HOW CAN AVIATION REGULATORS RETAIN EFFECTIVENESS IN A PERFORMANCE-BASED ENVIRONMENT?

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ABSTRACT

Regulation of aviation has entered into a deliberate and noticeably movement away from purely compliance-based regulation towards performance-based regulation, by which the providers and operators are required to reach a certain level of performance, while being granted a larger degree of freedom to choose the methods to achieve their target. Hence the focus of the entire aviation community is shifting to the performance of organizations and their safety management systems, and a change of the regulation, the safety oversight and thereby the role of the regulators becomes necessary.

This thesis is focused on the consequences of the regulatory changes to safety and questions if the regulators are capable of achieving the desired safety improvement; the thesis reports on a qualitative study of the common experiences of the European aviation community on how to retain effective regulation in a performance-based environment. It points to areas of concern as well as to positive implications of the on-going development towards a performance-based environment.

The thesis demonstrates a positive attitude towards the change in safety regime, but concludes that a lack of common understanding of the concepts related to performance-based regulation is a shared experience between all actors in the European aviation community and that more guidelines are needed. The research likewise points to an imbalance in resources and competencies between regulators and regulated entities as well as across different states in the region.

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LIST OF ABBREVIATIONS

AMC   Acceptable Means of Compliance
ANSP   Air Navigation Service Provider
CAA   Civil Aviation Authority
EASA   European Aviation Safety Agency
EU   European Union
GM   Guidance Material
ICAO   International Civil Aviation Organization
NSA   National Supervisory Authority
PBR   Performance Based Regulation
SMS   Safety Management System

INTRODUCTION

This thesis project emerged from my professional background as a regulator and my personal experience with the challenges of a regulatory organization in a changing regulatory environment; I am concerned about flight safety in general and the regulatory safety oversight in particular.

Historically regulating aviation safety has been done by laying down rules and requirements with which the service providers and operators had to comply; this dates back to the beginning of the more widespread commercial flying after World War II, which caused the creation of the International Civil Aviation Organization (ICAO) in 1944. ICAO has, ever since its creation, been the forum for international rulemaking. Over the years, as flying and especially commercial flying has increased, more regulations to comply with were implemented when the need arose; subsequently the regulatory regime known as compliance-based regulation became the basis of the societal safety assurance and the authorities' safety oversight (Dekker, 2006).

A change of the safety regulation philosophy and regime has been developed over at least the past 30 years, e.g. in the building regulations since the early 1980's and in the forestry regulations since around 2000 (Meacham, 2010; Hoberg & Malkinson, 2013); aviation regulation has, during the first half of these 30 years, undergone minor changes. Approximately 15 years ago, after aviation and space accidents e.g. the Alaska Airlines 261 and the Columbia Space shuttle, which attracted huge public attention and pointed to flaws in the regulation of an increasingly complex domain, regulation of aviation then entered into a deliberate and noticeable movement away from purely compliance-based regulation towards performance-based regulation (ICAO, 2013c). The performance-based regulation requires the service providers and operators to reach a certain level of performance, while being granted a larger degree of freedom to choose the methods to achieve their target; the argument for the change was to increase the level of safety and efficiency (Eurocontrol, 2000; Eurocontrol, 2001; EC Commission, 2005; ECA, 2013). ICAO (2013c) reflects in a flyer about the Global Aviation Safety Plan (2013 edition) on the continued development needed by stating: "The midterm objective therefore represents the evolution from a purely compliance-based oversight approach to one which proactively manages risks globally through the identification and control of existing or emerging safety issues. The target implementation date for the mid-term objective is 2022." (ICAO, 2013c, p. 2).

Considering the implications and challenges of this movement for the regulating authorities, a long list of uncertainties arises:
- How does such an innovation in safety occur?
- And how does the regulatory work change (including the safety oversight)?
- Are the drivers for change really increased safety (and efficiency) as stated? Or is it rather driven by the need for increased efficiency due to scarce resources and the political exemption of liability for this fact?
- What are the conditions of work for and the requirements aimed at the regulator in a situation of changing regimes in general?
- And, more specifically, what are the conditions of work for and the requirements aimed at the regulator following the implementation of the new set of performance-based regulations?
- Who considers the possible outcome (positive as well as negative) of a change, given the level of resources and competencies of the regulators?
- And what are those possible outcomes?

This thesis is aimed at identifying both areas of concern and possible mitigations to these problems in order for the aviation sector to remain safe during the on-going change to a performance-based environment.

LITERATURE REVIEW

Searching the literature in this area provides relevant perspectives from scientists, who as a response to accidents, where the regulatory process was perceived as a contributory factor, were focusing on system safety and organizational shortcomings. Inspiration can be found especially from Dianne Vaughan (1996), who wrote about the normalization of deviance and structural secrecy, Erik Hollnagel's (2014) viewpoints on "Safety II", i.e. focusing future safety management practices on successes, Woods, Dekker, Cook, Johannesen & Sarter (2010), who accounted for the complexity of cognitive systems and flaws in organizational life, Jens Rasmussen's (1997) theory about risk management as a control problem requiring a system-oriented approach and Sidney Dekker's (2011) ideas on bureaucratic accountability. Despite studying these scientists and many other perspectives and informed debates (described in further details below), it seems that answers and theories, which are focused on the regulator's influence on and capability to support successful implementation of safety innovations were scarce (Geest et al., 2003; Dees et al., 2006; Njå et Solberg, 2010; Hoberg et Malkinson, 2013; Bloom et al., 2014); subsequently, an interesting topic for a thesis project could be how regulators can retain effectiveness in a world of changing approaches to safety?

One initial thought was, after visiting Rasmussen's article (1997) around risk management in a dynamic society, that his reflections and figures, which argued for control mechanisms to regulate the industry, were also true for the general concept of regulation in a dynamic society. Rasmussen states: "The socio-technical system involved in risk management includes several levels ranging from legislators, over managers and work planners, to system operators. This system is presently stressed by a fast pace of technological change, by an increasingly aggressive, competitive environment, and by changing regulatory practices and public pressure."(Rasmussen, 1997, p. 183); this description seems pertinent to the present European aviation community, placing the regulator in between the government and the companies, and under influence of changing political climate and public awareness. Building on that and Rasmussen's statement that regulation is a control mechanism, the schism of the regulatory capability to support safety innovations could be illustrated as Rasmussen's risk model, depicting the triangle of moving boundaries to economic failure, to acceptable workload and to acceptable performance and putting the regulator in the tight spot in the middle (Rasmussen, 1997); Rasmussen states: "In particular during a period with a fast pace of change, it is important to analyze how effectively information of changes of technology, processes, and policies are communicated. This analysis identifies the control structure, the information flow *content* and serves to determine whether the decision makers *can* make the appropriate risk management decisions and whether their mutual interaction *is capable* of a coherent safety control function." (Rasmussen, 1997, p. 196). Another question would then be if the figure merely indicates the normal difficulties of all regulatory work rather than a specific situation during changing regimes?

Definitions and prerequisites

To examine how regulators can retain effectiveness in a world of changing approaches to safety, the literature was further explored with the aim of identifying ideas and theories in this field; the initial challenge became to locate useful definitions of effective regulation.

The literature describes a number of different and in some cases opposing theories on how to create and maintain safety. A common denominator is that safety has traditionally been seen as the avoidance of accidents, and the responsibility for this as belonging to the regulator of the specific domain (Dekker, 2011; Hollnagel, 2014). This implies that effective regulation can be defined as regulating the domain to a level, where accidents are avoided. Geest et al. describe in their report on aviation safety management in Switzerland, the output of a state safety policy: "Armed with the necessary resources and powers, the civil aviation authority FOCA uses the legal framework (and furthermore the guidance from the department) to regulate the industry in order to ensure that the operators behave in accordance such that the desired safety performance is achieved." (Geest et al., 2003, p. 30). Assuming that the desired safety level would be to avoid accidents, this supports the views cited above.

Based on the above, the following definition of effective regulation is used in this research:

- Effective regulation is providing the legal framework and the necessary guidance and performing safety oversight of operations to ensure that the safety performance of the total system meets an acceptable and defined level of safety.

Another veiled statement in the question above emerges from the choice of the word "retain"; in this research this implies, that regulators used to be sufficiently effective, thus making the question rather value-laden; nevertheless this formulation is maintained, while setting the prerequisite that:

- Retaining effectiveness of regulators should result in a stable or increasing safety performance level.

Historical safety developments in general

Since the early safety theories, based on Newtonian ideas such as the relationship between cause and effect, the regulators way of fulfilling their responsibility became requiring specific behavior and checking the compliance with requirements; this is reflected in ICAO documents and annexes as well as in national Danish legislation published in the 20th century (ICAO, 2013b) Scientists stated already in the beginning of that century that humans were responsible for the unsafe acts (Heinrich, 1931) and that workmen were only suited to follow procedures created by management (Taylor, 1911; Dekker, 2006); it was therefore relatively easy to believe, that if barriers were put in place, i.e. procedures were created in accordance with requirements and adhered to by the workforce, safety would be assured (Reason, 1990). At the same time, as the public and politicians during the 20th century saw more and more examples of accidents in many domains, a need for the regulation to afford the society protection from harm also kept tightening the compliance-based regulation (Dekker, 2012). Moving beyond this safety view towards a systems view, which considers the context of the work, the complexity of the interactions, the comprehension of tight coupling and the centralization of organizations did not foster seminal changes to regulation; it rather tightened the requirements (Perrow, 1999).

As safety science developed with more ideas, research and new arguments it still did not change the fundamental idea of compliance-based regulation of safety critical organizations (Rochlin, La Porte & Roberts, 1987; La Porte & Consolini, 1997; Hollnagel, Woods & Leveson, 2006). When scholars such as Turner, Starbuck and Milliken, and later Vaughan and Snook began to explore the gap between work as described and work as done, attaching different labels to the phenomena like fine-tuning, path dependency and practical drift, it revealed yet another constraint in the compliance-based way of regulating; most states and international organizations like ICAO (in the domain of aviation) however replied by tightening the compliance-based regulation even more (Turner, 1978; Starbuck & Milliken, 1988; Vaughan, 1996; Snook, 2000).

Progressive safety science argued that complexity was a major factor in system safety. The complexity theory provided new perspectives focusing on interactions between components, risk management and organizational behavior (as opposed to merely individual behavior) and introducing safety management as a control problem (Rasmussen, 1997; Leveson, 2002; Leveson, 2011; Hollnagel, 2004; Woods, Dekker, Cook, Johannesen & Sarter, 2010; Dekker, Cilliers & Hofmeyr, 2011).

Historical developments in regulation of aviation

In the aviation domain, regulation followed the pattern of many other domains; regulating in more details and overseeing compliance with the regulations have followed each new safety theory and this has historically demonstrated great safety developments (Dekker, 2011). The areas of safety improving regulation has shifted from technical and physical requirements (concerning airframes, airports, communication and navigation equipment etc.) over requirements to the human contribution (certification, language proficiency, Crew Resource Management etc.) to end at present time by looking for improvements of the organizations, their safety management and the supporting processes (Arendt, 2012; ICAO, 2013a).

The focus on organizations was formally introduced to the European aviation domain in 2000, when the Eurocontrol Safety Regulation Commission adopted a set of requirements for the use of safety management systems (SMS) by Air Traffic Management providers. When introducing this changed approach to safety, the safety responsibility was clearly stated, while the topic of accountability remained unspoken of: "The prime responsibility for the safety of an ATM service rests with the service provider. Within the overall management of the service, the service provider has a responsibility to ensure that all relevant safety issues have been satisfactorily dealt with, and to provide assurance that this has been done." (Eurocontrol, 2000, p. 9). These requirements were a few years later made directly applicable for European states by the European Commission; in 2005 the European Commission issued common requirements for Air Navigation Services, including requirements for the Air navigation Service Providers' (ANSP) organizational structure and their management of quality and safety, as well as requirements for the National Supervisory Authority (NSA) concerning certification and on-going safety oversight of the ANSPs (European Union Commission, 2005). With the implementation of Regulation (EC) 2096/2005 (and later revisions), the responsibility and accountability concerning aviation safety in Europe became shared amongst regulators and the ANSPs. The regulation is in parts rather nebulous, which has led to years of debating the level of performance and the safety management of the ANSPs; this debate might have slowed down further implementation of performance-based regulation while simultaneously advancing the continuous changes towards an even more performance-based environment.

Regulation during changing conditions

Despite the large amount of scholars who have progressed safety theories in general, it seems that the area of regulation during changing conditions is only vaguely described; literature concerned with the issue seems to be focusing on changes in more physical prerequisites (political, societal or economic changes) than a change of the fundamental theoretical philosophy and safety regime.

Rasmussen (1997) claimed as part of his theory about risk management being a control problem, that the classic top-down approach to regulation would become inadequate in dynamic situations. This claim is supported by Diane Vaughan, who describes how changing political and economic conditions influences the conditions for the regulator, affecting the regulator's autonomy as well as the interdependence between the regulator and the object (Vaughan, 1996). Along the same line of static versus dynamic situations, Wang, Qiang, Chen & Yi-chong discuss the historical and cultural influence on the role of the regulator in Japanese nuclear regulation and propose a set of preconditions to obtain an effective safety regulation; likewise Bloom, Henson & Peters account for the historical, economic and socio-political influence on regulation of health care focusing on low and middle-income countries (Wang et al., 2013, Bloom et al., 2014).

Lessons learned about regulatory short-comings

Investigations of accidents in many domains have found that insufficient regulation and especially inadequate safety oversight are contributing factors to accidents; it is obvious that these deficiencies in regulation can be the result of developments in the operational "real" world, which are not being endorsed by regulation. Reports have pointed out how the complexity of operations, the goal-conflicts of the authority and the involved organizations, and in some cases a remarkable interdependency hampers effective oversight; recently the complex web of regulations on global, regional and national levels and operations divided in several states have proved to contribute to the competent authorities loosing the overview (Vaughan, 1996; Snook, 2000; Wang et al., 2013; AAIU, 2014; Dees et al., 2006; Geest et al., 2003).

In the wake of several accidents involving Swiss operators or service providers, together pointing to an adverse trend in Swiss flight safety, the Swiss Confederation in 2003 ordered an evaluation of the safety of the aviation domain in Switzerland; it was suspected that structural causes of the safety trend could be identified (Geest et al., 2003). Amongst the issues being scrutinized was the changed role of the Swiss Civil Aviation Authority, FOCA; the context in which their safety oversight was performed was heavily influenced by the on-going privatization, corporization and reorganization of air navigation service

provision. At the same time no clearly stated safety policy was published, which hampered the regulation of the entire domain. The report concludes: "that active and explicit safety management is required to further improve the level of aviation safety." (Geest et al., 2003, p. 32); it further concludes that the Swiss authorities were lacking in both the area of safety management processes as well as in safety management organization, which of course made it even more difficult to adjust to a change of role and responsibility.

Another interesting study of the outcome of a series of political decisions, which led to a number of changes in the Norwegian aviation domain, likewise deals directly with the safety implications of the changing conditions. The authors describe how risk and safety were only considered at a later stage of the change management process, and then mainly with the purpose of either legitimizing or counteracting the changes; safety and risk were not assessed on empirical studies, but on subjective opinions (Njå & Solberg, 2010). The report concludes that any changes and their related implications on safety must be seen in a power context; safety considerations will be traded off against political, economical and cultural goals, and thus the concepts of risk and safety are not presentations of objective truth (Njå & Solberg, 2010).

The previously mentioned reports on the Swiss and Norwegian aviation regulation in the aftermath of major changes to the framework regulation reveal amongst other things the problematic change of the basic understanding of safety towards a systems view. Besides these sources, the topic of retaining safety and effective regulation during times of changing conditions is rather unexplored.

Recent challenges in the aviation domain

European aviation regulation is presently undergoing a major change from compliance-based regulation towards performance-based regulation; the amendments have been developed, following similar shifts in other domains, e.g. building and forestry regulation (Meacham, 2010; Hoberg & Malkinson, 2013; Kneepkens, 2012). The main argument for the change of regulation regime claim that safety regulation in a compliance-based environment has reached its peak of positive influence, and suggests that the current prescriptive system needs to evolve towards a performance-based environment in order to keep up with the technological and business model changes in the aviation sector (CAA UK, 2014; EASA, 2014); or, in the words of Geest et al.: " However, due to the continuous growth and the increasing complexity (technical and operational) of commercial aviation, it has become apparent that a system merely based on compliance with rules and regulations is not sufficient to guarantee safety." (Geest et al., 2003, p. 32). Another argument has been to avoid adding further to the already very extensive and complex jungle of rules and requirements, which causes especially smaller operators and service providers to lose any sense of ownership for their risk management (Hale et al., 2013).

Critics claim that strong influence from privately owned organizations in the wake of the separation of operators and air navigation service providers from state authorities pushes towards a performance-based environment primarily for economic reasons; the competitive business model being just one of the reasons, while also lack of competencies and resources at the authorities are said to be important (Njå & Solberg, 2010). Dekker (2003) explains how informal work systems, i.e. systems that are not strictly regulated, compensate for the organization's inability to provide the resources needed for its task performance; the move towards performance-based regulation could be claimed to be a reaction to such a lack of resources.

As safety focus is shifting to performance of organizations and their safety management systems, a change of the safety oversight and thereby the role of the regulators becomes necessary. Woods et al. present, when talking about control theory, the viewpoint that "degradation of the safety-control structure can be due to asynchronous evolution, where one part of a system changes without the related necessary changes in other parts" (Woods et al., 2010, p. 70). This explains the importance of understanding the need for changes in the regulatory organization (structure, competences, mind-set, etc.) if any innovation in safety should be carried out effectively.

Dekker supports this argument by explaining how "protective structures themselves can consist of complex webs of players and interactions, and are exposed to an environment that influences it with societal expectations, resource constraints, and goal interactions. This affects how it condones, regulates

and helps rationalize or even legalizes definitions of 'acceptable' system performance" (Dekker, 2011, p. 154).

Hollnagel agrees with the importance of the regulator's role for the outcome of a system: "What happens during actual day-to-day operations - the sharp end - is clearly affected by what has happened in organizational strata 'above' the operations… Indeed, the upward extension of interest may easily stretch to the very top of an organization and beyond that, to company boards, shareholders, regulators, etc." (Hollnagel, 2014, p. 115).

Hollnagel (2014) also points to a classic challenge in the regulators' safety oversight: Safety seen as the absence of accidents is hard to measure. Dekker (2003) argues along the same line, that past successes might not be the best guarantee for future safety. These arguments are probably even more significant for the safety oversight in a performance-based environment, since regulators as well as the regulated organizations are left with less strict requirements and subsequently room for different opinions on how to prove the assurance of safety.

More specifically concerning introduction of performance-based regulation, the European Aviation Safety Agency (EASA) very recently released a paper revealing the responses from the aviation community to proposed changes of the regulation; amongst the areas of responses was the topic of a performance-based and integrated approach to safety. According to EASA "A number of stakeholders caution that the implementation of PBR (Performance-Based Regulation) will be more resource-intensive and will negatively affect safety…"(EASA, 2015, p.4); this seems to be a clear indication of the still unresolved uncertainties around organizations, performance, management systems and accountability.

Based on the above literature, it can be concluded that scholars in safety science in general and more particularly in the international aviation domain are well aware of some of the challenges of regulation, especially in times of changing conditions; cultural background and historical mind-set, goal conflicts in areas of political support, budgets and resources, and lack of competences have all been identified as problematic areas. Unfortunately it can likewise be claimed, that exact knowledge of how to avoid negative consequences on regulation when changing the approach to safety has not been sufficiently explored; this leaves the safety effects of the on-going change to performance-based regulation uncertain.

RESEARCH QUESTION

To investigate the identified knowledge gap in the literature and seeking to clarify the initial list of uncertainties, it is necessary to further condense the topic into one research question and define a set of limiting factors of the research. This thesis will focus on the on-going change towards a performance-based approach to safety management in the European aviation sector; this choice is made due to the lack of empirical data and knowledge, which hopefully can be at least partly neutralized with this research. It is the anticipation that data gathering by interviewing regulators and regulated entities and subsequent analysis of the data might provide useful insight to this area, focusing on:

- **How can aviation regulators retain effectiveness in a performance-based environment?**

Sub questions

To fulfill the ambition above, a number of sub-questions were developed, while considering the above-established definitions of effective regulation and regulators retaining effectiveness; the sub-questions were then considered for inclusion in the data-collection:

- What makes up effective regulation in terms of capacity as well as safety? Is there any discrepancy?
- What is the aviation regulators' belief of how to ensure safety in a performance-based environment? Does it differ from the belief of the regulated organizations?
- How do the competent authorities reveal that any performance is safe?

- How is performance assessed objectively? Is it possible at all?
- What are the expectations of the regulated organizations in terms of objectivity?
- If performance is assessed on available hard data (in order to retain objectivity), then what is the difference to compliance-based regulation and oversight?
- What are the exact shortcomings of the present regulators in relation to the new approach (mind-set, competences, resources), - if any? Do organizations and authorities point to the same constraints?
- Does the performance-based safety oversight invite to a larger degree of interdependence between regulators (including safety oversight inspectors) and the object?

METHODOLOGY

Choosing the method

A qualitative study of the thesis question (as opposed to a quantitative study) was considered the most suitable since the purpose was to explore the change of regulatory work and the possible change in effectiveness as perceived by as well regulators as regulated objects in the European aviation community in the transition from compliance-based to performance-based regulation.

This study is based on a phenomenological research approach; this research approach is suitable for "the common meaning for several individuals of their lived experiences of a concept or a phenomenon" (Creswell, 2013, p. 76), which fits exactly with what I hoped to do, as described above. Moustakas (1994) explains how the aim of phenomenology is to determine what an experience means for an involved individual who are able to provide a comprehensive description of it; from this description general or universal meanings are derived, which are the essences of the experience.

Sanders likewise explains that phenomenology is "a qualitative research technique that seeks to make explicit the implicit structure and meaning of human experience" (Sanders, 1982, p. 353). Applying this research technique in practice means carrying out a descriptive investigation of the implicit structures and the meaning of human experiences in the field of changing aviation regulation; it is thereby my hope to reveal the essence(s) of these experiences, beyond the point of merely objective observations, which could have been derived in a quantitative study.

Methodological framework

Applying the phenomenological research technique in practice means: "In deriving scientific evidence in phenomenological investigations, the researcher establishes and carries out a series of methods and procedures that satisfy the requirements of an organized, disciplined and systematic study. These include:

1. Discovering a topic and question rooted in autobiographical meanings and values, as well as involving social meanings and significance;
2. Conducting a comprehensive review of the professional and research literature;
3. Constructing a set of criteria to locate appropriate co-researchers;
4. Providing co-researchers with instructions on the nature and purpose of the investigation, and developing an agreement that includes obtaining informed consent, insuring confidentiality, and delineating the responsibilities of the primary researcher and research participant, consistent with ethical principles of research;
5. Developing a set of questions or topics to guide the interview process;
6. Conducting and recording a lengthy person-to-person interview that focuses on a bracketed topic and question. A follow-up interview may also be needed;
7. Organizing and analyzing the data to facilitate development of individual textural and structural descriptions, a composite textural description, a composite structural description, and a synthesis of textural and structural meanings and essences." (Moustakas, 1994, p. 103).

Designing the research

The design of a phenomenological research can be described by three sub-tasks:

1. The first task is to determine the limits of what and who is to be investigated; this was partly accomplished when deciding on a research question and what kind of informants were needed, in order to gather the experiences that could form the data for the research. Further limitations of the research emerged from thorough considerations of the subtask described below in point 2.a- 2.c.

2. The second task is the collection of data; this included a number of preliminary subtasks before the actual data collection, which was based on interviews.

    a) Working out open questions based on the original uncertainties that led to the research question. The questions should lead to answers, which revealed "what" the participants experienced with the phenomenon as well as "how" the experience happened; this has later allowed the writing of "a composite description of the phenomenon incorporating both the textural and structural description" (Creswell, 2013, p. 194).

    b) Applying a peer review before starting the process of interviewing; I excluded interviewing inside my own organization (National Supervisory Authority (NSA) Denmark) as well as Danish operators or Air Navigation Service Providers (ANSP), to avoid any ethical or power-related distortions and to shield both parties from biases derived from any personal discrepancies. This had a positive side effect in opening the possibility to use a Danish colleague in the NSA for a peer review of the planned interview questions; in addition another test interview of a person with experience of writings on safety science and the method of phenomenology was performed.

    c) Selection of informants; after deciding to focus on the regulation of the European aviation community and at the same time recognizing the need to work with only a limited sample, 6 informants were selected, all of them being directly involved stakeholders in the on-going process towards a performance-based environment. The informants were divided between regulators and regulated objects in 3 states and 2 major international organizations (Sanders, 1982). Fortunately consent were obtained from informants, who are representative for European states and organizations influenced by and actively taking part in the current change from compliance-based to performance-based regulation; amongst the interviewees were European regulators employed by EASA (a depersonalized list of informants is contained in appendix 1).

    d) The actual data sampling was carried out by semi-structured interviews, using open questions and audio-/ video-recorded for subsequent transcription (List of interview questions is contained in appendix 2).

3. The third and final step is to analyse the information and expound the essence(s) of the lived experiences of the participants; this is the process also referred to as eidetic reduction (Sanders, 1982). The research has, as far as was practicable, been carried out applying a systematic approach, which provides analytical rigour. In reality, this meant searching for themes from the interviewees' description of the phenomenon or the experience. The themes were then deduced into a composite description of the essence of the lived experiences of the concept, in this case the ability of regulators to retain effectiveness.

Challenges and mitigations

The primary challenge of applying this research approach has been the lack of experience with the methodology; I tried to restrict the effect by studying the literature on the subject and by applying peer reviews during the research process.

Another challenge was my personal background, being deeply professionally involved in the difficulties the research question seeks to explore; as a basic belief of phenomenology is that the interviewer is biased

by his or her own assumptions, which might hinder the interviewer in reaching objective results about the researched topic, it has been essential for my study to start by suspending all my personal preconceptions or biases; this process is by some scientists described as "bracketing" (Creswell, 2013). Already in the initial process of identifying and suspending my biases it became clear, that my bracketing process would never be complete. I revisited the meticulousness of my bracketing several times during the research process by discussing the aspect with peers and supervisors as well as setting strict pre-conditions for the analysis of the data.

A practical challenge that could have obstructed the research is the perceived dependencies in the European aviation community; in combination with my professional position, this might have caused organizations and their employees to fear a business risk or a loss of professional image or authority as a consequence of participating. Fortunately this was not the case because of the information shared in advance; providing a comprehensive description of the research purpose in the interview advert and having an open dialogue with the participants before asking for their consent, resulted in a sufficient amount and representative sample of informants (the interview advert and the informed consent form are contained in appendices 3 and 4).

Quality and validity

To assure the scientific integrity and the validity of the outcome of the research I adopted an approach to methodological rigour by following Creswells' recommendations of how to assure an acceptable quality of phenomenological research by, while undertaking the research for the thesis, asking myself:

- "Does the author convey an understanding of the philosophical tenets of phenomenology?
- Does the author have a clear "phenomenon" to study that is articulated in a concise way?
- Does the author use procedures of data analysis in phenomenology, such as the procedures recommended by Moustakas (1994) or van Manen (1990)?
- Does the author convey the overall essence of the experience of the participants? Does this essence include a description of the experience and the context in which it occurred?
- Is the author reflexive throughout the study?"
(Creswell, 2013, p. 260).

The validity was further assured by peer reviews of the interview questions as well as reviews of the results of the analysis; the methodological rigour is described in more details in the chapters "Results" and "Analysis".

Even before starting the research it was obvious that the validity could be challenged by several interventions:

1. The participants were not selected randomly; this was not possible in applying the phenomenological research approach, since participants who have actually experienced the phenomena had to be found.
2. The research is based on a very limited number of interviews; this might not seem a compelling argument compared to many quantitative research methods.
3. Due to the limited number of participants a generalization can be challenging; in stead, in Hycners words, the research ends up with a result, which is phenomenological informative about humans in general (Hycner, 1985).
4. The phenomenological method differs from standard scientific research since it uses no control groups and no replication is possible; the method is <u>not</u> trying to test a hypothesis, rather it is staying away from already developed theories. These are preconditions for a phenomenological approach, in order for the researcher to bracket his or her own biases and to respect the meaning of the experiences as they are described by the participants.

In addition the emergent themes and underlying essences may serve to either refute or validate and complement quantitative research findings (Sanders, 1982); such quantitative data on regulators'

effectiveness could be derived from many sources, e.g. plans for amendment of national rules and regulation, audit plans, audit reports and follow up, or incident trend analysis. This implicates that any findings of my research could, with the support of quantitative data, produce an even stronger analysis and thereby a more compelling argument than has been possible inside the scope of this purely qualitative research.

Ethical considerations

Any research involves possible adverse outcomes, which should be carefully considered before starting the project; Blaxter, Hughes & Tight (2010) was studied for general advice on research methodology; Fraser (1997) provided additional inputs around ethical dilemmas and Oates, Kwiatkowski & Coulthard (2014) establish the "Code of human research ethics" published by the British Psychological Society.

Moustakas (1994) explains how the main target of phenomenological knowledge is to understand the implicit relations in the interviewees' description of an experience in the context of a particular situation. Another philosophical presupposition of phenomenology is that the lived experiences are conscious; this implies that "the reality of an object is only perceived within the meaning of the experience of an individual" (Creswell, 2013, p. 78), and that we all share subjective as well as objective experiences of a phenomenon with other people. These experiences are the data, on which the research is based; a major challenge has been to reveal, understand and make scientific use of the experiences and their context, while paying respect to the ethical constraints concerning the informants' anonymity and display of personal feelings.

Hence, in order for the interviews to successfully reveal the conscious experiences and thereby the phenomenological knowledge, the following ethical issues were considered:

1. My own bracketing, i.e. suspending all my personal preconceptions or biases (as explained above) was an essential challenge for the success of the research (Creswell, 2013). Hence I described my own professional background as well as my intentions of "bracketing" to the participants and their organizations prior to seeking their consent; the process of bracketing when analysing the data and concluding on the research was verified by repeated peer reviews and is discussed further below.

2. As already described, I decided not to do research in Denmark due to my professional (Danish) position, in order to avoid any ethical or power-related distortions and to shield both parties from biases derived from any personal discrepancies.

3. Respect for the autonomy, privacy and dignity of the interviewees and their organizations has been assured by anonymity and confidentiality in the process and in this written thesis. All data has been securely stored; further, the interview advert and the informed consent form advised the participants of the purpose of the research and all conditions, including the right to withdraw at any time and the process of their review of the answers in the interview before the analysis was carried out; this assured that all participants consented freely on the basis of adequate information.

4. In order to mitigate any possible risk of adverse impact on the informants employment status, it was a prerequisite to obtain written accept from the organizations of the participants.

5. Finally, it is of major ethical importance, that the participants and their organizations are the ones to possibly benefit from this research, since they are the ones who, in their every day life, struggle with the topic of the research, retaining effectiveness in a performance-based environment.

Data collection

In the process of applying the phenomenological approach to investigating the thesis question: **How can aviation regulators retain effectiveness in a performance-based environment**? ,

it became apparent that researching the phenomenon was a search for **what** the interviewees experienced as contributing or hampering an effective aviation regulation and **how** these experiences were connected to the introduction of a performance-based regulation (Creswell, 2013). The interview questions were designed to provide these data; the test interviews and a peer review resulted in a revised list of background questions and 12 research questions (appendix 2).

The research interviews were carried out in September 2015, some face to face, others by videoconference or telephone. All interviewees were provided with an interview advert (appendix 3) and asked to fill out and return an informed consent form (appendix 4).

Selection of informants

The informants were selected with the intention to collect experiences from a variety of mature employees within the European aviation community and with participation of both regulators and regulated organizations. This inflicted the randomness of selection, as did the difficulties of having participants committing to the research project. The group of informants finally consisted of 6 persons in total with a wide range of diversity:

- 6 different nationalities.
- 3 regulators and 3 regulatee: 2 representing the ANSPs, 1 representing a NSA, 1 representing a large international organization of airline operators and 2 representing EASA.
- 2 female and 4 male.
- 1 with airport operations background, 1 with aircraft maintenance background, 1 with pilot background, 2 with ANSP background and 1 without any aviation background prior to the present employment.
- 3 with a military background, 3 with civilian background.
- 3 employed at management level, 3 at inspector level.
- Experience with regulatory work and safety oversight ranging from 10 to 21 years.

A depersonalized list of participants can be found in appendix 1.

RESULTS

Organisation and initial analysis of the data

The analysis is based on the transcripts of the 6 conducted interviews. Already in the process of transcribing, it became clear that there were some statements, which were more significant than others; significant statements are the statements, which clearly answers the question, i.e. indicates how the interviewees experienced the effectiveness of regulation in the process of introducing a performance-based environment. Making such a judgment easily clashes with the bracketing process, since detailed knowledge of the research area needs to be applied to fully understand the answers, and the personal beliefs of the researcher might interfere, even unconsciously. An attempt to mitigate this effect was made by revisiting if the answers regarded significant were really answering "what" was experienced and "how".

The transcripts likewise proved that some answers were almost identical in several interviews.

The actual analysis was continued by systematically going through each answer to all questions, identifying and listing all the significant statements while grouping the answers that were very alike, or where the essential statement was the same (see table 1). This implied that I had to bracket my personal experiences as far as possible in order to stay objective to the answers given; but a review and assessment of the answers demands a certain knowledge and evaluation, thus a complete bracketing is not possible (Moustakas, 1994; Creswell, 2013). The different answers and the grouping of those in relation to each research question, along with an indication of the informant who provided which answer, can be found in Table 1.

Table 1: Research questions and answers

Qx indicates the question number, Ax indicates the answer number and the number in parentheses (x) indicates which interviewee gave the specific answer.

Q1: What is effective regulation in terms of capacity and cost-efficiency?

Q1A1: Leave the stuff to the market / ANSPs should be privatized (1)
Allow the aviation sector as much freedom as they see fit to produce a safe and efficient transport system. (2)
Regulation that is proportionate and leaves to the Safety Management System (SMS) to balance production with protection (3)
Regulation should be proportionate, and Applicable Means of Compliance/Guidance Material (AMC/GM) should reflect the complexity of the rules (5)
Looking at processes instead of details; prescriptive regulation is less effective than process-oriented (6)
Q1A2: It makes very good business sense to be safe (2)
Q1A3: Enhancing cost-efficiency and capacity but keeping safety in mind (4)

Q2: What is effective regulation in terms of safety?

Q2A1: Combine compliance-based basic rules with safety targets on leading indicators (1)
Q2A2: Regulation, which trickles the industry to perform good enough. (2)
Q2A3: Safety is not the prime objective of business (2)
Q2A4: Regulation that tells…achieves an acceptable level of safety as defined by the authority (3)
Q2A5: Leaves to the regulated entity the ability to decide how to achieve a particular result (3)
Looking at processes instead of details; regulating the processes and that they are followed (6)
Q2A6: Set safety objectives for each organization and each state (4)
Q2A7: Process-oriented and risk-based oversight is more effective (6)

Q3: Is there any discrepancy and if so, can you describe it?

Q3A1: Yes, definitely (1)
Currently there is, because of separate regulation for safety, costs and capacity (2)
Yeah, but they are interconnected (4)
Q3A2: You can't just demand more for less money unless you understand what the mechanics of the system are. (2)
You have to find the proper balance between safety and cost-efficiency and capacity (4)
Definitely a balance (5)
Q3A3: The regulation has shown great disrespect for the relationship between capacity, costs and safety (2)
Q3A4: I don't think so; in a SMS environment there is a balance between ensuring the operational efficiency and the maximum possible safety/ the lowest possible risk. (3)
I would say you could regulate the areas in the same way (6)

Q4: How can safety be ensured in a performance-based environment?

Q4A1: Make sure to measure the right (positive) things (1)
Q4A2: Measuring is useless without common definitions (1)
We need to understand what is safety performance (2)
Q4A3: Look at both success and failure criteria (1)
Q4A4: Be very, very cautious, you can't just replace compliance-based with performance-based. Several prescriptive rules need to be preserved. (2)
Q4A5: Look at how well we control the processes rather than look at the performance (2)
The ANSP needs to have good processes, to have in-depth processes and … Safety needs highest priority and the ANSP needs good processes (6)

Q4A6: By setting very clear safety targets (3)

Q4A7: Regulator should be able to really understand the risk profile of any organization and define acceptable level of safety for that particular organization. (3)

Consider certain key performance indicators (when establishing risk-profile) (5)

Q4A8: By a good performance-based oversight function and a well-established reporting system (4)

Q4A9: Target the oversight to problematic areas (4)

By establishing oversight program in accordance with risk-profiles (5)

Q5: How can the competent authorities determine if a performance is safe (what are the criteria)?

Q5A1: Gather lots of data, watch trend and try to understand how things have changed over a period of time (1)

By establishing a risk-profile from data gathering over a 2 years cycle… Provision of service in a proper performance is linked to the safety (5)

Check if ANSP does a proper safety case and establish a trustworthy performance (6)

Q5A2: You are going to look at all those parameters that will guarantee you safe output (2). Implementation is key issue, demonstrating that you are doing what you said you would do (3)

Q5A3: Use compliance-based regulation as a minimum basis (2)

Q5A4: Having a set of meaningful safety performance indicators (3)

Q5A5: Inspectors must be trained in accordance with a performance-based oversight environment; trained to look for implementation of SMS (3)

Q5A6: This will come from the State Safety Program (4)

Q5A7: CAA/NSA needs to trust ANSP has the competence (6)

Q6: How can the competent authorities determine if a performance is ensuring adequate capacity and cost-efficiency?

(4) + (5) never answers this question.

Q6A1: Lots of measures like delay, demand and costs (1)

Q6A2: It's a cross-domain issue (1)

Q6A3: It is easier measured for cost and capacity than for safety (2)

Q6A4: Setting a meaningful set of targets and checking how they are achieved (implementation of processes/ mechanisms) (3)

Q6A5: I guess it would be the same (trust the ANSP?) (6)

Q7: How is it possible to assess performance in an objective way?

Q7A1: Look for several better, different measures to form dashboard (better picture)… We need more measures to keep the authorities objective (1)

Determine meaningful safety measures (3)

Q7A2: It is possible, but you are never sure the regulators are objective (2)

It is theoretical possible (3)

Q7A3: Objectivity based on collision risk is the best measure you can have (2)

Q7A4: You cannot always calculate things; quantitative is the best way but also the impossible way (2)

Authorities might not have the capability to analyze the amount of data they will receive (resources and tools). (3)

Q7A5: You can't get away from the emotional and perceptive part of safety performance (2)

Objectivity depends sometimes on the inspector (4)

It is challenging, you are very often influenced by different things (6)

Q7A6: To move away from compliance-based oversight, you need common trust. Safety is a shared responsibility (5)

Q7A7: By the use of key performance indicators (5)

Q7A8: Well-trained auditors and proper checklists (4)

Requirements related to processes to follow when you do the oversight (6)

Develop guidelines for inspectors (6)

Q7A19: An audit is only a snapshot making a sampling (5)

Q8: What are, if any, the exact shortcomings of the present regulatory organizations (NSAs, CAAs, EASA, EU) in relation to implementing performance-based regulation?

Q8A1: Lots of shortcomings (1)
Many (2)
Q8A2: Lack of common understanding of what performance-based regulation is (1) (3)
We do not interpret the regulation in the same way (6)
Q8A3: Different definitions of data means they are not comparable (1)
Q8A4: Huge range of abilities with different regulators across Europe (1)
It differs how different nations use guidelines (6)
The regulators are not in contact with reality and they have the wrong competences (2)
Application of performance-based regulation is not consistent due to different resources (1)
Different implementation in different states (3)
Q8A5: States, EASA, EU and organizations need time to adapt (4)
We are not 100% ready to advance to performance-based regulation; it will take some time (4)
Q8A6: EASA is a factory of rules (2)
Limited standardization results from EASA visits (3)
Lack of guidance material related to the regulation (6)
We are left alone when it comes to guidelines and guidance material (6)
Q8A7: The rules are not enhancing safety at all; we spend time that is not effective for safety trying to satisfy regulation (2)
Q8A8: We shouldn't think performance-based oversight is going to replace compliance monitoring; it is a supplement (5)

Q9: Do you/ did you experience interdependence between regulators and regulated objects in the compliance-based environment?

Q9A1: The basic concept of performance-based regulation is a relationship about trust (1)
Regulator needs to trust ANSP, and the ANSP needs to maintain open, transparent and very honest with the regulators. (2)
Q9A2: Of course! (2)
Absolutely (3)
Yeah, especially in small countries, where ANSP is a monopoly; in some cases the ANSP prevails the authorities for political reasons (5)
Yeah, in the eastern countries, where the income of the inspectors are less than those working for the ANSP (5)
Q9A3: ANSPs are dependent on regulators' rules; regulators are depending on ANSPs' knowledge and their evidence about the safety performance. (2)
It is a business issue in the end; safety has become a common objective and is a cooperative effort (3).
The organizational interdependence has been removed, but the knowledge interdependency will always be relevant. (6)
Q9A4: I have never seen this as a problem (6)

Q10: Will that change/has that changed with the introduction of performance-based safety oversight?

Q10A1: No change, still based on trust and honesty (1)
There is a great interdependency (2)
No; it is connected to the resources of the oversight within the state (4)
The dependency is not related to performance-based regulation or oversight (5)
No change; good results in a performance-based environment rests on a partnership approach (3)
Performance-based oversight doesn't work without mutual cooperation, trust and partnership (3)
It could be, but I can't think of any examples. (6)
Q10A2: Regulators need to be educated; we need them to understand our industry (2)

In order to limit the influence of my personal experiences and opinion (the bracketing mentioned above), and to further validate my result, I then produced a matrix (figure 1), depicting more aspects of the findings from table 1. The matrix indicates which and how many of the interviewees replied alike to each question, and how the answers were divided between the group of operators and service providers (informants 1-3) versus the group of regulators (informants 4-6).

It would be easy to create more groups, e.g. divide the interviewees by gender, by size of their organization etc., but after constructing, testing and comparing different groupings I concluded that for the purpose of this thesis it seemed irrelevant since the individual experiences form interesting and convincing data, while no particular patterns or connections could be deduced from grouping the informants in different ways.

Figure 1, matrix of questions and alike answers given by which informant:

Informants and groups / Questions and answers	1	2	3	4	5	6	1-3	4-6
Q1 A1	+	+	+		+	+	3	2
Q2 A5			+			+	1	1
Q3 A1	+	+		+			2	1
Q3 A2		+		+	+		1	2
Q3 A4			+			+	1	1
Q4 A2	+	+					2	

Q4 A5		+				+	1	1
Q4 A7			+		+		1	1
Q4 A9				+	+			2
Q5 A1	+				+	+	1	2
Q5 A2		+	+				2	
Q7 A1	+		+				2	
Q7 A2		+	+				2	
Q7 A4		+	+				2	
Q7 A5		+		+		+	1	2
Q7 A8				+		+		2
Q8 A1	+	+					2	
Q8 A2	+		+			+	2	1
Q8 A4	+	+	+			+	3	1
Q8 A6		+	+			+	2	1
Q9 A1	+	+					2	
Q9 A2		+	+		+		2	1
Q9 A3		+	+			+	2	1
Q10 A1	+	+	+	+	+	+	3	3
Q11 A1	+	+	+	+	+	+	3	3

The process above visualized how some questions were answered more homogeneously than others; when compared and contrasted opposite each other, the table and the matrix also revealed that research question 6 and 12 did not cause any alike answers, which will be further discussed below.

ANALYSIS

Clusters of meaning and themes

When scrutinizing table 1 I constructed clusters of meaning from some of the answers and significant statements, which across the different questions pointed to the same main issues (Creswell, 2013). The analysis therefore proceeded by juxtaposing the statements, numbering and attaching headwords to each cluster (see table 2). The process of forming clusters of meaning was problematic in relation to bracketing my personal experiences; to limit the personal influence, I decided that each headword should consist of

the spoken words of my interviewees. The clusters were then organized into themes (also contained in table 2), reflecting different areas of what the objects experienced and in some cases also how this was experienced (Moustakas, 1994; Creswell, 2013; Saldana, 2013).

Table 2, indicating clusters of meaning (Cx), themes (Tx) and the questions and answers (QxAx) forming the basis for this categorization.

T1: Regulation concerns

C1: Common definitions and understanding Q4A2, Q8A2, Q8A3, Q8A4
C2: Proportionality Q1A1
C3: Leave to the service provider how to achieve targets Q1A1, Q2A5, Q12A3, Q12A4, Q12A6
C4: Support regulation by AMC/GM, checklists, guidelines Q1A1, Q7A9, Q8A6
C5: Maintain basic compliance-based regulation Q2A1, Q4A4, Q5A3, Q8A8
C6: Balance between safety and costs/capacity Q3A1, Q3A2, Q3A3
C7: Focus also on success criteria Q4A1, Q4A3

T2: Regulator shortcomings

C8: Lack of education/ understanding Q4A7, Q5A5, Q7A5, Q8A4, Q9A3, Q10A2
C9: Lack of resources Q7A5, Q8A4, Q9A3
C10: Trust in ANSP Q5A8, Q9A1
C11: Objectivity Q7A3, Q7A6, Q7A9
C12: EASA position/ role Q8A4, Q8A5, Q8A6, Q8A7

T3: Process focus

C13: Oversight effectiveness Q2A7, Q4A5, Q6A4, Q7A9
C14: SMS importance Q11A1, Q12A3, Q12A6, Q12A7

T4: Risk orientation

C15: Establishment of risk profile Q4A7, Q5A1
C16: Data gathering/ reporting systems Q5A1
C17: Oversight effectiveness Q2A7
C18: Possible targeting of oversight because of risk profile Q4A9, Q12A7

T5: Relationship issues

C19: Trust Q7A7, Q9A1, Q10A1
C20: Interdependence Q9A2, Q10A1

When analyzing further the themes in table 2, it became possible to deduce the textural and structural description of the experiences (Creswell, 2013).

Textural description

The textural description consists of **what** the participants experienced in relation to retaining effective aviation regulation in a performance-based environment; the meaning of this description is explored and discussed in the chapter "Essences".

The similarity of many of the answers shows that the informants share a lot of experiences around:

- The regulation is not proportional, based on common definitions and ensuring the understanding of all parties.
- Performance-based regulation still needs a basis of compliance-based requirements and is not sufficiently supported by guidance material.
- Regulators are lacking behind in competences and resources and have to rely on operators and ANSPs to support their tasks.
- Relationship between regulators and regulatee must be based on trust and transparency.
- Interdependence is endemic.
- Safety management systems and risk profiles are important and accepted tools.
- Regulating safety, cost-efficiency and capacity is a fine balance.

Structural description

The structural description consists of **how** the participants experienced the phenomenon; the meaning of this description is likewise explored and discussed in the chapter "Essences".

The interviewees were all very helpful in providing examples, which provided substantial data to form clusters and themes. It is remarkable how all the clusters and themes are supported by a different mix of informants, meaning that very few experiences are unique to only one informant or to only one of the groupings (regulators or regulated entities); this might indicate the perceived seriousness of the shared experiences, especially given the limited number of informants. Another very interesting observation is that the interconnection between many areas of regulation becomes illustrated by the way in which the majority of the provided statements point to more than one cluster of meaning or even to more than one theme.

By way of example, the cluster around interdependence (C20) is formed by experiences from all informants and point to different kinds of interdependence. The interviewees explained how only the ANSPs possessed a lot of essential knowledge and information, which had to be revealed to the regulators and named this mechanism "knowledge interdependence". They supported this view by statements like: "The knowledge interdependence will always be relevant." (6) or: "Regulators are sometimes dependent on ANSPs in terms of the knowledge that we can provide to them. And certainly in terms of the evidence about our safety performance that we are giving to them."(2). Another interdependence aspect, the organizational interdependence, is commented in statements like: " I think after being split that the ANSPs now is a separate organization and the CAA then is also completely separate organization that the organizational interdependence at least has been removed"(6) and somehow opposing: "This happens where we have a monopoly of the ANSP" (5).

Other clusters of meaning, e.g. the need for a proportionate and balanced regulation (C2 and C6) is also mentioned in answers to several different interview questions; the experiences are underpinned by examples like: "And you can set up a high level of safety, but if this will cost you a fortune or it is very difficult to implement then it doesn't make any sense. And so you find, you have to find, the proper balance between safety and cost-efficiency and capacity."(4) and: "You can't just look at the system and say OK, I want more for less money, unless you understand what the mechanics of the system are."(2). This cluster is expressing an agreement on the need for proportionate and balanced regulation, and does not reveal the expected contents of such regulation.

Experiences, which at first glance seem unconnected, supporting on one hand the lack of guidance material and on the other concerns around regulators objectivity (C4 and C11) demonstrate to be interconnected by a statement like: "I guess that's the way you can stay objective, that you have a certain well described process to follow when you do the oversight… for me, the experience so far has been that we are being more or less left alone when it comes to guidelines and guidance material."(6); another example is: " To be truly objective… you need to look at a range of different measures, almost like a dashboard, which gives you a better picture." (1). As shown, it is a common experience for both a

regulator (6) and a regulated entity (1) that objectivity demands a certain set of defined measures and procedures.

Positive examples of experiences pointing to a development towards a process-orientation in oversight (T3) are likewise shared by both a regulator (6) and a regulatee (3) e.g.: "An advantage is clearly that we are looking beyond just implementing regulation into implementation of best practices and taking on board, I mean taking proper accountability and responsibility for ensuring safety" (3) and: "I've ended up being less prescriptive…now we are much more into process-oriented oversight and risk-based oversight and I think that's more effective" (6). In general all the informants acknowledged the on-going development, while their different background and recent employment might be the reason for their different experiences of the state of development.

Experiences around the relationship between regulator and regulatee (T5) are structured in statements like: "I don't think our relationship has changed hugely, I think we still try to act like grown ups, we still try to make mature decisions, we still try to be honest with each other and work well."(1) or: "Safety is a cooperative effort" (3) and: "We need to have common trust… safety is not only the responsibility of neither the industry nor the competent authority or the state, this is a shared responsibility amongst all actors in the system." (5). It is obvious from my data that all informants share the experience that a good, honest and open relationship is essential for the success of the on-going development towards a performance-based environment, but also that this relationship is not equally matured across Europe.

ESSENCES

The essences of the informants' experiences are the general or universal meanings (Moustakas, 1994). The process of conveying the essences is the researcher's final exploration of the data, builds on my own comprehension of the experiences even if "bracketing" is applied, and is intended to follow the path described below.

This research is exploring the question: **How can aviation regulators retain effectiveness in a performance-based environment**? I interviewed 6 persons, who all have long personal and professional experience representing different functions and roles in the domain. When interviewing the informants and scrutinizing their experiences, I considered which statements should be considered significant; this choice was an important basis for further analysis, forming clusters of meaning and themes. I found that some essential experiences were common, no matter the professional background, the gender or the nationality; they were repeatedly mentioned in several forms and in answers to different questions. The formed clusters of meaning and the deduced themes above indicate how the informants perceive the meaning and interpret the importance of their experiences; examining the themes in relation to the number of different questions and yet interconnected answers, which supported each theme, led me to finally convey 3 essences:

Essence 1: Lack of common understanding of performance-based regulation

The primary essence of the experiences of the informants seem to be the basic lack of a common understanding of what performance-based regulation and a performance-based environment mean; almost all informants were supporting this, e.g.: "There is a huge misconception about what things like risk-based or performance-based regulation are" (1) or: "The first thing we need to understand is, what is the safety performance…If you are a rule-maker, to you that is the performance…I make the rule and I see how well you behave… that misperception is based on, if you follow the rules, the result will be right" (2) and: "The first shortcoming that comes to my mind, is the common understanding of what a performance-based environment is"(3). Many statements from the informants point not only to a lack of common understanding, but *de facto* to several misunderstandings of performance-based regulation, risk-based oversight, safety performance etc., as these terms seem to be unclear to some of the informants or at least not commonly agreed or understood.

Essence 2: An imbalance and interdependence between the regulators and the regulated entities

The research results also point to an imbalance between the regulators and the regulated entities; this essence is based on common experiences from both regulators and regulate and thereby forming a convincing argument. The essence is supported by statements mentioning economic issues affecting resources and tools, as expressed like: "The interdependence is connected with the resources to be ensured by the member-states" (5), but also understanding issues created by lack of education and competences; the latter is described e.g. as: "What we also need is that regulators have inspectors that are trained in accordance with a performance-based oversight environment…. They need to be able to train people to actually look for implementation of this safety management system" (3). It can be argued and supported by the data that the lack of competences and training is also an indicator of economic restraints, i.e. the resources and finances being allocated to the regulatory work by the states and EU.

Several statements explain how this imbalance contributes to experiences of interdependence, since the regulators' oversight becomes dependent on the explanations and documentation from ANSPs and operators: "To achieve good results in a performance-based environment you really should have a partnership approach"(3) or: "You need to have different people with the government to understand why we are doing it and how we are doing it. So they need to be educated along the way… the interdependence is great; we want them to understand our industry. We need them to understand our industry"(2). Another example is: "The organizational interdependence at least has been removed, but the knowledge interdependence will of course always be relevant" (6). It seems from the data to be an accepted state for all involved parties that regulators are lacking behind in resources and competences, thus struggling to perform their duties and requiring the regulated entities to support them.

Essence 3: The transformation to a performance-based environment is on-going

A third and more positive essence is that an obvious development is on-going at present; this is substantiated by the overall favourable experiences with and backing to safety management systems, risk-based safety oversight and focus on positive performance indicators. This was expressed in statements like: "In the performance-based environment you have to make sure that you are measuring the right things. And it's about measuring positive things rather than negative things"(1) and: "It is my main feeling that also the ANSP have kind of accepted that SMS is an important part of the performance-based safety regulation; and I definitely have that view"(6). Such statements indicate that the informants acknowledge the move from one state to another, but also that the target of the move has not yet been reached; they thereby indicate an on-going transformation.

The essence of on-going transformation is likewise supported by the alleged differences amongst states across Europe, depicting how a gradual process at different pace is taking place in the region; this is expressed in statements like: "There is a huge range of abilities with different regulators across Europe" (1) and: "We need time to adapt… And this will take time and it is a course that will take many steps" (4). Again, the informants indicate that a process is taking place, i.e. a transformation is on-going.

DISCUSSION

To explore my research results further, revisiting the definitions attached to the research question seems necessary in order to determine if the data support a common understanding of these fundamental terms. The research question was substantiated by a definition of effective regulation stating that: Effective regulation is providing the legal framework and necessary guidance and performing safety oversight of the operations to ensure that the safety performance of the total system meets an acceptable and defined level of safety; it was further supported by the prerequisite that: Retaining effectiveness of regulators should result in a stable or increasing safety performance level.

In comparing the first definition with the very different answers to the research questions "What is effective regulation in terms of safety?" (Q2) and "How can the competent authorities determine if a

performance is ensuring adequate capacity and cost-efficiency?" (Q6), the data illustrate a broad agreement of necessary guidance being part of effective regulation. Many examples were provided of experiences of ineffective regulation based on a lack of guidance and definitions, which might have caused the experienced difficulties in shaping a common understanding and mindset. Several interviewees also mention the need for a balanced and proportionate regulation, i.e. pointing to flaws in the legal framework. The research did not reveal if the agreed opinion on this matter was accompanied by any agreement of how a more complete set of regulations could be defined and obtained; I suspect that completeness of regulation is an eternal challenge, which is not specific to the on-going transformation to performance-based regulation besides by the fact that such a seminal change demands an enormous change to the legal framework. The agreed lack of common definitions, regulations and guidelines is further supported by the many statements on a lack of common understanding across the region and across the domain, which will be further discussed below; it is furthermore significantly supported by some of the research questions, which unlike other questions did not obtain any or only obtained very few alike answers, indicating that the informants' understanding of the questions were very differentiated.

Many statements from the informants point not only to a lack of common understanding, but *de facto* to common and individual misunderstandings of important concepts like performance-based regulation, risk-based oversight, safety performance etc., as these terms seems to be unclear to some of the informants or at least not commonly agreed or understood; the implications of not directing attention to possible misunderstandings or misinterpretations has been thoroughly described by several scientists, e.g. Snook (2000), who gives an account of how factors like local perspectives and separate belief systems led to a tragic accident. In relation to this research, it should be considered that the revealed unrecognized misunderstandings could potentially cause more harm to the transition towards a performance-based environment than an acknowledged lack of common understanding, since the realization of flawed knowledge is a prerequisite for changing the situation.

In contrast the informants did not comment on the topic of the other part of the initial definitions, describing a maintained or increased level of safety performance; this could, seen from the researchers points of view, indicate that this understanding is a true, fundamental prerequisite for all actors in the European aviation community. When seen from the inside, taking the view of my informants, their statements indicate an agreement on the overarching target, namely maintained or increased safety performance, but also that they need more clear definitions, objectives and guidelines to make this vision real; this research does not, as stated above, reveal neither agreement nor disagreement on the contents or directions of the framework and guidelines in demand.

Another aspect of the above alleged demand for clearer legal framework and more guidelines is, if it could be seen as a wish to revert to a compliance-based safety regime or if it is rather an illustration of the uncertainties amongst professionals, who all want to serve their domain in the best possible way? Since the data does not include any indications of the former, it leads to a suspicion that the latter is probably the case. This paradigm shift is likewise substantiated by the answers to the question: How can safety be ensured in a performance-based environment (Q4)? The answers prove that the informants have generally accepted the transition to a performance-based environment and they point to e.g. importance of positive performance indicators as well as oversight based on risk-profiles; together this indicates a developing community, building an understanding of the relatively new focus on risk profiles in the aviation regulation (based on older theories around risk management) as well as the recently developed theory of developing the safety perspective from Safety I to Safety II (Rasmussen, 1997; Hollnagel, 2014).

Looking across the informants and considering their different background, it has not been possible to reveal any connection between this and the answers given. The clusters and themes are supported by a different mix of informants and by several answers given by one individual to different questions. This indicates that the individual conviction is strong and convincing to each informant and the lack of pattern proves that the beliefs and experiences do not automatically depend on gender, age, employment or role. In a larger view, it indicates that very few meanings of experiences are unique to only one informant or to only one of the groupings (regulators or regulated entities); on the other hand, the research does not reveal if the meanings are unique to members of the European aviation community.

An eye-opening observation is the fact that most informants mentioned the differences across the region, but just stated this as a fact or even an unchangeable state; this indicates how most informants are kept well occupied trying to implement the performance-based regulation in their own organization and their statements fully underpin parts of the complexity theory's focus on local rationality (Snook, 2000; Dekker, 2006; Woods et al., 2010). From the view of the informants, the data prove that they regard a uniform implementation as directly linked to the effectiveness of the regulation. Likewise, from the outside view of the researcher, it seems essential to consider how a more uniform development can be ensured as well as the consequences of an uneven implementation; this view is supported by the control theory presenting the viewpoint that "degradation of the safety-control structure can be due to asynchronous evolution, where one part of a system changes without the related necessary changes in other parts" (Woods et al., 2010, p. 70). The observation also indicates that the responsibility of a more even evolution must rest with international regulators and organizations, since the individual organizations and states does not seem to have the strengths to embrace this task. This statement is supported by findings and conclusions in accident investigations, e.g. when AAIU (2014) concluded that the complex web of regulations on global, regional and national levels and operations divided in several states have proved to contribute to the competent authorities of single states loosing the overview.

The complexity of aviation in general and the aviation regulation in particular, along with the interconnection between the many different areas of regulation, become illustrated by the way in which the majority of the provided significant statements point to more than one cluster of meaning or even to more than one theme. From the informants' point of view this is a visualization of their daily work situation, which was described as a number of uncertainties around different understandings, goal conflicts between safety and efficiency, lack of guidelines, scarce resources and much more; their experiences and statements are supporting Dekker's viewpoints on the importance of understanding of complex systems (Dekker, 2011).

Several scientists provide accounts of the difference between "work as imagined" and "work as done" and the developments that leads to such a situation (Vaughan, 1996; Snook, 2000; Dekker, 2006; Woods et al. 2010). As a consequence, it was expected that this research would probe into a possible difference between "work as imagined" and "work as done". This expectation was not fulfilled; the informants describe work as done as "working as they imagine they ought to" while the uncertainty of what is really the imagined work makes them call for a description of the work, they are supposed to carry out.

When revisiting the analysis of this thesis and concluding the research, it is necessary to consider the success of the bracketing process, as recommended by Creswell (2013); as pointed out earlier, some parts of the research and most of the analysis does not allow for a complete bracketing, since they require some detailed knowledge of the research topic. However, I carried out the analysis with an approach of methodological rigour and based on open questions and the spoken words of the informants and derived clusters of meaning trying to be as reflexive as possible. It is further my firm belief that the derived essences are substantiated by my data.

This research has been an attempt to contribute to the empirical data and knowledge on how to retain effective regulation in a performance-based aviation environment; while researching this topic a whole range of related concerns surfaced, all of them begging to be further explored. The most urgent being: What are the exact shortcomings in the legal framework and the guidelines supporting implementation of a performance-based environment and how can they be resolved? A closely related research question, which could be either general or targeted to the transition to a performance-based environment is: How can a common understanding of key concepts be ensured?

More very interesting topics, both in general and in relation to the on-going transition are: How can a more equal development throughout the region be ensured and what are the consequences of an uneven implementation? And: What are the criteria for a balanced and proportionate regulation and can these be agreed across the domain?

Finally, when the development has reached a more mature state, it would be interesting to target research towards best practices for regulators and regulated entities in a performance-based environment.

CONCLUSION

This thesis is aimed at identifying both areas of concern and possible mitigations to these in order for the aviation sector to remain safe during the on-going change to a performance-based environment; in this respect it has been easier to collect data on the concerns than on the possible mitigations. The researcher was also curious to know, if the experiences of different actors in the European aviation community were comparable; the data show that the informants all had a strong, personal conviction and their experiences do not seem to be influenced by their belonging in the group of regulators versus the group of regulated entities.

The essences of the experiences of the informants are explained and discussed at length above; however it is the conclusion of this research that a lack of common understanding supplemented by a number of common and individual misunderstandings are the primary challenges for regulators to retain effectiveness in a performance-based environment. The suggested possible mitigation is a more comprehensive legal framework including clearer definitions and more guidelines.

It can also be concluded that an imbalance between the regulators and the regulated entities exists; all informants point out that regulators are lacking behind in resources and competences and for that reason become dependent on the operators and ANSPs to provide expertise and knowledge. A worsening of the imbalanced situation in some states and the differences in implementation across the region is of major concern. The informants seem to accept this a static circumstance and express no illusions about a change in this situation.

The research proves that the transition towards a performance-based environment is presently on-going and significant statements substantiate an overall positive approach to the process; the experiences support a more intelligently focused and effective safety management and safety oversight while expressing concerns about the regulators' ability to adapt at the needed pace. Again, there seems to be a resigned acceptance of the lack of resources and competences at the regulatory authorities amongst the informants, who did not provide any possible mitigation.

The ambition of collecting best practices from the informants is somewhat unsatisfied; several informants offered individual accounts, but most experiences gave the impression of still being in the phase of "learning-by-doing". Along with the everlasting call for common understanding and more guidelines, it points to the conclusion that such data are not yet available and research in this area should be pursued at a later stage of the implementation of a performance-based environment.

APPENDICES

Appendix 1

List of informants

Names, nationalities and employers are excluded from the list, in order to assure the confidentiality and anonymity of the informants; the six informants have 6 different nationalities and are employed by 5 different organizations.

Informant 1
>   Male
>   Technical education
>   Employed by civil ANSP
>   Previous experience in military aviation sector
>   15 years of experience in working with regulatory issues.

Informant 2
>   Male
>   Technical and pilot education
>   Employed by civil ANSP
>   Previous experience in state aviation sector
>   21 years of experience in working with regulatory issues.

Informant 3
>   Male
>   Pilot education
>   Previous experience as military and civil pilot
>   Employed by major international air line operators organization
>   19 years of experience in working with regulatory issues.

Informant 4
>   Male
>   Aerodrome operations background
>   Previous experience in state aviation regulation sector and civil aerodrome operations
>   Employed by international regulatory agency
>   10 years of experience in working with regulatory issues.

Informant 5
>   Female
>   Theoretical education
>   Previous experience in state aviation regulation sector and aircraft maintenance companies
>   Employed by international regulatory agency
>   10 years of experience in working with regulatory issues.

Informant 6
>   Female
>   Technical education
>   Employed by civil aviation authority
>   Previous experience in civil and military state sector (outside aviation)
>   11 years of experience in working with regulatory issues.

Appendix 2

Interview questions

Reference (for the researcher):   Date of interview:

Background data:

Name:

Position/ Employer:

Please tell me (in short) about your professional background:

How long have you been working in this organization:

How much experience do you have with regulatory work/ safety oversight/ audits:

Do you have any experience from "the other side" (if working in ANSP, experience from regulator organization and vice versa):

Research questions:

1. What is effective regulation in terms of capacity and cost-efficiency?

2. What is effective regulation in terms of safety?

3. Is there any discrepancy and if so, can you describe it?

4. How can safety be ensured in a performance-based environment?

5. How can the competent authorities determine if a performance is safe (what are the criteria)?

6. How can the competent authorities determine if a performance is ensuring adequate capacity and cost-efficiency?

7. How is it possible to assess performance in an objective way?

8. What are, if any, the exact shortcomings of the present regulatory organizations (NSAs, CAAs, EASA, EU) in relation to implementing performance-based regulation?

9. Do you/ did you experience interdependence between regulators and regulated objects in a compliance-based environment?

10. Will that change/has that changed with the introduction of performance-based safety oversight?

11. Are SMS-processes an important part of performance-based safety regulation?

12. Do you see any particular advantages or disadvantages of that?

Appendix 3

Interview advert

Dear participant,

I am a student at Lund University, pursuing a Master of Science Degree in the field of Human Factors and Safety Science. To finish my study, I am conducting a thesis trying to add to the scientific and practical knowledge of how to retain effective regulation in a world of changing approaches to safety.

My professional background is air traffic control, with a record of 21 years as an operational tower and approach radar controller. I have since 2007 worked as a regulator, being employed by the Danish Transport Authority in a position as Senior ATM Expert at the Danish National Supervisory Authority. With my professional background and the present change of regulatory regime in the European aviation community, I decided to form my thesis on the research question:
How can aviation regulators retain effectiveness in a performance-based environment?

Your participation in my thesis work will be an important contribution to my research, since I expect to learn from your experiences being regulated or providing regulation in the domain of air navigation service provision.
The interview is in two parts; a short introduction part, revealing your professional background and experience followed by 12 open questions in relation to your experience with aviation regulation in a performance-based environment. I expect the duration of the interview to be about 1 hour.

The interview will be video-recorded and I will subsequently transcribe the tapes; the transcript will be sent to you for verification before being further used in the thesis work. All material will be treated with strict confidentiality and protected from disclosure. No names of persons, organizations or nations will be mentioned in the thesis.
I am very grateful for your participation in my study; should you have any questions, please feel free to contact me at kirs@tbst.dk

Sincerely,
Kirsten Sonderby

Appendix 4

Informed Consent Form

How can aviation regulators retain effectiveness in a performance-based environment?

Student Investigator: Kirsten Sønderby

Project Purpose and Procedure: This thesis project aims at, by applying a phenomenological research approach, investigating the common experiences in the European aviation community in relation to the research question: How can aviation regulators retain effectiveness in a performance-based environment?

The investigator will through interviews with national and European (EASA) regulators as well as representatives from Air Navigation Service Providers and operators collect information, which will subsequently be analysed to derive the common essences of the experiences and finally form a thesis project for a Master of Science Program at Lund University.

Confidentiality:
Identities of all participants will remain anonymous and will be kept confidential from all other parties other than the interviewer. Video recording and notes will be taken during the interview for the purpose of recall by the researcher for future analysis. Anonymity will be further protected in any future portions of the thesis paper and any presentations that may result from this work. Participants' names will be kept in a locked secure filing cabinet separate from the information collected by the researcher. Participants' names, video-recordings and the researcher's notes will be disposed of using confidential waste no later than 3 month after the acceptance of the thesis by Lund University.

Contact Information about this Thesis Work:

Any questions concerning this thesis are welcome at kirs@tbst.dk

Risks/Benefits:
There are no known risks or benefits to participating in this research.

Consent:
Your participation in this research project is entirely voluntary. You may refuse to participate or withdraw from the research at any time. In addition, your organization should be informed of your participation, by receiving the same interview advert information as you.

Your signature indicates that you have received a copy of this consent form for your own records and that you and your organization consent to participate in this research.

I,_____agree to participate as outlined above. My participation is voluntary and I understand I can withdraw at anytime.

My organisation,_____ has received the above mentioned information and agreed to my participation in the project.

_____
Participant's Signature

Date

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