Safety culture in an aircraft maintenance organisation: A view from the inside

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ABSTRACT

This article deals with a case study about the safety culture of an aircraft maintenance organisation. The case study provides ethnographic accounts based on participant observation, interviews and document analysis. Safety culture is specifically related to the development and growth phase of the organisation and explicitly relates safety culture to production interests. The analysis focuses on the various roles and the tensions between the quality assurance and maintenance management departments, and the way aircraft maintenance technicians (AMTs) in practice deal with tensions between safety and production interests. Theoretically this article stresses the value of a process view on organisational development for the analysis of safety culture and the paradoxical relationship between safety and economic interests.

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1. Introduction

Aviation is closely associated with safety culture, not so much because of a high rate of incidents but rather because of the severe consequences in case something goes wrong. Travel at high speeds and high altitudes in complex traffic systems means that even small human and technical errors can quickly lead to disasters. Air traffic involves a typical case of low probability/high consequence risks, and aircraft manufacturers and airline companies do what they can to prevent accidents and safety incidents from occurring. As a rule, such organisations claim to put ‘safety first’. Safety should also be regarded as crucial for the reputation of such organisations. Companies involved in the manufacturing, operation and maintenance of aircraft therefore heavily invest in safety measures and carefully guard their safety image. However, ‘safety’ is not an objectively given condition, but rather a socially constructed and relative organisational property dependent upon organisational values, meanings and safety practices (Gherardi et al., 1998, p. 143; Richter and Koch, 2004). Organisations may indeed put ‘safety first’, but what this means in practice may depend on the technology at hand, the kind of organisation and the changing market conditions under which these organisations operate.

Because of the comparatively high levels of risk awareness and preventive measures airlines and other organisations in the field of aviation can be regarded as so called ‘high-reliability organisations’ (HRO) (Weick and Sutcliffe, 2001). As we can learn from TV series such as ‘Seconds from disaster’ and ‘Air crash investigation’, it is by now part of popular understanding that accidents in today’s HROs are not caused by a single mechanical or human failure. Extensive researches into disasters such as the nuclear melt down at Chernobyl (Reason, 1998), the Boeing 747 collision at Tenerife (Weick, 1990) or the explosion of space shuttle Challenger (Vaughan, 1990), typically focus on the chains of events which caused these disasters. When such disasters are studied more closely, organisational problems are often revealed as being part of the causal chain of events. Indeed, in safety studies there has been a shift away from individual factors that might be responsible for accidents towards organisational factors (Kingma, 2008; Chang and Wang, 2010). Safety culture should be regarded as the organisational dimension par excellence for addressing safety in HRO’s because this concept explicitly refers to the way safety issues are handled in organisations (Pidgeon and O’Leary, 1994; Richter and Koch, 2004).

This article deals with safety culture in an aircraft maintenance company. Aircraft maintenance is generally regarded as crucial for aircraft safety (McDonald et al., 2000). At the same time aircraft maintenance is a remarkably under researched link in the overall system for ensuring safety in aviation. Of course, the maintenance records are immediately checked in case of aircraft accidents, but apart from these after the fact investigations and regulatory monitoring, maintenance organisations are usually hidden from public view and only indirectly known to social scientists. It therefore should be considered as a unique advantage for our research and this article that one of the authors for several years worked as an aircraft maintenance technician (AMT), and in 2008 for several months also conducted explicit field-work on the topic of safety.

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1 In aircraft maintenance the professional positions are hierarchically divided in four classes: A = mechanic, B1 = technician, B2 is avionic technician and C = base maintenance engineer. In this article the concept of AMT includes all classes. In some examples we will specify the AMT as mechanic, technician or engineer.
culture in – and with the consent of – the aircraft maintenance company under scrutiny. The view from the inside presented in this article is consequently partly based on the views of an insider.

In this article we first discuss the concept of safety culture in relation to the wider organisation. Subsequently the case study and the aircraft maintenance company will be introduced. After that we analyse the various aspects of this organisations' safety culture, in particular the tensions between the safety and production strands of organisational culture. Finally we discuss the findings and highlight the paradox between safety and economic interests and the value of a process approach for studying safety culture.

2. Safety culture

The term ‘safety culture’ emerged in scientific debates on safety largely after the Chernobyl disaster in 1986 (Cooper, 2000, p. 113). The concept is often loosely used to describe the corporate culture in which safety is understood to be the number one priority. In this article we view safety culture as a ‘focused aspect of organisational culture’ (richter and Koch, 2004, p. 705; richter and Koch (2004) define safety culture as ‘the shared and learned meanings, experiences and interpretations of work and safety – expressed partially symbolically – which guide peoples’ actions towards risks, accidents and prevention’. This aligns with Pidgeon and O’Leary’s (1994, p. 32) definition of safety culture as ‘the set of beliefs, norms, attitudes, roles and social and technical practices within an organisation which are considered with minimising the exposure of individuals both within and outside an organisation to conditions which are considered to be dangerous’. Reason (1998) metaphorically described the ideal safety culture as an engine that drives the organisational system towards the goal of sustaining resistance against unsafe acts.

Initially, the field of social psychology dominated studies into risk and safety cultures (Tierney, 1999). There are a number of reviews about the methodology and content of these safety studies, which tended to study safety culture as a special, separate part of the organisation (Choudhry et al., 2007; Glendron and Stanton, 2000; Guldenmund, 2000). Most of these studies consider risk and safety as objectively quantifiable entities and use surveys and questionnaires to picture safety cultures. In such studies culture is understood as something that organisations have rather than what they are. The functionalistic overtone of such studies, in which safety and culture are largely defined and explained in terms of organisational outcomes, is usually also favoured by managers and practitioners (Cooper, 2000, p. 114). However, an isolated focus on safety may disconnect the topic of safety from the broader organisational context, the organisational cultural framework and power structures which might be crucial for understanding safety culture. For this purpose a view in line with bate (1994), who considers organisations as cultures, is more appropriate. This way of thinking about organisational culture leads us to consider products of organisations, including safety standards, incidents and accidents, as cultural ones.

In an aviation maintenance organisation, services provided, repairs performed and inspections carried out can all be analysed as cultural products. We approach safety culture from this wider organisational perspective and argue that organisational cultures evolve through time in a dynamic relation with a wide range of organisational resources. According to Schein (1985) culture refers to the following questions: How are things done in particular organisations? What is acceptable behaviour? What norms are imparted to new members? What norms are members expected to use to solve problems of external adaptation and internal integration, and which ones do they actually use? Schein (1985) distinguishes between three levels of organisational culture. The artefact level represents the artefacts such as buildings, interior, ceremonies, uniforms or a poster. Level two indicates the explicitly formulated organisational norms and values. This is the level where strategy, goals and the right way of acting are formulated and consciously expressed. The third level is about basic assumptions, which lie hidden beneath the artefacts and values. This level shapes the employees’ way of thinking and behaviour. Although Schein’s approach offers a good start for analysing organisational culture, the approach is at the same time restricted. It has in particular been pointed out that Schein's focus on the shared nature of cultural meanings one-sidedly views organisational culture from an integrative perspective (richter and Koch, 2004). However, in practice organisational culture, including safety culture, is often to a greater or lesser extent differentiated (Alvesson, 2002; Gherardi et al., 1998; richter and Koch, 2004). This differentiation may result from a wide range of structures including external influences and internal differences in power, gender, leadership, tasks, groups, spatial layout, experience and knowledge.

To address cultural differentiation we follow an approach as suggested by richter and Koch (2004), who base their approach on the work of Martin (2002) and Alvesson (2002). They apply Martin’s (2002) three perspectives of ‘integration’, ‘differentiation’ and ‘fragmentation’ to the field of safety culture. And they extent this analytical divide with Alvesson’s (2002) concept of ‘multiple configurations’ in order to characterise organisational culture (richter and Koch, 2004, p. 705). In short the ‘integration’ perspective refers to the shared understandings in organisations. In contrast the ‘differentiation’ perspective focuses on the lack of consensus and the existence of sub-cultures. The third perspective, ‘fragmentation’, highlights ambiguity and a lack of clarity and conflicting or changing meanings in organisations. As stressed by Martin and also by Richter and Koch these perspectives co-exist, the balance between these perspectives is often unequal and one perspective may dominate the others. Our research and this article basically aim to analyse the texture of a maintenance organisations’ safety culture in terms of integration, differentiation and fragmentation.

In safety studies, a dominant group of scholars is in accordance with the integration perspective. But some studies clearly reveal a differentiated texture within the safety culture (Clarke, 1999; McDonald et al., 2000). Some studies also highlight the ambiguity (Besco, 2004; Gherardi et al., 1998; Weick, 1990). Gherardi et al. (1998) indicate that ambiguity is situated at the heart of social construction of safety since consensus and dissension are issue-specific and constantly fluctuating entities. They conceive of safety as ‘an emergent property of a socio-technical system, as the end product of a process of social construction involving people, technologies and texts assembled into systems of material relations’ (Gherardi et al., 1998, p. 203). In their empirical analysis of the safety culture of three companies, richter and Koch (2004, p. 720) found that integration in the safety cultures was rather weak, whereas differentiation and ambiguity were much stronger.

We will try to move this debate a little further by adding a process view of organisational development and by explicitly relating the development of the safety strand of organisational culture to the development of the production strand. Culture can metaphorically be conceived in terms of a cable having many strands. Safety culture might be one of them. Since we focus on frameworks of meanings rather then on organisational groups (Bateau, 2000), we also conceive of office functions in terms of the management of meaning. For instance, quality offices in aircraft maintenance organisations seek to manage safety, including the meanings of safety, and the production related offices seek to also manage ideas concerning production. Different strands of culture may tend towards integration, differentiation or fragmentation as they evolve...
through time. And changes in one strand may affect the development of another. Top management may for instance try to increase integration around production values while the safety strand suffers from a lack of attention and ambiguity.

Although in the debate on safety culture sometimes distinctions are made between ‘safety culture’ and ‘safety management’ (McDonald et al., 2000, p. 153), we will in this article consider the management dimension of safety as integral to the meaning making regarding safety in organisations. Regarding management McDonald et al. (2000) claim that the reason for many accidents in the airline industry is deeply rooted in organisational and management factors. Managers may for instance recruit and promote management factors. Managers may for instance recruit and promote and encouraging poor performance may dilute employees' perceptions about the right way of doing things (Besco, 2004).

In this article we aim to unveil how the texture of safety culture evolves through different phases of organisational development, and how various organisational actors in each phase attempt to influence safety culture. The life cycle of an organisation is often roughly divided into three phases. Martin (2002, pp. 142–144) relates these phases to the subsequent dominance of fragmentation, integration and differentiation perspectives. In the first phase, uncertainties about the present and the future of the organisation make the differentiation perspective dominant, and the integration and the differentiation perspectives are suppressed. In the second phase financial problems and survival instincts make that the integration perspective dominant over differentiation and fragmentation. As the company matures in the third phase of development the differentiation perspective becomes the dominant overall perspective on organisational culture. For instance, when an aircraft maintenance organisation gets into financial problems, employees may start to work harder and longer to help the company's survival, just like in phase two of Martin's (2002, p. 143) start up company. But there are more things to see in this phase. Rose (1990) for instance indicates that lower profitability is correlated with higher incident rates, particularly for smaller carriers. Thus, when cultural integration takes place around production values of the organisation in order to survive, the safety strand of culture may at the same time become fragmented, resulting in incidents and accidents. This is the central hypothesis we explore in this article. An organisation may experience a shift in dominance of cultural overtones. In times of difficulties a maintenance organisation may aggressively try to reach production goals, whereas after a near miss the same organisation may concentrate on safety issues.

3. The case study

3.1. Ethnographic methods

Although some safety studies recognize the value of ethnographical research (Choudhry et al., 2007), there is not much ethnographic work in the field of safety, except for a few pioneering works (Farrington-Darby et al., 2005; Gherardi et al., 1998; Richter and Koch 2004). Approaching safety culture with an ethnographical stance means that we seek to understand the social world of members in a maintenance organisation through immersion in their everyday activities to produce detailed descriptions of the cultural actor's activities (Neyland, 2008). This means that we embrace an interpretive, insider, subjective and qualitative point of view. Beyond the statistics of safety records, surveys and safety models, lie the often unheard stories concerning the everyday life of managers and AMTs. In our research we bring these stories forward in order to show how safety culture is interrelated to other aspects of the organisation.

Qualitative methods locate the researcher in the world of the researched. In the case of this research one of the researchers was, as an AMT, since 2003 even part of the organisation and conducted focussed participant-observations in the second half of 2008 while still working for the company. This laborious endeavour consisted of making field notes, interviews, conversations, observations, interpretations and a personal ethnographic account with reflections of the researcher. The method of auto-ethnography proved of great value to our research. Boyle and Parry (2007) point to the value of auto-ethnography for exposing the reader to stories that would otherwise be ‘shrouded in secrecy’ (Ellis and Bochner, 1996, p. 25):

‘Hence, organisational autoethnographies can provide firsthand accounts of taboo topics such as sexual harassment and bullying, motherhood at work, various moral dilemmas and highly charged emotional situations in the workplace. These are situations that otherwise remain shrouded in secrecy, or are considered “untouchable” by serious organisational researchers.’ (Boyle and Parry, 2007, p. 189)

In our case the topic of how one deals with, and deviates from, safety standards should be regarded as such a sensitive topic, which is susceptible to social desirable response but can be uncovered through participant observation and auto-ethnography.

We extensively address the position and role of the participant observer (PO) because participant observation forms the core-method of this case study. The position as an AMT gave the PO rather easy and almost complete access to the research field. Since 2003 the PO has himself experienced the pride of the profession, the joy of accomplishing a task, the frustrations of being neglected, and the dilemmas between cost, safety and, to be honest, self interest. The PO did not merely experience these work aspects but also talked about these, listened to stories and discussed them with fellow workers. By participating in the everyday life of the organisation the PO was able to gain insights which otherwise definitely would have remained hidden, since information about safety issues is extremely difficult to get via other research methods. Ex employees might for instance be willing to talk, but in that case there is a great risk of getting biased statements and, more importantly, there are hardly options for checking on these statements.

During the participant observation data was recorded by taking notes of important events. Wolfinger (2002) calls this method of documenting events according to their importance 'the salience hierarchy'. We also compared notes with organisational memorandums to pin point and match other details. However, we have to admit that in some cases we solely had to trust the PO's memories. In order to prevent misinformation, we tried to match these memories with information from other sources such as documents and informants. The events and incidents mentioned in this paper are carefully noted and compared with other sources such as official company documents.

Additional interviews with different cultural actors were necessary in order to represent actors own experiences, motivations and interpretations. A short and semi structured topic guide was used to obtain in-depth interview data (Ritchie and Lewis, 2003). The interview scheme has been enriched with some enabling and projective techniques to trigger thoughts, feelings and experiences of respondents (Will et al., 1996). The idea was to extract the respondent's interpretations by providing several cases and incident
reports during the interviews. In total five in-depth interviews were conducted, including three AMTs, someone working at the quality assurance (QA) office and a maintenance manager (MM). These individuals represent the range of organisational strata involved with safety issues.

Finally, next to extensive participant observation and some in-depth interviews, documentary analyses were employed. Documents partly served to increase the level of accuracy and reliability of the research (Golden-Biddle and Locke, 1993). The studied documents included organisational memos, in particular quality assurance memos and management memos, emails, joint aviation regulation documents (JAR), maintenance organisation expositions (MEO), and incident reports. The documents were very helpful in exploring the formal procedures and the official arguments of different organisational actors (McDonald et al., 2000). Memos and incident reports proved for instance useful in validating differences in opinion between quality and maintenance managers.

3.2. The development of the company

The research for this article has been conducted in one aircraft maintenance organisation and therefore deals with a single case study. In order to safeguard the identities of informants and the company’s name, it will be referred to as Alfa aircraft services (AAS). AAS is one of the major independent maintenance organisations in Europe. This company has experienced several mergers since its foundation in the mid 1970s. The last merger took place in 2001. Since then AAS has grown by taking over maintenance tasks from airline companies and by expanding business to various countries in Europe. The top-management, appointed in 2001, was in 2009 still in charge of the company. Most of the employees agree that the company owes its success to a new business philosophy: increasing efficiency for better financial results and performance as a professional organisation. AAS delivers different aircraft maintenance services including line maintenance, base maintenance, corporate jet maintenance and night stop services. These tasks are performed on the aircrafts of the operators. AAS itself does not own aircraft. Being an independent maintenance provider, the market-focus on customers, the necessity of finding customers and satisfying them in quality and cost of their services has a huge impact on the organisation. Aircraft maintenance is performed at two different locations. Small line checks, including pre-flight inspections, daily and weekly checks and trouble shooting procedures are carried out on the airport apron (parking areas close to the passenger terminals). This is called line operation. Major checks and repairs are carried out in a hangar.

Between 2001 and 2009, AAS succeeded to enlarge its workforce from about 45 to about 260. Three distinct phases of development can be discerned, more or less in line with Martin's (2002, pp. 142–144) model of cultural change mentioned above: The start, the development and the maturation phase. In the start phase between 2001 and 2003, AAS was doing low profile jobs for foreign airlines, such as push backs (assisting to push aircrafts backwards from parking spots), pre-flight inspections (a small check performed before each flight), daily checks (a maintenance check performed once a day) and night stop services (including removing power from the aircrafts, closing and sealing doors). AAS’s focus on foreign airlines can also be seen on the organisational slogan of this period: ‘Your destination is our station!’. In these years AAS also tried to survive by renting out excessive manpower to other companies. There were no certainties about the future of the company. At the end of the start phase AAS employed around 20 AMTs representing over 50% of the technical staff, used every necessary means to resist the organisational changes. In particular safety issues became a new front for the old guard to resist the new management and the changes. Safety was used as the ultimate resource to use against the new management team. Safety related issues were exploited to work less hard or to write extra over times. Sometimes rules and regulations were followed precisely and some other times checklists were not done completely. In this period the safety arena witnessed a polarization between the new management and the old guard. Safety related norms were used by the old guard to regroup and organise themselves and persuade young recruits against management strategies. In this period the safety strand was clearly part of a fragmented organisational culture. The safe way of working or the proper way of doing a task was unclear. But the old guard lost their struggle and many left the company. Playing the safety card to resist change brought no success for the old guard and the organisation’s new cultural texture developed further.

The PO’s account of this period was quite chaotic. Even though he could clearly see the conflicts between the different camps, as a newcomer he was unaware of the historical background to these conflicts. Concerning safety, his questions were numerous. What was the right way of doing things? Should he defer a problem or try to rectify it? Would it be acceptable in this company to use short cuts? He sticks to the rules in order to overcome confusion. But even though the checklists were clear, there were evident mismatches between the rules and the daily practices. The PO mimics behaviours of colleagues to fit into AAS. His reference points for this were senior AMTs. He considered them as role models, as representatives of the desired culture. While AAS entered a new phase of development, he became part of the company.

After 2003 AAS went through a rapid growth phase. Two new customers signed full maintenance contracts with the company. These new customers were outside AAS’s conventional customer profile because AAS mainly used to perform low profile jobs. The whole organisation was very eager to start with the more extensive operations. A new slogan, ‘Here we are!’ was a manifestation of this new ambition. This slogan was a bold, self confident and a challenging statement to the whole airport. Top-management and the work force wanted to show the whole airport that they were able to manage a total maintenance concept. Managers and AMTs were all eagerly speaking about how they could accomplish the more complex operations.

In the first phase the old guard strategically used safety issues in their resistance against changes and the new management. But in the second phase, the old guard was marginalized and almost eliminated from the organisational scene. In this period a new polarization emerged. This was the polarization between quality assurance (QA) and maintenance management (MM). Aircraft operators had outsourced tasks to AAS because they assumed that AAS could perform these tasks more efficiently and cost effectively. AAS was very aware of this fact and therefore gave great emphasis on production goals. It was the task of MM to guard these goals and to implement an efficient way of working. This focus on productivity forced QA to counter act because of its legal responsibilities to local and international regulatory authorities. In a way QA filled the vacuum left by the old guard. And the young work force in their turn started to use QA as a shield against the productivity push of MM.

In the second phase the safety strand suffered because of the integration of organisational culture around the values of efficiency and productivity. Even though QA tried to defend the walls of safety culture, MM had much better organisational resources to deploy. Every one knew about the insecure market position of AAS. AAS had to succeed in productivity gains in order to prove its capabilities to (potential) customers. Employees were therefore willing to do overtime and some people even worked double shifts. In
spite of a constant shortage of manpower, the AMTs succeeded in keeping the maintenance delays below the usual values. But behind the heroic stories about these achievements there were alternative stories about the pressure that was put on the safety strand of culture which suffered from a lack of attention.

Was the PO lost in this integrative texture concerning productivity? What was the main objective? Did not he know which route to follow when he faced a technical problem? Even though he was not following QA rules precisely, he knew what to do. When he signed an aircraft to fly while it was not airworthy from the QA perspective, he was well aware of the conditions under which he was doing that. He was drawn into a new discourse on safety which stressed a flexible and practical attitude and which was used to justify his actions. He did not want to be a trouble maker and tried to be a part of AAS by adapting to the new norms. But the PO did not feel comfortable with this situation. He formally left AAS, started to work for himself and thus became an outsider and an insider at the same time. As a freelancer he avoided any conflict with MM and for him QA's discourse on safety became secondary.

The second phase was rounded of, and the maturation phase started, after AAS succeeded to close yet a new and major maintenance contract in 2008. In the third phase increasing the number of customers, marketing and profitability were no longer the primary goals of the organisation. Instead, the organisation devoted more attention to customer satisfaction, quality management, internal issues, employee relations, and new recruitments. AAS had to double its work force to meet the demands of all its customers. Advertising stickers saying 'Do you want to work solo or together?' were put on company cars and office buildings to attract new employees. AAS's overall statement became: 'We never let our employees put on company cars and office buildings to attract new employees. AAS's overall statement became: 'We never let our employees put on company cars and office buildings to attract new employees. AAS's overall statement became: 'We never let our employees put on company cars and office buildings to attract new employees.

Fig. 1 provides an overview of safety culture in the subsequent phases of AAS.

### 4. Safety versus production

In this section we analyse the safety and the production strands of organisational culture, including the organisational actors and their respective safety related practices. This section leads to a detailed analysis of three revealing safety related maintenance events. This way of analyzing organisational culture enables us to

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Fig. 1. Safety culture in subsequent phases.
highlight the interactions between the two cultural strands, safety versus production. The analysis in particular addresses posters, documents and maintenance events. The MM office and QA office will be regarded as central organisational spaces.

4.1. The safety strand and quality assurance (QA)

As indicated in the theoretical section, the safety strand constitutes organisational culture together with other cultural strands. The QA department is responsible for managing the safety strand. The function of this department is tightly regulated by international and local regulations, the national civil aviation authority and joint aviation authorities [JAA]. What QA actually does is managing safety culture in accordance with the demands of external regulatory actors. The main objective of QA is to prevent poor maintenance which might result in accidents. This task starts with the strictly regulated education of maintenance personnel. The same authorities that control QA also strictly control the education of AMTs. The training of AMTs continues during the entire course of their employment. Next to training sessions QA continuously shapes shared understandings within the technical staff by means of posters, memos and specific safety instructions.

During the growth and development of AAS these tasks and responsibilities of QA were under pressure of the focus on productivity. An employee of the QA department clearly underlined this pressure: ‘In those days, safety was somewhat neglected and the pressure came from the production side’ (Interview QA, December 2008). An AMT expressed his concern regarding this phase about safety as follows:

‘Every time you sign off a not airworthy item, you are signing your life away. Every read and sign paper, all those courses were meant to cover up their sins. There was no real QA policy, they reacted [to safety incidents] instead of preventing. I was expecting things to go badly then but they were lucky.’ (Interview AMT, December 2008).

While safety culture was neglected because MM aggressively pursued production goals, top-management also did not give full priority to safety culture. In his talk during a coffee break a QA manager said, just before his resignation from AAS: ‘It is not as easy as it may seem to manage a post like QA in here. It is not only implementing rules and policies but also negotiations with top-management. I did not have the freedom I wanted to have.’ (Talk QA manager, summer 2007).

In the second phase, when QA became more active, this department mostly relied on written communication and face to face interaction like courses and trainings. QA addresses several cultural layers. An immediately visible artefact concerns for instance this poster Fig. 2 on professionalism on the hangar wall.

Such posters are a self-evident part of the standard working environment, to the extent that the AMTs barely notice them anymore. The AMTs have internalized their messages. The (to be shared) understanding of the identity of a professional AMT, as expressed by the posters, functions as a direct and continuous reminder about the ideal professional attitude at the shop floor. The ‘I’ on the poster refers, of course, to the licensed AMT. The quality of the work that these people deliver, and therefore their professional attitude, is crucial for aircraft safety.

The QA department further communicates with technical personnel mostly in a written form by memos. The memos are usually framed on the basis of safety incidents. From these incidents QA derives conclusions regarding the correct ways of performing specific tasks. Memos urge engineers to fill in technical logs in the right way, follow the aircraft maintenance manuals, and provide definitions of maintenance terminologies. QA gives training to AMTs in small groups. These quality trainings are often framed around the twelve items presented in Fig. 3., also referred to in literature as the ‘dirty dozen’ (Dupont, 1997). These items address the basic safety related pitfalls of maintenance work.

The ‘dirty dozen’ are considered to be the main cause of human related safety problems in aviation. There are many forms of dirty dozen posters spread around the hangar and the line maintenance centre. These posters depict situations in which AMTs face a challenge with one of the twelve pitfalls. By memos, read and signs, meetings and courses QA tries to reinforce awareness and create a consensus concerning these pitfalls. QA continuously tries to focus the AMT’s way of thinking, habits and perceptions, all with an eye to assuring the quality of performed tasks and airworthiness of course. For QA really ‘nothing is above air safety’. A closer look at one of the dirty dozen items, with the help of a memo (Fig. 4), may clarify the quality manager’s perspective further. This memo was copied from the read and sign files of 2005 and falls in the development phase of AAS.

QA thus investigates near misses, discusses the incidents with the involved staff and management, and then publishes memos of QA. QA aims to stimulate collective learning by distributing detailed descriptions of the incidents. And as part of the collective learning process, QA opens these safety issues to discussion during training sessions. These trainings all end with the question ‘How can we avoid such incidents from happening again?’ Then QA proposes improvements, sanctions or new rules regarding the discussed maintenance tasks.

Above we described the methods that QA employs in managing safety culture. Deviance is not tolerated and lessons learned from

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I am a professional because I ….

- have acquired specialized knowledge.
- achieve my status by accomplishment.
- make decision based on my specialized knowledge.
- make decisions based on conformity to a standard and not on self interest.
- am dedicated to quality workmanship.
- place the safety of the aircraft above my personal gain.
- do not allow circumstances to sway my judgment from correct course of action.
- belong to a voluntary association of fellow professionals.
- have a strong pride in my profession.
- and reflect this pride in my work.

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Fig. 2. A poster’s text on professionalism.
Mistakes reinforce the consensus regarding safety culture. Thus QA strives for an integrated texture within the safety strand of organisational culture. But how is it possible that AMTs make mistakes, despite many years of strictly regulated and harmonized education, numerous quality trainings during employment, numerous posters to remind them of the right professional attitude, and despite hundreds of incident memos? In the next section we explore how the inner texture of the production culture and the role of MMs may put pressure on the safety strand of organisational culture.

4.2. The production strand and maintenance management (MM)

AAS is an independent maintenance organisation and not the technical department of an airline company. AAS owes its survival to efficiency. Delivering better services against lower costs, and

Dirty dozen:
1- Lack of communication
2- Lack of team work
3- Norms
4- Pressure
5- Complacency
6- Lack of knowledge
7- Lack of awareness
8- Lack of resources
9- Distraction
10- Assertiveness
11- Fatigue
12- Stress

Fig. 3. The ‘dirty dozen’ of aircraft maintenance.

Incident
During descent, the right hand engine hydraulic pump warning appeared, just after the left hand engine hydraulic pump warning came. The reset attempt was unsuccessful. A priority (PAN-PAN) landing was requested by the flight crew. The landing was uneventful.

(After MAYDAY, PAN-PAN is the second highest safety alert. When announced by the flight crew it is directly followed by emergency procedures at airports.)

Investigation:
One day before the incident a brake unit replacement was performed and the hydraulic reservoir was refilled. The hydraulic reservoir was filled beyond the normal level and it was not pressurized. Appropriate maintenance data was not used. No aircraft technical log entry was made about the replenishment of the hydraulic fluid. Low hydraulic tank pressure in combination with an overfilled hydraulic tank caused the lack of hydraulic supply to both hydraulic pumps which eventually caused cavitations and the failure of the pumps.

Conclusion:
Procedures for replenishing the hydraulic system had not been carried out according to the aircraft maintenance manuals which resulted in an overfilled hydraulic tank. The failure of performing the task in accordance with the appropriate maintenance data is indicated as the direct cause of the incident. The following human factor principles have contributed to this incident: Lack of knowledge, ignorance of norms and complacency.

Fig. 4. A safety related memo by quality assurance.
flexibility to deploy manpower in an optimal way, is essential for AAS. Therefore, also the position of MM is crucial to the company. Unlike the position of QA, MM is structurally situated directly in between the AMTs and top-management. MM directly translates top-management’s demands into action for AMTs. MM may face severe pressure from above in times of crises, because then organisational survival might ultimately be at stake. In the following quote a new MM explains to a senior AMT, during a coffee break somewhere in the winter of 2007, what top management expects from MM and AMTs: ‘One hand needs to know what the other hand is doing. That is why I want to know exactly who is where and who is doing what. We have to pull the harnesses a bit tighter. These men need to be set to work. That is why we have been sent here.’ Another MM explained this core task as follows: ‘We are here to earn money, keep the wheels turning and motivate people to make money.’ (Interview, December 2008)

In the development phase the number of AAS’s MM managers increased from one to six. These six are supervised by the technical director. They all have technical backgrounds. With their hands-on experience and been-there attitude, they have a strong influence on the AMTs. Unlike the QA managers, MM managers interact with AMTs directly on a daily basis. Especially for the young AMTs, the MM can even function as a role model. The MM only reached his position by climbing several hierarchical steps of the organisation. They often enter the organisation as mechanics on the shop floor, they then become technicians, senior technicians, engineers and finally MM managers. A young recruit therefore admires him and easily accepts him as a role model. This respect is the main reason why MM has such a great influence on the AMTs. In addition MM also plays a key role in deciding who will receive particular trainings and who will become engineer and senior engineer.

The communication between MM and the AMT is based on face to face interaction rather than in written form as in the case of QA. Memos from MM mostly address punctuality, customers, contracts and operational procedures. MM does occasionally publish memos concerning human safety factors, but only in so far as these have operational consequences, for instance regarding delays. We did not come across memos in which MM memos were in direct conflict with QA. We demonstrate the difference in focus with the following MM memo (Fig. 5). This memo was also taken from the read and sign files of 2005 and therefore also refers to the development phase of AAS.

We can easily see the difference between this MM memo and the safety related memo by QA discussed in the previous section. There is a clear shift in focus from airworthiness to commercial issues. Similar to the QA memos the importance of following the procedures is always emphasized. The difference in focus between QA and MM deepens, and becomes more complicated, at the shop floor level. In the following section three events from first hand experience will be discussed that further specify the (changes in) tensions between QA and MM.

### 4.3. Three maintenance events

#### 4.3.1. Event one: values and power

In this event, which took place in 2005, the PO was asked to install a flow control valve. The previous shift had already removed the old valve but due to a lack of new seals the new valve was left uninstalled. The PO received the manuals and seals needed to finish the job. While preparing the installation he noticed that he had not received the correct seals. He called MM to ask if they had anything left in the office. The MM manager responded: ‘This is the second time that they are ordering the wrong part numbers. This can not be. How am I going to explain this to the customer? We can not wait one more day, just install the parts’. However, the PO showed the MM manager how bad the seals actually were. The MM said: ‘These parts are coming from Airbus but a taxi costs too much, via normal channels it will arrive no earlier than tomorrow morning. We have to get that thing back there; I will schedule a gap between the flights as soon as possible to replace the seals. Okay?’ The PO could not confront this MM manager any further and returned back to the aircraft quite worried. Airbus engineers were at the same time working on the aircraft. The PO asked them when they would be ready. The PO subsequently exaggerated the given estimate and contacted the MM manager once more. He told him that the Airbus engineers would not be ready before the next day. Only then did the MM agree to halt the installation of the flow control valve until the proper seals had arrived.

If the PO had acted in line with QA, he should have rejected the use of the damaged seals in the first place. He did not do that but did not install the parts either. On the one hand QA wants the AMT to act according to manuals and check-lists regardless of operational demands and pressure. On the other hand MM is more flexible and wants to get things done. As long as an AMT gets the work done, the path followed is not that important for MM. At the time of this incident the PO worked for AAS as an external contractor, which means that he worked for them only if there was work to do. It was entirely up to MM to decide upon the hiring of the PO. So, MM was at that time the key organisational figure for the PO.

In this event we not only see differences in the values between MM and QA (flexibility and practicality versus rules and regulations), but also a difference in power between MM and QA vis-a-vis the AMT, a difference in power that in practice can be difficult to circumvent by the AMT.

#### 4.3.2. Event two: QA used as a shield

This event took place in May 2008. The PO was helping a colleague AMT with the pre-flight inspection of a Boeing 737 NG aircraft. He did not have the maintenance license for this type of aircraft and his colleague only had a limited authorization for pre-flight inspections. The colleague discovered a hydraulic leak from the left hand strut. This leak was already known for some time. The colleague called the MM manager and told him that he could not sign the pre-flight clearance because he did not have the necessary authorization. He asked the PO to report the leak to the MM manager. The PO showed the MM manager how bad the seals actually were. He called Airbus to check if there were any available seals. When he had confirmed that there were enough seals, he called the MM manager again. The MM manager responded: ‘These parts are coming from Airbus but a taxi costs too much, via normal channels it will arrive no earlier than tomorrow morning. We have to get that thing back there; I will schedule a gap between the flights as soon as possible to replace the seals. Okay?’ The PO could not confront this MM manager any further and returned back to the aircraft quite worried. Airbus engineers were at the same time working on the aircraft. The PO asked them when they would be ready. The PO subsequently exaggerated the given estimate and contacted the MM manager once more. He told him that the Airbus engineers would not be ready before the next day. Only then did the MM agree to halt the installation of the flow control valve until the proper seals had arrived.

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**Fig. 5. A safety related maintenance management memo.**
the full authorization. The MM could not find an AMT with a full authorization and finally had to ground the aircraft. In this event we witness an AMT confronting the MM manager. That action of the AMT, referring to the dirty dozen, can be classified as an example of assertiveness. This is in contrast with the previous event in which the AMT lacked assertiveness due to his dependence on MM.

For a superficial observer such incidents are difficult to interpret. Only if one can emphatically creep under the skin of the AMT a meaningful interpretation becomes possible. For, the AMT in the present event had a complex motivation for his action. He knew that according to QA norms he had to ground the aircraft but at the same time he knew the financial consequences this decision would have. Besides, he was also endangering his professional reputation as an experienced AMT, by failing to judge the limits beyond the official ones. Being able to judge limits beyond the official ones relates to the mastering of knowledge and skills and is mostly put forward by MM. In the present case the leak had been signed off for days, so why should the AMT object to signing it of now? In this event MM had also agreed with the customer to fly the aircraft in this condition. Even the pilots knew it and were ready to fly. So, the AMT’s decision should not only be interpreted in relation to the QA norms but also in relation to other organisational circumstances. From personal talks with this AMT we know that first, the AMT was pushing MM in order to give him a full authorization course for the particular aircraft. Secondly, the AMT was countering the aggressive approach by MM. Finally, his decision should partly also be understood as a subversive response to organisational changes he did not agree with. In a number of cases we observed similar responses by some marginalized old guard AMTs.

In sum, we suggest that neither the AMT in the previous maintenance event nor the AMT in the present event had a fixed stance regarding the norms and values of MM and QA. Rather, when MM crosses a certain line in the work pressure, AMTs seem more inclined towards following the strict way of working ordered by QA. AMTs then use QA as a shield against MM pressure.

4.3.3. Event three: time pressure

This event occurred in the autumn of 2007 and deals with a so-called ‘go/no-go’ decision. The event highlights that line maintenance is done under strict time constraints. Usually within the timeframe of an hour the aircraft has to be prepared for the next flight. When a problem occurs, pressure is put on the AMT to solve it as soon as possible. In this case an Airbus A320 aircraft arrived with a de-icing problem on the windshield. The PO studied the technical logs and saw that this problem had a history. He knew that replacement of the windshield was the only solution. Since it was not possible to perform such a task without grounding the aircraft, he checked the so-called ‘minimum equipment list’ (MEL). This list indicated that this problem was a ‘no-go’ item under icy conditions. The PO suggested to sign the aircraft off since the problem was not visible on the ground. However, the pilots were initially not willing to take the risk. The PO then went to the MM office and while he studied the options he overheard a conversation between the MM manager and the customer representative. The PO did not intend to ground the aircraft but thought it best to defer it to the MEL so that it would be the pilot’s decision and responsibility. The PO had the following discussion with the MM manager:

MM: ‘If you don’t sign it off, I will go and do it my self. What is the problem anyway? The pilots are now willing to take it as it is. Their maintenance control is more than happy to see it flying.’

PO: ‘Why should we risk ourselves? How much do they pay for a turnaround [a pre-flight inspection]? It is not worth it. Let them decide. If we just defer the problem, then it is their problem to decide. What would the authorities do if something happens?’

MM: ‘Nothing will happen.’ And talking to the customer representative: ‘Can you give the pilots to me?’ Talking with the pilots now: ‘My AMT will sign it off under one condition: Whatever happens with the windshield you will not land back here but continue! We don’t want to have any problems with the authorities.’

MM: ‘Are you signing it off now? Otherwise I will do it myself!’

Under the pressure of their headquarters, the pilots were willing to take the aircraft as it was. The PO returned to the aircraft and signed the technical problem off. In the second phase of AAS this was not an unusual maintenance event. It was considered normal for MM to influence the AMT in order to make him decide in line with the customer’s needs and the commercial interests of AAS. Thus, even though an AMT has obligations and freedom to act in accordance with the safety norms, these norms may be eroded in practice under the time pressure of line maintenance in combination with pressure exerted by the production strand of culture.

5. Discussion

In line with our theoretical framework we now discuss the interaction between safety and organisational culture. Overall the safety standards in the researched organisation were definitely regarded as appropriate by most of the employees. However, assessing safety standards is not the primary aim of this article. Our aim was to investigate the (changing) meanings of safety in relation to organisational culture. More specifically, we studied the inner texture of safety culture in Martin’s (2002) terms of fragmentation, integration and differentiation.

Our case study dealt with an aircraft maintenance organisation named AAS. We focussed particularly on the process dimension of organisational development. Previous studies into safety cultures clearly demonstrated the existence of different kinds of safety cultures within and between organisations. Richter and Koch (2004, p. 714) described for instance three types of safety cultures, which they metaphorically called the ‘production’, ‘welfare’ and ‘master’ culture. These types of safety cultures differed in the acceptability of risk, the attitude towards accidents and preventive measures. In addition to this we would like to stress the importance of a process view in which one can analyse the development of safety cultures over time and, more importantly, find out the causes and consequences of these safety cultures in relation to the wider organisation. In this respect we found a clear shift in the safety culture of AAS from, in terms of Richter and Koch (2004), a ‘production’ oriented to a ‘master’ oriented type. Where in the production oriented type productivity is key and risk taking is acceptable, in the master oriented type risk taking is unacceptable and production is guided by professional safety standards. In line with Richter and Koch (2004) we also stress that one can never speak of a unified safety culture but should rather speak of a ‘multiple configuration’ of safety cultures. In contrast with Richter and Koch we did not only find weak integration of safety cultures but, especially in the maturation phase of AAS, even a rather strong integration in which tendencies towards differentiation and fragmentation were suppressed. This contrast can be attributed to the type of organisation. Safety simply serves as a primary concern in an aircraft maintenance organisation, which therefore should be classified as an HRO in the first place. In the development of this safety culture we discerned three subsequent phases as summarized in Fig. 1.

The first phase demonstrates that, even in an HRO, the idea that safety comes first is not self evident. In the empirical part of this article we outlined how the QA department manages safety
culture. Posters, memos and trainings are deployed to reinforce safety standards and foster a professional safety climate. However, the role of QA was in the first phase rather passive while the top management of the new organisation sought to integrate the organisational culture around new values concerning productivity and customer interests. This change and the new management were resisted by the old guard of AMTs. For a newcomer like the PO the safety culture was confusing and he therefore clung to senior AMTs as role models. In this period the organisational culture was fragmented and safety was clearly under pressure of production goals. In the daily practice of maintenance work this could lead to events as described in 'event two', where AMTs strategically used safety issues and strictly followed the prescribed rules in order to defend their position against management pressures to cut short on safety. It is a well known fact that ‘if every one followed procedures to the letter, production would be hugely delayed’ (McDonald et al., 2000, p. 173). What AMTs seem inclined to do, when MM crosses a certain line in putting up the work pressure, is work-to-rule and follow the strict way of working ordered by QA.

In the second phase, QA started to interact more actively with MM, partly because of the vacuum left by the marginalized old guard and partly because of an increasing number of safety incidents – a number of AMTs shared the impression of this increase. QA intensified its interference to counteract the strong focus on production by top management and MM. However, the integration of the company’s culture around production values did not so much end the beating down of safety standards but rather the beginning of a transitional phase in which QA and MM negotiated safety standards. An increasing number of organisational actors got involved in these negotiations but QA and MM were the focal departments where the organisational interests of safety and productivity were played out. These actors related, as we have seen, their understanding of safety to their specific organisational practice, i.e. their position, tasks and identity within the company. In particular MM tended to frame safety standards in terms of production interests. From the viewpoint of actor-network-theory the emergence of a new safety culture went together with the translation of safety into the terms of the various organisational actors involved (cf. Gherardi et al., 1998).

Gherardi et al. (1998, pp. 208–210) showed for instance a clear difference in the explanation model for accidents used by the engineers and the site-managers of a construction firm. By focusing in our case on the modifications of QA as well as MM a differentiated organisational culture, safety is itself shaped by the production environment which on its turn is deeply affected by safety standards. The development of safety rather involves a redefinition and a re-organisation of the entire production context.

6. Conclusion

With this article about safety culture in an aircraft maintenance company we wanted to make a clear case for the cultural and contextual analysis of safety from an ethnographic point of view. Our aim was to decode the inner working mechanism of safety culture and to understand this culture as the outcome of wider organisational processes. For this we adopted a process view on organisational development and applied the three perspective view of Martin (2002) as also suggested by Richter and Koch (2004). We have seen how safety culture became problematic in the startup phase of the newly formed company AAS that resulted from a merger. Safety culture was problematized by the ‘old guard’ of AMTs, but the weak structural position of QA and top-management’s focus on productivity as implemented by MM led to the relative neglect of safety interests.

The tensions between safety and economic interests at AAS can itself be presented as a highly specific and localized part of a more general change in the neo-liberal regulation of aviation, in which privatization, increased competition and commercial interests might put safety cultures to the test. Therefore, it is important to focus on the mutual shaping of safety and organisational culture. In the case of AAS we analyzed in particular how ultimately a new meaningful configuration of safety and productivity emerged in which safety and production interests matched. However, this new organisational culture did not come about overnight and without struggles. This culture emerged out of a transitory phase characterised by an integration around production values in which QA and MM struggled and negotiated practical safety standards. With this we have highlighted the paradoxical relationship between safety culture and its production context, and what this paradox in practice means for the everyday work of AMTs who, often under great time pressure, have to creatively deal with conflicting interests. What our case particularly reveals is the need for a sound internal safety system with a structurally strong position for QA. Top-management should also unambiguously align safety with the company’s commercial interests. For regulatory agencies which control, and airlines which outsource to, maintenance companies, our analysis suggests the need for a shift, as more generally advocated by Power (2007), from a standard-based to a risk-based mode of control, in which the work of external control agencies is redefined in terms of ‘the control of control’. The self-regulation within maintenance companies then becomes a primary concern. In the case of aircraft maintenance companies this would entail the monitoring of not only safety procedures but also the organisational preconditions such as the position of the QA department and the market strategy and economic viability of the company.

References


McDonald et al., 2000, p. 173) suggestion that aircraft technicians form ‘a strong professional sub-culture, which is relatively independent of the organisation’. According McDonald et al. (2000) this ‘professional sub-culture mediates the effect of the organisational safety system on normal operational practice’. As we have seen, as a freelancer the PO could in the third phase rely on professional work ethics and safety standards. In the daily practice of maintenance work this could lead to events as described in ‘event one’, where the AMT himself creatively matched safety and production interests.

In a differentiated organisational culture, safety is itself shaped by the production environment which on its turn is deeply affected by safety standards. The development of safety rather involves a redefinition and a re-organisation of the entire production context.