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## **Reasons for choosing a technically oriented education: An interview study within the fields of pipefitting and industry**

### **Introduction**

Globally, there are megatrends such as “increasing internationalization of economy, new communication and information technology, demographic development and changed value patterns” (Achtenhagen & Oldenbürger, 1996 p. 387). To meet the changed globalised structures there is a need of well-educated researchers, engineers, technicians and other professionals with innovative ideas and the capacity to solve problems, i.e. meet challenges from the megatrends. Hence it follows an increased need of people’s technological competence, which makes demands on research about learning and teaching technology (Säljö, 2002; The European Parliament and the Council of the European Union, 2006). Employees must learn “new knowledge, skills and attitudes in order to avoid possible unemployment” (Achtenhagen & Oldenbürger, 1996). Knowledge is thus of importance in order to get a job and may be an argument to attract youths to choose technically oriented education. Previous research shows that external promotion and family involvement are crucial aspects for youth’s choice of career-paths (Frost, 1992). Frost also found that career choices often are delayed until late in the school programme and that careers that provide financial reward and the opportunity for further training has impact on career choices. Another study points at cultural differences as an essential element for the career choice (Auyeung & Sands, 1997). Individualistic cultures are mostly found in northern- and Western Europe and North America and collectivistic cultures mainly in Asia, South America and Africa. This may be reasons for using different types of agendas and arguments in different countries to promote technical education as important for the students. Furthermore, many gifted and talented students are unsure about educational and career choices (Leung, 1998). They lack knowledge and information on how their multiple talents can be integrated into a career role. The global need of well educated technicians and the knowledge about youths’ struggle with future career choices opens possibilities for positive technically oriented intervention programmes. However, there is a need of information about future career possibilities. To attract students there is therefore a need to find significant factors and advantages within technically oriented trades. This knowledge could be implemented in messages to encourage students to make technical career-related decisions.

Nationally, major initiatives from both the Swedish government agencies and other actors have been done, because of the problems recruiting students to B.Sc. and M.Sc. degrees in engineering programmes. The Swedish government has made two big efforts. One is to appoint a committee, The Swedish Technology Delegation, to promote greater interest among children and young people in mathematics, science, engineering and ICT (Utbildningsdepartementet, 2008) and the other one is to initialize and support an experimental project with trainees in upper secondary education, which includes half the time of the education at a workplace (Sveriges Riksdag, 2009). Today working life demands both breadth and depth of the employees’ competences. The experimental work with trainees in upper secondary education is an attempt to meet this need. The aim is to give students a fundamental vocational education, increased work experience and advanced knowledge in the working field instructed by a supervisor at a workplace (ibid. §7). A parallel can be drawn to a study of the Swedish compulsory school, where theoretical and practical tasks were separated (Bjurulf & Kilbrink, 2008). The conclusion of the study was that theory and practice needs to be interwoven in order to help students to reach holistic learning.

The need for a better match between education and training outputs and labour market needs has lead up to the Swedish government’s intention to reform the current integrated upper secondary schooling. There will be three distinct programmes: academic; vocational; and apprenticeship training. This new upper secondary system is not scheduled to be launched before the autumn of 2011. Therefore, the government launched new apprenticeship training pilots in the autumn of 2008. The results presented in this article are a part of a wider study with two teachers, four professionals (in addition supervisors) and four students where the upper secondary school in question has been a part of the government’s investment in apprenticeship training. This study is a contribution within the field of vocational education focusing on the field of pipefitting and the field of industry, while the results could be seen as a contribution to why youths should consider studying at the Energy Programme and at the Industry Programme at upper secondary school. Pipefitting and industry have been chosen as examples representing technical trades. The study will also meet the need of qualitative research within the field of vocational education.

### *Aim and research questions*

The aim of the present study is to investigate how professionals within technical businesses describe their ways into their trade and why they have remained. This knowledge is of importance to attract youths to choose a technically oriented education.

The specific research questions are:

- What factors do influence plumbers and industrial workers to start working within their respective trade?
- What advantages and disadvantages do plumbers and industrial workers experience in their trades?

### **Theoretical grounding**

The theoretical framework of the study is grounded in the area of phenomenology (Bengtsson, 2005). Due to phenomenology there is only one world, human life-world, but depending on people's positions, perspectives and earlier experiences they conceive phenomena in this world differently (ibid.). From the phenomenological ontology follows that empirical studies are needed in order to obtain knowledge about the attractive factors within technically oriented trades.

### **Research method**

A qualitative method has been used in order to investigate factors that influence plumbers and industrial workers to start working within their trades and why they have remained. Semi-structured interviews with two teachers and four professionals have been implemented (for research questions see Appendix) (Cohen, Manion, & Morrison, 2000). The method allows modification of questions to the individual informants and for exploration of the responses. The narratives told in the interviews will be seen as a co-production in the interview situation, since the narratives are framed by the questions from the interlocutor (De Fina, 2009). This means that the narrators do not tell "anything" but recapitulations of past events, in this study concerning their career choices, constructed as responses to evaluative questions. The narratives will also be seen as negotiations. The negotiations in semi-structured interviews are about:

- insertion in the conversation (should they be told at all?)
- form (how long and detailed should they be?)
- content (what should they be about?) and
- tellability (are they worth listening?). (ibid. p. 246)

The narratives told in the interviews are also framed by the context in which they are told, for example: What stories were told to me as a female academicer? Did the narrators positively color their backflashes? The reasons for telling can be that people want to: "entertain, to resolve tensions, to justify or explain actions, to demystify and make sense of life events, to complain, to instruct and so forth" (Vásquez, 2009 p. 260). In this study the informants knew that I was interested in why they worked with what they did and why they had started to work within their trades in the first place.

### **Participants and data collection**

This article covers interviews with teachers and professionals, who all educate students in vocational study programmes in the Swedish upper secondary school. One of the teachers, Erik<sup>1</sup>, is in the Energy Programme. He cooperates with the two plumbers Ernst and Evert in the students' workplace training. Ernst works at a staffing company with 20 employees whose main field is the installation and service of different heating and cooling systems such as piping systems, tanks, boilers and other water treatments. Evert works at a company with three employees that offers the customer a complete solution for heating, cooling and electricity. Their main field is heating.

The other teacher in the study is Ivan, who works at the Industry Programme and cooperates with the two industrial workers Ingvar and Ingemar in the students' workplace training. Ingvar works at a company with 16 employees which is a supplier in mechanical machining. They produce machinery parts

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<sup>1</sup> All names in the article are fictitious

to world-leading companies. The other industrial worker, Ingemar, works at a company with 150 employees whose emphasis is in the truck industry and is specialized in cold forging, deep drawing and machining.

The choice of the informants was made with the point of departure that the teachers would work at a school at a reasonable distance from Karlstad's University and that they would teach either in the Energy Programme or the Industry Programme. Thus, a deliberate selection process was used (Cohen et al., 2000). When the selection of teachers was done and they had given their oral consent to participate in the study, two of the companies with professionals that each teacher interacts with regarding the workplace training were contacted, i.e. four companies. The senior manager at each company was contacted to approve of the employees' participation. When the managers had given their oral consent to the employees' participation in the study, these were contacted by phone and/or e-mail. They got information about the purpose of the study and all four were in favor of participating in the study. An appointment was set with each one of them, even the teachers, and I went to their workplaces and informed of section 16 of Act 2003:460 on research involving humans. All informants gave their written consent to participate in the survey (SFS 2003:460). The Swedish Research Council's research ethics were followed in the study (Vetenskapsrådet, 2002). This means, apart from the description about information and the consent requirement above, that all information, i.e. names of informants, schools and workplaces, are fictitious in the article. Neither are the municipalities where they operate revealed. The data collected about the informants are kept so that no unauthorized person can access them and this information will be used only for research purposes.

The semi-structured interviews were conducted during fall 2009. It was important that the informants felt comfortable, and therefore the interviews were conducted in familiar milieus for the informants, i.e. at their workplaces in rooms where we could sit undisturbed. The interviews lasted between 30-70 minutes (see table 1) and were recorded with a voice recorder and transcribed verbatim.

**Table 1:** Overview of the interviews

Name:	Date for interview (in 2009):	Length of the interview (minutes):
Teacher Erik	October 15	45
Plumber Ernst	October 30	60
Plumber Evert	December 23	70
Teacher Ivan	October 14	45
Industrial worker Ingvar	October 29	30
Industrial worker Ingemar	November 02	50

#### Data analysis

The interviews have been analyzed by analysis of narratives. Polkinghorne (1995) distinguishes between analysis of narratives and narrative analysis in this way: "analysis of narratives moves from stories to common elements, and narrative analysis moves from elements to stories" (ibid. s. 12). Analysis of narratives means to look for common themes, concepts or categories (see for example Goodson, 1996; Karlsson, 2006; Pérez Prieto, 1992; Rhöse, 2003). In this study I have listened to the recordings and read the transcripts several times and written six narratives about what the teachers and professionals remembered and/or chose to tell about their career and choice of career. Based on the seven interview questions (see Appendix), the narratives are written in order to describe the informants' ways into the professions and why they have remained. The introductions of the narratives are plots, which are the points of the narratives, followed by different themes that underline the plots and give the narratives meaning (Polkinghorne, 1995). When the narratives were written, the next step in the analysis was to look for similarities and differences across the stories. The differences and similarities were categorised (see table 2 and 3 below) based on the two research questions in order to respond to the purpose of the study. In the discussion these findings are discussed in the frame of previous research.

#### Results

In the following, six narratives are presented. First there are the narratives of the three informants in the pipefitting business: Erik (the teacher), Ernst (the plumber) and Evert (the plumber). Then the three

narratives of the informants in the industry business: Ivan (the teacher), Ingvar (the industrial worker) and Ingemar (the industrial worker). Thereafter follows the result of the comparison across the narratives.

### **Erik – the teacher at the Energy Programme**

Erik is a teacher on the Energy Programme at the upper secondary school and he teaches the subject Energy Technology. When I met Erik he was doing his fourth year at the school. Prior to being a teacher he had been working as a plumber for 15 years. He had always wanted to become a teacher, but he says: “I have been really scared of talking to other people”<sup>2</sup>. Erik’s father was a schoolteacher, and “he was quite authoritarian, so I thought, no, no, no, no, that is not something for me”. He also says: “you cannot just become something that Dad is”.

When Erik was in junior high school, he had school fatigue and had plans to become a professional bandy player. He therefore went to an upper secondary school which focused on sports, and studied the Energy Programme. He thinks the reason why he chose the Energy Programme has to do with the fact that two of his cousins worked as plumbers. When he graduated he got a job in a plumbing firm immediately, which was also the company he worked for during all those 15 years. He never became a professional bandy player, but continued to play alongside his work for many years. Finally, Erik retrained to become a teacher.

### **Influence**

Erik has always liked to do paperwork and to structure things. During the time at the plumbing firm, he had many ideas for rationalization. For example, he proposed that each team would have an equipped container at the industrial field. When a new project started, they would just have to lift the container on site. This rationalization would save a lot of time and money for the company: “Instead of having to prepare them each time by adding sand and tiles, build a workshop, bring all the tools and so on. To establish it took two weeks for two men, at each new project.” He also pointed out that the container could be a base for leftover material, “a small buffer that was already paid for, from previous projects”. He meant that the container would contain “screws and machinery, mounting devices, and such stuff. Basic”. Establishment takes an amount of time and Erik saw this kind of rationalization early in his career as a plumber. He says that “you don’t have to be Einstein to see it”. Erik, however, did not receive any response for his ideas from the company.

Erik resigned after 15 years at the same company. He really liked it the first few years, when it was “cozy at the company”. He was an apprentice and “I was the youngest so everyone took care of me”. After a few years there was a recession and there were not so many jobs. Therefore the company expanded by acquisition of other companies. This expansion did not suit Erik. “It is important for me to be involved”, he says. In a big company there are many wills and therefore he is convinced that there were other persons who, like him, could not bring up their ideas. But Erik resigned since he “likes it better in smaller groups”.

On the whole, Erik enjoys being a teacher: “That’s spot on, it’s my cup of tea!”. To be a teacher on the Energy Programme is an advantage, when Erik “has much of the knowledge at the tip of my fingers” since his time as a plumber. Thanks to that experience, he knows that “it is not so technically difficult to become a plumber”, but you have to be alert and “be on time and behave”.

### **Theory and practice**

During all the years as a plumber Erik has enjoyed screwing things together, but he says that he never understood what he was doing, “I just connected”. In retrospect he had wanted to understand what he did. “I like to screw things together” and as a plumber “I was fast, but I never wondered why things worked as they did”. Today he says that it is “worthless” to do things when you don’t know what you are doing and states that “it is when you become a teacher that you learn”. But he also says that he needed the experience as a plumber to get the knowledge he has, it gave him the whole picture and the insight of how to teach. He therefore always integrates theory and practice and gives an example of this:

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2 All quotes from the interviews are the author’s translations from Swedish and marked by quotation marks.

“If I want to discuss a district heating exchanger, for example I ask: what is that? Then I use the whiteboard to draw on and ask if there is somebody who knows. You can get such a discussion; the best discussions, however, come if somebody has an idea of what it is. It is much more dynamic in that way. We are buzzing about it in theory, not too long, but just to get a grip of it. Then we go out and look at it in the workshop. There the students can experience how it works. And we finish with: what did we do?”

The integration of theory and practice means that Erik both begins and ends with theory. Yet sometimes there is no need of theory. Sometimes the students only have to “get a feeling for the tools”, he says.

Erik takes the students on a tour early in the first term to give them the whole picture of plumbing. During that tour they visit different places in the municipality, such as the power station, the water catchment and the water-treatment plant. He wants the students to discern different systems involved in plumbing: heating, cooling, water and drainage. Another aim with the tour is to give the students a general view of the trade, because most students have not chosen the programme because they want to work as plumbers. Most of the students not yet have decided what they want to do after they have graduated.

### **Ernst – the plumber**

Ernst has been working as a plumber for 24 years, and he has supervised students from vocational education in upper secondary school during all his years as a plumber. He received his first wage slip when he was 14 years old. In the beginning of the career he ran errands, packaged materials, and hung up radiators. His father sold materials in the plumbing business, and Ernst knew early that it was a plumber he wanted to become. When it was time for Ernst to choose a programme for upper secondary school his only choice was to study at the Energy Program, since he wanted to be a plumber. Ever since he finished school he has been working, he has always had a job. He has worked for several companies and for the last six years he has worked for a staffing company.

#### Variation

Ernst describes his job in terms of “varying, balanced and free”. It is a “nice work”. Best of all he likes “to screw things together”. He also likes the way he meets a lot of people in his work. Within the different projects there are carpenters, electricians and ventilation fitters. They become “a cheerful gang who go together to different projects.” “It’s wonderful,” he says. Ernst describes his job as creative, a job where “you have to think”. There is a lot of planning, “you can’t stand with your hands in your pockets and hope that the material will come to you automatically. You must conceive and carry out a delivery plan for the projects.” It is a job where you “weld thick pipes or bend pipes as thin as the forefinger, which are two completely different jobs”. At the time of the interview he was working at two different places. One of the locations was built in 1948:

“We have had to knock on the walls and floors to find out where the pipes are located since we didn’t have any drawings. We have to make our own picture of how they have put the pipes, so we know how to work. Meanwhile, I have started another job, where we put in underfloor heating. These are two widely different places and two different operations.”

In addition to the differences in the tasks, the workplaces also differ: “It’s not often two workplaces look the same”.

There is nothing that Ernst doesn’t like in his job, the only disadvantage he can come up with is that his body has been battered. It is a lot of crawling in a plumber’s job, it is rare to you stand upright because “there is no one who wants the pipes at breast height, but in the ceiling or under the floor, and this affects your body.” There is also a lot of heavy lifting, there are boilers weighing 200 kilograms that must be lifted which leads to a body that “starts to speak up”. This might be a reason for Ernst to make a change in his career in the future. He has thought of working as a teacher, either as a handicraft teacher, since he likes to work with his hands, or as a vocational teacher. If he starts to work as a vocational teacher in the Energy Programme he “would be in the same branch“. If his body allows him to keep working as a plumber, however, that is what he wants to do.

“You don’t need to know when the Vasa ship<sup>3</sup> sank”

To work as a plumber you need to be skilled in mathematics, but in order “to bend tubes you have absolutely no need to know when the Vasa ship sank”. He means that craftsmen usually are good at mathematics but that they may have problems in reading. You must “be able to add two plus two plus two plus two” and also understand isometry, but “it doesn’t matter whether you think mum is spelled with one or two *m* when you are working as a plumber”, Ernst says. Concerning mathematics, Ernst uses the yardstick daily to get things in the right place. “You need to know how to handle a yardstick and you have to be able to think logically. Without the yardstick I might put the loo in the middle of the floor”, he says.

Ernst describes the “optimal clientele” for the Energy programme, and the plumbing work, as the “farmer boys who have tinkered with cars and driven a tractor”. These boys know how to work and don’t fear being dirty, “plumbing is dirty”. These boys don’t hesitate to “assert themselves”. Unfortunately these boys seldom have grades good enough to enter the programme. This means that the students who are the “optimal clientele” for the business are excluded from the profession. Furthermore, Ernst says that everyone is not suited for the plumbing job. If he gets students who fiddle with their mobile phones or stand with their hands in their pockets he sends them back to school immediately. “I never hesitate”, he says.

### **Evert – the plumber**

Evert has been working as a plumber for three years at a heating and sanitation company and before that he was working at another company for 21 years. At the other company he didn’t work as a plumber only, he did “a little bit of everything”. When Evert finished junior high school, he had school fatigue and therefore phoned different companies, he wanted to start working instead of continue his studies. He was offered three jobs immediately as a sixteen-year-old, and he chose to start on the biggest company. It didn’t matter what kind of job he got at this time, as long as it “was about screwing things together, because I have always done that”, he says. During his career Evert has been offered several jobs and when he got an offer from a heating and sanitation company three years ago he accepted, and it is at that company he is working today. He does not really know why he accepted that time and it was a hard decision after so many years in one place, but he does not regret it. Evert did not study to be a plumber, but has learnt by experience in the course of the years. “In the beginning nobody told you how to do”, says Evert, “they just said: ‘do it!’”. He has also learnt by looking at his workmates and through a lot of education within the company. For example he attended a 600-hour course in assembling. He has also worked in both Germany and Norway and acquired knowledge for himself in this way.

### **Advantage versus disadvantages**

To screw things together is the best part of the job as a plumber, according to Evert. “I have always screwed a lot of things together”, he says. When Evert grew up his father had a car repair business and when Evert was there helping out, he got to use a lot of tools. For six years Evert himself ran a car repair business beside his ordinary job. The car repair business was a kind of hobby and he spent a lot of time in the garage, he seldom came home before midnight. Eventually this hobby became too expensive, since you need computers in order to troubleshoot and reset cars today. And you also “need different computer programmes for each make of car, so it is an expensive business”, says Evert. After six years he decided to shut down the car repair business.

Evert’s previous job was at a big company where he was “inside the gates all day”, but today he goes between different places all the time. “To be out” is another advantage in his job that he compares to his previous job. But there are also some disadvantages in his present job as a plumber. The first thing is that he is not that physical active anymore, “I have increased a lot in weight”. At his formal job he walked “at least five kilometres a day” back and forth in the big industrial area, but today he spends a lot of time sitting in the car. Often he must go back and forth to get tools, pipes and so on, since it is impossible to bring everything you need in one car. Some days he spends half the day in his car. The second disadvantage he mentions is the problem of having to leave jobs unfinished, when another job is higher prioritized: “you cannot work in a bathroom if the pipes have broken because of the cold elsewhere”. But these disadvantages are no reason for Evert to change job, because he really likes all the screwing work in the

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<sup>3</sup> The Swedish royal Vasa ship sank in the middle of Stockholm harbor during the maiden voyage in 1628.

plumbing. He sees a bright future for the heating and sanitation business, since “people will always need help with their heating systems”. Furthermore are a “lot of people interested in heating since there is a lot of money to save”, he says.

As a plumber you spend a lot of time in other people’s homes. To make the customer satisfied you therefore have to be careful about not making their homes dirty, otherwise you will not have any customers in the future. Evert tells about a former colleague who walked around in a house after he had changed a boiler. There was soot all over the place, so they had to decontaminate the house. “This customer did not call us again”, says Evert. As a plumber you also need to be patient when the customer has read about how to do the plumbing. Evert says that “they know what the literature says, but you can seldom do it that way”. Moreover you have to be patient with irritated customers who expect you to be there immediately after they have called. This may be particularly apparent at a small company, which is the case where Evert is, when there are few employees and they have to give priority to some jobs. It can be rather tiresome for Evert when he has sometimes carried all his tools into a house when the phone rings and he has to move to a place of higher priority. He has to carry back all tools to the car, but sometimes he leaves some tools and thereby may lack tools at the other workplace.

#### Variation

Evert says that he likes his job because of its freedom and variation. Within the heating and sanitation business you work with different kinds of heating systems. Evert mentions: oil, pellets, geothermal heating, solar heat and earth heat. “There are a lot of alternatives”, he says, and “we must know how to do everything”. The variation is also about service and new installations. He says that “you never know what to do from one day to another”.

Evert says that there are sometimes drawings available for the jobs he is about to do, but he never follows the drawings. “The final result ends up as the drawing says, but I do it in my own way” he says. But most often there is no drawing at all and he means that every new order deserves a unique solution. He gives an example from a customer who had bought a commode for the basin. The commode had such big legs that it was impossible to place the pipes behind the legs. Evert therefore bent the pipes around the legs on the commode. This example illustrates, except from the variation in terms of unique solutions, the importance of communication with the customer. Often he presents different solutions for the customer to decide from, so “you have got to have ideas and present these to the customer, because they can’t solve it themselves”, but they must be satisfied.

#### **Ivan – the teacher on the Industry Programme**

Ivan is a teacher on the Industry Programme at the upper secondary school where he teaches the subject Production Engineering. Ivan had been working at the school for three years when I met him. He worked as an industrial worker before he became a teacher and started in the industry when he was 15 years old.

When Ivan grew up he had to move a lot because of his father’s job, a job where he built paper machines all over the world. The family therefore came to live only one and a half years in each place, places as Argentina, Brazil, Canada, South Africa, Turkey, Germany and Austria. In between the time they stayed abroad they came back to Sweden for one year. When Ivan was 15 years old the family came back to Sweden in the middle of a term and he got a placement in an industry while waiting for the next term. This was the start of his career as an industrial worker. “Ever since, I’ve been working whenever I have got a minute to spare”, says Ivan. But after 16 years in industry he had to quit, since “I became allergic to coolant”. He retrained to be an electrical- and computer engineer, but he was offered a job as a teacher on the Industrial Programme at a secondary school, which meant he never got to work as an electrical- and computer engineer. When I met Ivan he was in the midst of a supplementary training course for teachers.

#### Choice of career

Ivan’s explanation of his early choice of career is that: “I like to use my hands when I am working”. There are a lot of jobs where you could fulfil this need, but for Ivan his choice also had to do with the material he got to work with. He “was used to metal and used to material that sounded and throbbed”. When he was eight years old he started to “tinker with the moped”, and liked it. Later on, he was told to choose the technology programme at upper secondary school, because mathematics came easily to him and people said that “you have to do the four-year technology programme, because that’s what you do if you are good with

numbers”. But Ivan wanted to do something else, he wanted to work with his hands and he therefore studied two years of engineering mechanics. It took him three years to complete upper secondary school, since he during this period worked at a paper mill in Austria when his father was there as a consultant.

Ivan worked for three different companies before he had to retrain because of his allergy. His tasks differed at the three companies. In the first place he manually built hydraulic cylinders from scratch. First he built every single part and then he welded them together and finally he painted them. At the next company he learned a new part of the profession called CNC (Computer Numerical Control). He learned to use computer systems to control industrial machinery in the manufacturing industry. At the third company he went to a course in programming, because of his growing interest in computers and CNC. “If you are interested, you learn quickly”, says Ivan, “so in the end I programmed most of the machines”.

In contrast to Ivan himself, who knew what he wanted to work with early, the students today have no idea of what they want to do in the future. They come to the school without a clue of what they have embarked on. When Ivan went to junior high school “there was something called technology”. The students “saw a lathe, they saw a mill and they bent plates in a small workshop”, but today’s students “haven’t seen anything when they come to the vocational education”. Sometimes Ivan sees immediately that “this will never work out”, then he sits down with the student asking: “is this really what you want to do?”

### Theory and practice

“You must have worked in industry to be an industrial teacher”, says Ivan. You must have encountered problems in reality in order to teach them theoretically. This is also a condition when the teachers talk to the professionals about the students’ workplace training: “you must know what you are talking about”. Ivan does not “think that it is possible to have a school without any industrial environment at all and believe that the students will become industrial workers”. The students learn a lot at the workplace training, but the workplace training can never teach the students all the competences needed, Ivan emphasizes. The students learn “to cope with a situation out in the workplace, to be punctual, to get up in time, and not to make a fool of themselves”. When the youths meet adults they “grow up very fast”. But when it comes to basic knowledge about machines they have to learn it at school, because “there’s no workplace that will teach a student a machine from scratch”. Instead they “may use a machine that is all ready to run” and then they “may be involved in measuring the pieces afterwards”. But there is an “abundance of things you have to do before you push the button”. He mentions programming and setting tools as things they have to learn at school. On the other hand they receive a good knowledge of how to drive the machines and control the pieces, at the workplace training, because at a company you cannot afford to make any mistakes. The students must have knowledge about all the parts in the process to be employable. They must be able to run the machine, control the pieces and maintain the machine. The students cannot learn all of this at the workplace training, and that is why Ivan needs machines at school and emphasizes the importance of a workshop: “You can’t run everything in theory, it is not possible. There is too much hands-on application to get it work”.

As an industrial worker you have to count a lot and you also need to understand different languages. Most students today lack sufficient knowledge of mathematics when they come to Ivan at the Industrial Programme and they do not understand the need of it either. It is when they are at the workplace training that they realize that mathematical studies “is probably not a bad idea”. They discover that the welder performs his job with a robot, and bends the sheets of metal in a CNC-machine, and to do that he uses a lot of mathematics. Ivan cooperates with the mathematics teacher at the school to help the students understand that there is a need of knowledge in mathematics if you want to be an industrial worker. He even includes mathematics in his own industry lessons. For example he can give the students a problem: “If you need a piece with a diameter of 300 metres, how long should we cut the ribbon? That way they get a real problem they must solve, where mathematics is the tool.” Besides mathematics, knowledge in English is of importance in order to become an industrial worker. Ivan does not use Swedish menus in the CAD-programs at the school, since he wants the students to learn the language of the trade, English.

### **Ingvar – the industrial worker**

Ingvar has been working in a workshop for 17 years and has supervised students from the vocational education in upper secondary school for seven years. He has worked at several workshops, but never for as long as the one he is currently working for. Before he came to the workshop he thought that the motto to “never work for more than four years in one place” was a good thing, but now he likes it too much to

follow his own advice. "I'll probably stay here until I retire", says Ingvar. He describes his work as independent. He decides a lot, for example "which machines I want to use for different tasks". He also thinks: "It's simple here. If you think of something, it is easy to go and talk to the bosses. They own the company and everyone working here knows them, both here and privately".

Ingvar wanted to be an electrician when he was younger, but when he was in junior high school he had school fatigue. "Because of my bad grades, I didn't qualify for any other education", says Ingvar as an answer to why he studied mechanical engineering for two years at upper secondary school. This was his last option, but he has never thought of retraining or changing his profession. He can hardly find anything that he does not like about his job. But if it is something he likes less, it might be "if there are long runs of some product". "But it does not happen that often", he says in the next breath.

#### Required learning

"School wasn't so interesting", says Ingvar when he talks about junior high school. But there were some subjects that he liked, namely technology and handicraft, and in these subjects he had the highest grades. When he later studied at upper secondary school it went really well, actually so well that he got a scholarship for the best grades in his age group. Ivan reckons he learns easily. Since he did not become an electrician he has developed his knowledge in this field by himself. In his spare time he devotes himself to electronics and "it gets stuck in the head so incredibly easily". He likes precision mechanics and says that "I repair televisions and such things". Some years ago Ingvar attended a course about computers and even then he grasped everything.

After upper secondary school Ingvar worked at several companies in industry. "I have no training from school on controlled machines", he says, since he started as an industrial worker in an era of manually operated machines. But there is always "an education in machines", sometimes at the company and sometimes at the distributor, when the company invests in new ones. The length of the trainings varies, but is usually between two days and a week. It is not all the staff that learns every new machine, it is the interested ones and those who are going to work at the actual machine. Ingvar says that "I can handle all lathes except one. But if I were to operate it I could read about how to do it, because they are a bit different. But otherwise I know all the machines here."

#### **Ingemar – the industrial worker**

Ingemar has been working at a workshop for five years and he has supervised students from vocational education in upper secondary school for about six months. When he was younger Ingemar wanted to be a professional football player and wanted to study at an upper secondary school with a football profile. Unfortunately he became injured during the summer before he had begun at the school and hence he never went to upper secondary school. "I was injured for a whole year and there was no point in starting when I couldn't play football", he says. Instead he got a job "as a kind of apprentice" at the National Road Administration and then as a driver of excavators and wheel loaders in his father's and brother's company. He has also driven the garbage truck and worked with the control of nuclear power plants. Ingemar has been educated in-house at the different places of work. Today he has an independent position at the workshop, where he decides a lot himself, for example "which machines I want to use". He cannot find anything that he does not like about his job.

"Slipped in on a banana skin"

For seven years Ingemar worked with the control of nuclear power plants. He travelled a lot in this work and also worked plenty of hours every day. After 12-14 hours out at the nuclear power plants he had to write reports, which is why he seldom slept more than 2-4 hours. "You were always a long way behind with the reports", he says. Ingemar was able to manage this tough and lonely work as long as he did, thanks to his good physique from football training. But after six years his body did not manage the stress anymore, so he was put on the sick list in two periods of five months each. He tells that "one day I woke up and thought I had got a cerebral hemorrhage. Nothing worked." This happened during a two-week long vacation and Ingemar says that "this usually happens when you chill down". He had had heart throb earlier, but had not reflected upon it. After the sick-listing Ingemar resigned and became unemployed. His administrator at the employment office thought that Ingemar was in the carpenter's business and offered him a demolition job at a workshop. "I am not a carpenter, but I can go and look at the job", he said. He accepted the offer and

worked with demolition for one month. During the same period a man retired from the workshop and Ingemar got his job, so “I slipped in on a banana skin”, he says. He really enjoys his job. He thinks it is “so varying and you have a lot of influence”. Ingemar describes the variation in terms of different orders and different products within each order. “We may have 15 moments on each product”, he says. This makes the job varied and Ingemar does not want to get into a rut and therefore the job really suits him. He thinks he will keep working at the workshop for many years, possibly as a foreman or head of production in the future. But right now he is satisfied with the tasks he is assigned.

### Influence

When Ingemar began to work at the company he sawed subjects for the mills. He produced a lot more every day than his predecessor had done and that was his goal: “I was determined to do more than anyone had ever done”. It did not take long before Ingemar was asked to be a team leader for 5-6 men at the division of the cold-moulding press. Ingemar did not know anything about this division and he met some resistance from the men in the group who had 20-25 years experience from the division in question: “Why should I teach them something I didn’t have a clue about?” He says that they felt “walked over”. But at the same time a new system for reporting was introduced at the company. The workmates were not that interested in computers so Ingemar agreed voluntarily to do this job for his colleagues. Thanks to that he became accepted in his new role as a team leader and it also meant that he got an overview of the production and thereby saw the possibilities to rationalize. “I came to the company with fresh eyes and saw what could be improved”, he says.

Ingemar cannot handle all the machines at his division, but he knows what things must be done what day. “You need to have knowledge about the flow to get things ready in time for delivery”, he says. Every morning all teamleaders at the company have a meeting when they are planning the day’s production. The meeting ends up in a “today-note” that is announced in the workshop and then they have follow-up meetings at lunch and in the afternoon. In the production Ingemar is in charge of surface finishing and the sewage-treatment plant. In the sewage-treatment plant he makes water tests for the municipality in order to measure the rate of aluminum, copper and zinc. With a background as a calibration technician he has knowledge of steering pumps. He uses this knowledge in his work and has reduced the consumption of water in the workshop. “To manage this was great fun and the sewage-treatment plant became my darling”, he says. A challenge is to “bring down the cost of consumables”. His earlier work experience has taught him to work meticulously and this “way of thinking could be implemented here and it became approved”.

Ingemar already had the experience as a teamleader when he got that position on his current workplace, for instance in the military service and in football teams. He even says that if he should do anything else in the future it would be something where he could work with people in a position of leadership. As a leader he does not like to “lay down the law”. He wants people to feel involved and today the employees in his team are acting independently when it comes to reporting at the computer, since he has gradually taught them. They have also an overview of the production and can make Ingemar aware of the flow in the production and ask why they are not doing things in a different order. “I have made them interested”, he says and that is a good thing.

### Similarities and differences across the narratives

Factors that influence plumbers and industrial workers to start working within their respective trade

To have a clear picture of one’s goals, interests, personality and talents is referred to as *high degree of vocational identity* (Holland, (1985) in Leung, 1998). The comparison across the six narratives yields that it was only Ernst and Ivan who had clear and stable pictures of their future careers as youths, by means of choosing upper secondary programmes within their forthcoming professions. Ernst father sold materials in the plumbing business and thereby Ernst was introduced in a profession that he liked. Thus, his choice of education and thereby profession was early crystal clear. Ivan got a placement in an industry when he was 15 years old, and he liked it and wanted to remain in the profession ever after. The other four informants had *low vocational identity*. According to Holland (in Leung, 1998 p. 327), people with low vocational identity has many goals within a small number of categories, but in this study it also captures those who do not know what to do and also those who are hindered of some reason to what they actually want to. Two of

the informants with low vocational identity, Evert and Ingemar, never attended to upper secondary school but did get jobs immediately after junior high school. Evert had school fatigue and did not want to study any further and Ingemar was injured and could not make it to the education he wanted to attend, i.e. an upper secondary school with a football profile. Both of them have ever since then been educated within their companies. The last two, Erik and Ingvar, went to upper secondary school where Erik studied at the Energy programme since he had relatives in the branch. Actually he wanted to be a teacher, but by that time he was shy and afraid of talking in front of a public. Ingvar, on the other hand, wanted to be an electrician but did not qualify for any other education than mechanical engineering.

Five of the informants mention the possibility to use their hands screwing things together as an important factor that influenced them to join the profession. Four of the informants point out the possibility to get a job and an income from early years as a driving factor. Two of the informants had relatives in the trade. Table 2 summarises the comparison of the narratives where they have been categorised based on the kind of vocational identity, high or low. The table illuminates that the factors that influence people to start working as a plumber or industrial worker are the same, independently of the kind of vocational identity.

**Table 2:** Factors that influence plumbers and industrial workers to start working within their professions

Reasons	
High vocational identity	Low vocational identity
Using hands screwing (Ernst and Ivan)	Using hands screwing (Erik, Evert and Ingvar)
Income from early age (Ernst and Ivan)	Income from early age (Evert and Ingemar)
Relatives in the branch (Ernst)	Relatives in the branch (Erik)

#### Advantages of being a plumber or industrial worker

One of the primary outcomes of the research conducted is that *variation and freedom* is a major part of pipefitting and industrial work and that it is one of the reasons why the informants appreciate their jobs. This variation and freedom is expressed in different ways. It is about deciding what machines you will use, which includes the fact that there are different orders and different products within each order. It is also about different workplaces and different operations. Both as a plumber and an industrial worker you have a specific task to complete within a certain amount of time, but you get to choose what tools or machines you want to use and how the working process is going to be. The variation is also about moving between different places and that two workplaces seldom look the same. This means that you have to find out unique solutions for each place. In one situation there is a new boiler to be installed, while in the next place you service the existing equipment. You also work with different kinds of heating systems, for example oil, pellets, geothermal heating, solar heat and earth heat. Meeting people is also a part of the variation and freedom and an advantage of being a plumber or industrial worker. The industrial workers like working together with their workmates in the workshop, whereas the plumbers get to work with peoples within other trades, for example carpenters, electricians and ventilation fitters. The importance of these meetings can be illustrated by Ernst's voice: "It's wonderful" and illuminates the social aspect in being a plumber or an industrial worker.

The informants describe their jobs as *creative*, jobs where you have to think and make decisions which mean that you have a lot of *influence*. There is a lot of problem-solving included in both pipefitting and industrial work. Often you have to consider different solutions and for a plumber it is necessary to discuss the different solutions with the customer. This is because you have to satisfy the need of not only functional solutions but also aesthetic ones, i.e. there is a lot of creativity in the actual trades and within the scope of creativity are variation and freedom.

The narratives also point towards the satisfaction of *working with the hands*. Evert likes to screw things together, in one way or another, and as a plumber you do just that everyday. Erik too, mentions screwing things together as an advantage of being a plumber. Ivan made his choice of career as a teenager because he liked to work with his hands.

#### Disadvantages of being a plumber or industrial worker

All six informants have difficulty in finding any disadvantages within their trades. They are obviously people who have found their places on the earth. But the fact that Ivan and Erik changed jobs could be a reason for dissatisfaction, and thus disadvantages within their trades. In Ivan’s case, the reason for changing job was allergy. He became allergic to coolant and therefore had to retrain. And in Erik’s case the change can be addressed to organizational reforms that made him feel uncomfortable. He did not like it in a big company and this became a reason for retraining and he became a teacher, which he had always wanted to be. The fact that both Erik and Ivan are teachers within their former trades could be a sign of their contentment with the businesses, but circumstances forced them to retrain and they became vocational teachers within their former trades.

Even if the informants really enjoy their jobs, the *negative body effects* must be seen as a disadvantage. For Ivan it was about allergy and in the plumber’s work it is about bodily attrition. There are hundreds of kilos to be lifted when mounting and dismantling a boiler. The ergonomic working situation is also a disadvantage, where Ernst mentions that there is a lot of crawling: “there is no one who wants the pipes at breast height, but in the ceiling or under the floor.” The attrition could be a reason for Ernst changing job, even if he most of all wants to continue as a plumber. From the narratives it is obvious that if the informants changed jobs, it would be to something similar to their current occupations. Evert mentioned that it would be something that involves a use of tools.

Evert mentions the dissatisfaction in having to leave jobs unfinished, when another job is higher prioritized. This *fragmental* also means that there is a lot of time used to carry tools and material in and out in the car and also that you sometimes lack tools you have left at another workplace. Another kind of disadvantage is mentioned by Ingvar, who says that long runs may be a disadvantage, i.e. *uniformity*. Table 3 summarizes advantages and disadvantages of being a plumber or industrial worker.

**Table 3:** Advantages and disadvantages within pipefitting and industrial work

Advantages	Disadvantages
<p><i>Variation and freedom:</i>            “It’s rare that two workplaces look the same” (Ernst)            “varying, balanced and free” (Ernst)            “a cheerful gang who go together to different projects.” (Ernst)            “you never know what to do from one day to another” (Evert)            “freedom and variation” (Evert)            “which machines I want to use” (Ingvar)            “We may have 15 moments on each product” (Ingemar)</p>	<p><i>Negative body effects:</i>            a body that “starts to speak up” (Ernst)            “I have increased a lot in weight” (Evert)            “I became allergic to coolant” (Ivan)</p>
<p><i>Creative and influence:</i>            “It is important for me to be involved” (Erik)            “you have to think”(Ernst)            “you have got to have ideas” (Evert)            “bring down the cost of consumables” (Ingemar)            “I decide which machines I want to use for different tasks” (Ingvar)</p>	<p><i>Fragmental:</i>            ”you cannot work in a bathroom if it has frozen apart elsewhere” (Evert)</p>
<p><i>Working with the hands</i>            “I like to screw things together” (Erik)            “to screw things together” (Ernst)            ”I have always done a lot of screwing things together” (Evert)            “I like to use my hands when I am working” (Ivan)</p>	<p><i>Uniformity</i>            “if there are long runs of something” (Ingvar)</p>

**Summary of the results**

The aim of the study was to investigate how professionals within technical businesses describe their ways into their trade and why they have remained. Through analysis of interviews with two vocational teachers and four professionals six narratives were constructed. Two of the informants had high vocational identity, they had clear and stable pictures of their future careers as youths, and four of the informants had low vocational identity. In the six narratives it emerged that the factors that influence people to start working as a plumber or industrial worker are the same, independently of the kind of vocational identity:

- To use your hands to screw things together.
- The possibility to get a job and an income.
- If relatives work in the branch.

However, once in the job you want to stay there. The six narratives constitute three main advantages of working within the pipefitting and industry businesses, which can be seen as reasons for remaining within the trades:

- Variation and freedom
- Creative and influence
- You get to work with your hands

On the negative side of working in the pipefitting and industry business you can see some problems to handle:

- Negative body effects
- Fragmentary
- Uniformity

### **Discussion**

Regarding a fast and constant development of technology in societies all over the world, there is an increased need of people's technological competence. Sweden and other industrial countries need educated researchers, engineers and technicians in order to maintain a strong position as an industrial nation in a globalised era (Achtenhagen & Oldenbürger, 1996). This means that youths must be attracted to choose technically oriented education- and career paths, in order to fulfil this need. The study reported in this article is therefore intended towards the field of technology education, since it contributes with knowledge about technically oriented trades from the employees' perspective. The aim of the study was to investigate how professionals within technical businesses describe their ways into their trade and why they have remained. The study was conducted with the focus on the field of pipefitting and the field of industry, while the results could be seen as a contribution to why youths should consider studying at the Energy Programme or at the Industry Programme at upper secondary school. The study is based on a small sample, which limits the possibility to draw long about the situation, but the six narratives contribute with arguments important for both academy and the commercial sector in recruitment. In the following the results from the study are discussed in the frame of previous research.

The results indicate that it is not obvious to have the future structured when you are 16 years old, since four of the six informants were unsure about their future careers in junior high school. Therefore the new Swedish pilot project with trainees and workplace training in upper secondary school seems to be a good way to clarify what the profession as a plumber and industrial worker is about and the advantages with the trades (Sveriges Riksdag, 2009). This study does not investigate what the youth's concerned think in the question about future careers, but both teachers in the study say that their students do not have any idea of what they want to do in the future. They begin their training without a clue of what they have embarked on, which can be compared to four of the informants in the present study and also to Frost (1992) who found that career choices often are delayed until late in the school programme. Frost (ibid.) also found that career rewards including earnings has impact on career choices, an aspect of importance for the informants in this study too. It was not in terms of earning lots of money, but the possibility to get an income in early years that affected the choice of career.

One main factor important for being a plumber or industrial worker, expressed by five of the six informants in this study, is the possibility of using hands screwing things together in the daily work. Many of the subjects in compulsory school, and also in upper secondary school, are focused on reading and writing. An alternative to the established school system may therefore be to choose a technically oriented education such as the Energy- or the Industrial programmes, after junior high school - knowing that both

the education and the future career include handiwork. Another reason for becoming a plumber or industrial worker proved to be relatives in the branch, a crucial aspect corresponding to Frost's (1992) study. The familiarity and knowledge about the content of a profession, such as pipefitting and industrial work, may be the reason for a young person's choice of career. In Leung's (1998) study, talented students had problems in finding their future career roles because of their lack of knowledge and information about different alternatives. Thus, there is a need of information about the content and the advantages within pipefitting and industrial work in order to attract youths to these branches. With examples of the advantages presented by young professionals within pipefitting and industrial work, it may be possible for young people to identify themselves as potentials for these branches. However, the arguments must be related and adjusted to the actual culture to promote the technical education as important for the students (Auyeung & Sands, 1997). According to the informants in this study there also seems to be a need to grab a wider clientele, for example the farmer boys who do not have grades enough, for the upper secondary vocational education. The educational system for recruiting new students are only based on grades and future possibilities for entering school by other criteria are therefore needed.

Even if the ways into the trades was not obvious from the beginning, all of the informants in this study have remained in pipefitting and industry for many years, from 5-24 years and are all satisfied in their professions. Furthermore are they convinced that there is a bright future in their trades, with many jobs. The informants express satisfaction concerning the variation and freedom within their professions. They appreciate the challenge of solving different problems and thereby have influence, be creative and take responsibility for their choice of solution. To be creative includes problemsolving, which emerged as finding unique solutions in different contexts and also to communicate and satisfy the costumers' needs in the narratives. Thus, problemsolving is an important ingredient that constitutes the basic content of the two trades. Problemsolving stimulates the personal development by a need of knowledge and competence. Concerning the competence in this type of business, the study illuminates that both pipefitting and industrial work presupposes successive learning (compare to Frost, 1992). The informants have good experience from workplaces and education offered by the companies, both internal and external courses. Another important ingredient in the trades is the combination of theory and practice. This study shows, for example, that mathematics is embedded in both pipefitting and industrial work. Students in vocational education and training are given the opportunity to see the importance of being skilled in mathematics when the study programme is organized with half time workplace training, i.e. the knowledge of mathematics becomes applicable in real life. These results support the idea of interweaving theory and practice (Bjurulf & Kilbrink, 2008).

When it comes to the disadvantages within the professions negative body effects can be a reason why people have to leave their jobs, even if they don't want to. In this study, the informants were affected by negative body effects such as allergy and bodily attrition. This result points to the need of a development in material and equipment within technically oriented trades in general, and in pipefitting and industrial work in particular. The need of technicians in different fields also becomes obvious according to this study, technicians prepared to design and build innovative products aiming to facilitate technically oriented trades. Fragmental and uniformity was also mentioned as disadvantages in this study, but more or less incidentally and by one informant per disadvantage only.

## **Conclusion**

In the results factors that influence people to start working within technically oriented trades appeared: 1) to use the hands screwing things together, which is a significant content in the professions, 2) to get an income, which is an argument for choosing professions with a bright future in terms of available jobs and 3) if relatives work in the branch, which indicates that insight and information in the professions is important for recruitment. The reasons for staying in the professions were significant content within the technically oriented trades: 1) variation and freedom, 2) creativity and influence, and 3) you get to work with your hands.

Based on the study it is not obvious for young people to know what they want to do after graduation. But the study, based on a small sample, also shows that even though the ways into the trades was not obvious from the beginning for everybody, all of the informants in this study have remained in pipefitting and industry for many years, five the least and 24 the most, and are satisfied with their professions. The reasons for staying in the professions, which emerged in this study, could therefore be arguments for recruiting students to these educations. The study, and previous research, also points at the potential to attract youngsters to the technical field by offering work practice, earnings and career awards.

The study also points at a need of making changes in the Swedish recruitment system, and possibly in other educational systems, in order to offer a chance for students suited for the programmes but who have not the grades to qualify for the education in upper secondary school. When the overall situation and the international trends ask for technicians and when different efforts in different countries try to stimulate the attraction and interest for this field, there must be possibilities for youths talented for the requested professions to enter the educations even if the grades from junior high school are not good enough. This study shows that school fatigue may be a reason for the insufficient grades, but within a school system with plenty of time at the workplace the youths may realise the meaning of knowledge in mathematics, languages and so on, and they thereby may be motivated to learn the subjects they struggled with in junior high school. Through the workplace training the students also get a richer picture of the profession which enhance their possibilities of grasping the requirements for being employable. The next part of the longitudinal research project, in which this reported study is included, is therefore to investigate what and how the students learn at the workplace and in school, i.e. how do the two contexts contribute to the students' learning.

### Appendix: Interview questions

How long have you been working for this company?  
 How come that you did start working here?  
 What did you do before you came here? (other jobs, education etc.)  
 What would you work with if you were not working here?  
 What do you like the most about your job?  
 What do you like the least about it?  
 What do you think you will be doing in 5 years? 10 years?

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