enter in your career?]

Schmidt: The Danish computer science research center collapsed in late 1989, and then I moved to the trade union federation and worked there for 18 months. After that I

moved to the Risø National Laboratory, which was started as the Atomic Energy Commission, because of the Three Mile Island experience. The Danish atomic energy lab started doing research in control room design and job design in process control. Especially process control based on lots of computer power. There you have cooperative work and some kind of computer mechanism between the people and the process. They employed me in 1991 and I did work there until 1998.

Daylight: So you weren't initially searching for the commonalties between these different case studies.

#### Schmidt: It evolves. It's not there from the beginning.

- Daylight: Did something resonate when you met Liam Bannon for the first time?
- Schmidt: We met in Athens and got very drunk and had great fun. We immediately hit it off. We had a lot of concerns and interests in common. I think Liam was interested that I had been doing all this field work. He mentioned that this conference was coming up in Portland about CSCW. I only knew too late to submit a paper and go there. Liam at that time lived in Aarhus so we started corresponding. He moved to Copenhagen a bit later. We began to write a paper for the ECSCW.
- Daylight: How would you position this CSCW community? You seem to want to seek conceptual clarity across different cases. But I don't see many people in CSCW do that.

# Schmidt: That keeps me awake and irritated. That's why CSCW doesn't really get anywhere in terms of technology.

Daylight: Because they don't generalize?

- Schmidt: [There's a crucial different between generalizing and abstracting.]
- Physicists, for instance, don't generalize, they abstract. They find the underlying principle by means of which different phenomena can be understood. Generalizing is like saying: everything that floats in the air falls down, apart from birds, smoke, clouds, and some other exceptions. Newton would provide an abstraction, saying that everything is attracted to the earth in proportion to their mass and inverse proportion to the distance squared.
- Which shows that I am an uncommon sociologist.
- Daylight: Indeed. My opinion was that sociologists eschew both abstractions and generalizations.
- Schmidt: It comes from my interests in rocketry as a youngster.
- Daylight: Coming to the CSCW journal, you started it, right?
- Schmidt: A group started it and I was part of that group. The common ideology of the time was: "Don't follow leaders watch your parking meters." But after the first issue, the journal was about to collapse; there was no coordinated process of acquisition and management of articles. I became coordinating editor, in 1992 or 1993.
- Daylight: Are you satisfied with the journal over the decades, in terms of the quality of the research papers?
- Schmidt: I think we have made progress overall. The CSCW community has lost focus. Whenever a new technology emerges, people run in that direction and forget what

has been learned and don't transfer the lessons learned to that technology. I think that's lazy.

Daylight: What would you like to see a young CSCW researcher invest his or her time in?

Schmidt: Enterprise resource planning systems, how they are actually used, how they can be either redesigned or how to put technology on top of them, so as to make them integrate better in actual work practices. Enabling shop floor workers to be able to do re-planning on the fly without losing coordination and an overview of what is going on.

I did field work in the early 2000s at a diesel engineering plant. They had an SAP system running, which produced a weekly master schedule for the whole plant. But, locally, things would be happening. Some workpiece turned out to have internal fractures. Or, the bottom frame of a Diesel engine for a ship, you don't have those on inventory. You order them and then they arrive on a big truck across Europe. Then it arrives and turns to be faulty. You have to order a new one, it takes two more weeks, and so you can't test the engine in the meantime. So they changed the local plans, but those local changes don't travel backwards up the workflow. They are not notified that this change has happened. So they are still rushing to get their components ready for the test run on this frame, while they could be doing other things more productively.

Daylight: This is logistics, operations research.

- Schmidt: Yes, but logistics is not an algorithm, it's part of their work on the floor. You need a system that allows them to see not only the masterplan but also derivations from the plan and the impact of these derivations.
- Daylight: On the one hand I don't think you would like to put theory first and then go to practice. Definitely, case studies come first for you. On the other hand, you do want to abstract. I guess you would like to see some students work on abstraction, right?
- Schmidt: Project management systems, group calendar systems, workflow systems, bank systems, accounting systems, manufacturing planning systems, .... You name it. It's all over the place and nobody studies them, not in CSCW. The CSCW mission is to engage in how to design or re-design technologies in such a way that they can be integrated better in actual practices.
- Daylight: Coming to professional practices and uniformity. One can go too far in standardizing, in seeking uniformity.
- Schmidt: As Elihu Gerson and Susan Leigh Star say in their 1986 paper, which was perhaps even more influential on me than Suchman's work, "representations are local and temporary closures". I found that deeply in harmony with what I learned from Marx. And it made it is easier for me to appreciate Wittgenstein later.
- Daylight: Once you start to abstract you will start to use or construct a model of some reallife happening. How do models come into your intellectual landscape? Is it true that several researchers in CSCW prefer not to work with models? A model is, after all, also a weakness because of what it leaves out.

Schmidt: Model is a better term than representation. Indeed, the model or the map is not reality and mathematics is [often deemed] to be reality.

These models that we build and find useful, they are local and temporary closures. This means that if they are appropriated (as Volker Wulf would put it), they become part of our practices. But they don't replace the practice. Machines may abolish a certain set of operations, but the machine is still part of our practice, our now somewhat transformed practice. That's basically what Suchman says.

But, still, building those models is not something you could do ad-hoc. The question "What would be an appropriate piece of program and what would not?" can be determined, not absolutely and not forever, but with sufficient degree of likelihood. So that it becomes more economically viable and has less negative impact, such as: companies going bankrupt, people despairing, people getting stressed, ... Whenever a program is inappropriately designed or introduced, it has all kinds of human suffering as a consequence.

Daylight: Is Garfinkel on your list of top authors?

Schmidt: Not really. I've read some of it. I find it pretentious beyond belief. And I'm not the only one who says that. I've heard very famous ethnomethodologists say the same. The first 36 pages of Garfinkel's book are brilliant, and the rest is just saying the same in different ways.

I found his colleague Egon Bittner far more interesting. Where Garfinkel is deliberately obscure, Bittner is very clear. Consider, for example, the concept of organization. We, as outsiders, reading the office procedure don't have a privileged access to understanding it. The standard operating procedure description is of course data, as is our observations about what people do and our record of what people say, but at the same level. If we find a discrepancy between what is stated in the procedures and what people say and do, then perhaps our reading of the procedures is wrong. And if people do something else, and they are not somehow held to account, then what they do is the operative understanding of the workflow, not our understanding.

So, the whole notion of the discrepancy between informal and formal organization is built on our assigning privilege to ourselves, as observers, as those who know the truth. No we don't. We aren't smarter than the guys working on the shop floor.

In that regard I can be seen in the tradition of British ethnomethodology; that is, the Wittgensteinian tradition of ethnomethodology. Over time I have become very close to that.

Daylight: Could you say something about Wittgenstein in this context? What did you take away from him?

Schmidt: That the mathematics is part of a practice, or different practices.

Daylight: I'm afraid a context-free epistemology (that is, a broad applicability of its findings) is considered by most people to be academic, while a practice-based approach to mathematics and logic is not.

Schmidt: There is a strong demand for [universal truth and the like] among [so-called] proper academics.

Daylight: It doesn't trouble you?

Schmidt: No. I started my intellectual life as a Marxist. It wasn't kosher then either.

Daylight: In the late 1990s you became interested in the problem of mutual awareness.

Schmidt: Yes, it was conceived of as a major problem of CSCW at the time. When people work in the same room, they take into account what the others are doing, if others are behind, if others have too much to do. Then they may adapt their own individual behavior accordingly. There are some very beautiful stories by Christian Heath and Paul Luff and by Dave Randall and his friends from the British air traffic control. Even in the most mundane, so-called unskilled work, you see highly developed skills. As soon as you then introduce computer mediated communication in between people, who would otherwise be working in the same room, everything falls to pieces. There were all kinds of dreams about using video-based media spaces, and it didn't work. Of course it did not work, because there is a completely different topology. Action in 3D over time reduced to a wire and then produced over a screen is not at all the same. I had an inkling that that whole approach was based on the wrong assumption: that observable, mutual awareness is somehow a generic ability of humans. That we can understand it generally, as a universal competence and we can then design for.

> I heard from a colleague of mine that he was going to visit the Danish Steel Works. They had a rather complex setting, transforming scrap iron into high-quality steel: melting, refining, casting. About 35 people on a shift, and they were in different locations, in different control rooms, with somebody even roaming around. They were doing this real time, highly complex, time-critical operation and mostly without a hiccup. How did they do that?

> I had an inkling it was because they understood the metallurgy of steel and the particular characteristics of the plant. That's the materialism of it and the contextualism of the practice. And that's what I found out. I focused on one operator at a ladle furnace. I stayed there because she was very articulate and happy to tell me what was going on all the time. She was a great informer.

I did field work at that plant for 18 months. They were using cues, such as changing light intensity outside of the control room, vibrations in the floor, sounds from neighboring shops, a video screen that you couldn't really detect what it meant but there were shifting light patterns, and some rudimentary information systems, plus looking out the window at the melt. She knew pretty precisely where everybody was in the process and whether she would be able to deliver the next charge on time. I wrote the whole field work up. And then I got stuck. I didn't want to write it in this cognitivist language that we slip into: "She perceives a light pattern and at the same time a vibration in the floor, after which she deduces that ..." No she doesn't. That's not how people act in a familiar setting. In a non-familiar setting, for sure. Or if in doubt. Then we stop, reflect, ponder, and come up with a solution. No, she

was certain and behaved with certainty. We do the same when we drive on the motorway.

Daylight:

You are talking about tacit knowledge, right? Schmidt: Yes, Ryle gave me some mileage. But then I started reading the biography of Wittgenstein. In his Philosophical Investigations, Wittgenstein discusses how we are able to follow a rule. His interlocutor asks "How do you know that that patch is red?" Wittgenstein answers: "Because I've learnt English," which is a rude answer, of course. What he means to say is that 'learning that this is red' is part of learning a language, it becomes part of our daily practices.

Having worked there for several years, she has learned to pick up all these signals and cues, and so on. She sees that they are on time. She does not see all these things, she sees that they are on time. Just like you see that the car in front of you is slowing down, you don't deduce that. You step on the brake before you even realize that the car in front of you is braking.

What's the take-away message concerning mutual awareness? Daylight:

- Schmidt: It's that awareness is not a generic characteristic. It is part of being a skillful practitioner. What you observe when you are aware depends on what you learned and what you are doing yourself. It's not some abstract ability.
- You seem to be saying that, essentially, humans are so intelligent that we should Daylight: forget about automation.
- Schmidt: [Not quite, because] the system was [far from] perfect. She had adapted to whatever was there. Some of the features she used were accidental. The door at the end of the control room had a window, otherwise she would not have noticed the light intensity. She couldn't leave the control room for a long time, because then she would miss all the cues and then she would be out of touch. She was kind of stuck there, chained to her chair. That's not good design. She should be able to move about and still be on top of events and know what is going to happen. Sensors in various places would be helpful, providing her with, say, visual data on one screen. She had a 24-hour Gantt chart. Each charge represented by its own row. She would also make very thin lines to express when she would receive it, based on her understanding of what was going on in the production process. If she doesn't receive it at that time, she would erase the line and make another line. She used the report chart as a planning sheet. I thought of using that as a dedicated planning representation, showing all charges in process. Where could they be in the process, given the amount of scrap, the current temperature, ... and transfer to her. This was the kind of design I discussed with myself.
- Daylight: I only recently learned the distinction between tacit knowledge and propositional knowledge. But you seem to be less inclined to highlight this distinction.
- My objection to tacit knowledge is that, well, there is a lot of tacit knowledge but it Schmidt: is not impossible for people to express it. You can learn to express it.
- What about modern technology, such as pacemakers connected to the Internet? Are Daylight: you for this kind of automation?

Schmidt: I have been involved in a study of that: ICDs. Privacy should be ensured of course. Transfer of the data from the patient to the hospital, how will that change the medical record? The record used to be notes written by doctors for their own use. Now you have gigabytes of data pumped in, but how will that affect the medical record as an institution. We did a 7-year study on that. We are very skeptical about most of the claims of electronical records. Doctors express themselves in rather delicate prose. It can't just be done by others, and not just in a form. They need to be able to express their hesitations, their degree of certainty or uncertainty. They do that all the time. In Danish they use all of the grammatical sophistication of the Danish language: "might be, could be, should be, .." Daylight: Have your research findings influenced Danish politics? Schmidt: We tried but they had wool in their ears. They had bought this American system. Daylight: I thought Denmark was one of the first nations in Europe to step away from these naïve forms of automation, especially with regard to health care. Schmidt: We were supposed to, but we are as corrupt as other countries. In the early 2000s you moved again. This time you went to the IT University. Daylight: Schmidt: Yes, I was there until 2008, after a brief spell at the Technical University. Funding of this kind of research in Denmark isn't very regular. There are gaps and suddenly you see yourself facing an abyss. But it has worked out. This steel plant study left me wanting an addequate language. So I read more Ryle, more Wittgenstein. I was horrified about the low quality of Polanyi's argument. I wrote about the concept of work. I wrote a critique of Polanyi. Which Polanyi are we talking about? Daylight: Schmidt: Michael Polanyi. His brother, Karl, was a Marxist and a good chap. The good Polanyi and the bad Polanyi. The bad Polanyi, Michael Polanyi, was a reactionary. He was close to Hayek, a neo-liberalist. The re-establishment of conservative ideology after the second world war, after it had received a bad press. Michael Polanyi already started in the 1930s saying that planning of science is not possible because science relies on tacit knowledge. That scientific research can't be understood. Therefore logical positivism, Marxism, and social democracy will just ruin science. I tried to show that his own arguments are incoherent. He says "In order to ride a bicycle you have to learn to do it, but you can't express it." And then he expresses exactly what you do when you ride a bike, because he was a trained chemist and could express it in exact physical terms. So, I wrote that. It took me a couple of years. Then I focused on the concept of technology and practice, from 2014 onwards. My final thought is that you seem to be both inside the CSCW community and Daylight: outside at the same time. Do you agree? Officially I'm very much in because I'm the editor of the journal. Intellectually I'm Schmidt: on the margin now. They have moved away from me. And I've moved too, partly in response to the way in which the field has developed.

I've done two things really. First of all, I started focusing on the conceptual foundations of the field. I can contribute there, better than in doing what everybody else does well. Moreover, the field is very much in need of conceptual clarification. It's in shambles. Secondly, most research areas die after a generation, do they not? When the steam has run out, when the enthusiasm has dissipated. CSCW has come a very long distance, has learned a lot. CSCW has demonstrated that a kind of research of practices is actually possible: an open sociological eye that can be combined with an almost scientific understanding of technology is actually feasible. That has been demonstrated, which also includes semiology and so on. All of these intellectual traditions actually can combine in actual fact as a kind of unified science, in the Vienna Circle sense. I'd like to put that in a time capsule and safeguard it. For, if it is just in a CSCW journal and conference papers, then nobody will notice.