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AIR TRAFFIC MANAGEMENT IN THE SINGLE EUROPEAN SKY
STANDARDISATION OF SAFETY AND LIABILITY ISSUES

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Abstract
This paper aims to analyse the European system of Air Traffic Management (ATM) as a specific case study of risk regulation in the framework of the European integration process. At the present, the implementation of the Single European Sky is a growing area of EU policy, which shows the potential and the difficulties of coordinating national competences in a supranational regulatory framework. This search for coordination has a direct impact on air traffic safety itself and it involves the development of risk mitigation policies at both the EU level and at the level of individual Member States.
The existing trade off between risk and safety as conveyed by technology affects both the instruments and the content of risk management. Since the failure of safety measures when providing air services could result in disaster, regulation needs to address this issue. Two main questions assist in the implementation of the regulatory framework: what level of protection is appropriate against such uncertainty and the risks of possible catastrophic impact, and who bears the risk in case the delivered safety system fails. Precautionary safety standards on the one hand and liability remedies on the other are therefore addressed as the key issues for the regulation and distribution of risks. By focusing on these issues, the fragmentation of the current legal framework in ATM illustrates the current legal difficulties in the integration of the European skies.

Keywords
Air Traffic Management, European integration, risk regulation, air traffic safety, supranational regulatory framework.

Marta Simoncini
Max Weber Fellow, 2011-2012

Introduction

This paper aims to analyse the European system of Air Traffic Management (ATM) as a new frontier of catastrophic risk regulation in the framework of the European integration process[1]. By focusing on this specific case study, the main legal issues of disaster risk regulation can be addressed. Considering that ATM concerns all the procedural and organisational aspects of the control of aviation safety, the understanding of the current regulatory framework highlights the existing trade off between risk and safety as it is conveyed by technology. Basically the search for technological safety in providing air services whose failure could result in disaster, affects the two main questions of disaster regulation: what level of protection is appropriate against such uncertain risks of possible catastrophic impact and who would then be charged with liability in case the delivered safety system failed.

In fact, by developing a common framework for ATM in Europe, the EU has improved its on-going strategy against disaster risks, by setting the standards beyond which the legal order does not want a specific risk to be incurred[2]. From this point of view, standards provide protection against threats, in the attempt both to preserve safety and to reduce the harm arising from the materialisation of the risk. In this way it is possible to control the level of risk that is to be considered unacceptable for the legal order, without turning an uncertain danger into an absolute and unjustified priority (in terms of resources) for the whole of society.

Since standardisation is based on the assumption that risk cannot be eliminated entirely, but can instead be rationally managed by fixing its acceptable levels, the definition of a rational and balanced relationship between risk and safety cannot function without providing the means to transfer the risk – whose materialisation cannot be prevented – to the parties who are in the best position to bear it. A regulatory system should therefore assess who bears the consequences, and to what extent, of a failure of the safety system in order to sustain technological progress and reduce risk. Liability remedies therefore play a significant role in the *ex post* management of risks by distributing risks among the relevant actors. This is particularly evident in a sector like ATM where a redistribution of tasks and responsibilities between automated systems and human operations[3] would improve the performance of air navigation and the mobility of people and goods. For instance, technology can help to make aircrafts fly on the same course, by controlling automatically the risk of mid-air collision. This highly innovative technology, which can have a great impact on the day-to-day number of flights, however, has not yet been used in civil aviation, since the liability framework is not clear cut in this socio-technical system.

By analysing the European case of ATM, this paper therefore aims to deepen legal research on standard-based risk regulation in disaster related contexts. Currently, even though the European Union is implementing a multilevel governance of catastrophic risks that is based on the standardisation of countermeasures, the European literature on the subject is still limited since it focuses basically on the application of the precautionary principle as a burden of proof on the party that would like to introduce a new risk, concerning its compatibility with the protection of health and the environment[4]. In the

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[1] I would like to thank Giovanni Sartor and Martin Scheinin for their valuable comments and remarks. Usual disclaimers apply.

[2] In this regard see M. Simoncini, *Regulating Catastrophic Risks by Standards*, in *EJRR*, 1/2011, pp. 43 ff.

[3] In this regard see G. Contissa, *Addressing Liability of Automated Systems in Air Traffic Management*, EUI Working Papers MWP 2011/30, p. 1 ff.

[4] Among others, see G. Majone, *What Price Safety? The Precautionary Principle and its Policy Implications*, in *Journal of Common Market Studies*, 1/2002, pp. 89-109; N. de Sadleer, *Environmental Principles: From Political Slogans to Legal Rules*, Oxford University Press, Oxford, 2002; E. Fisher - J. Jones - R. von Schomberg (eds.), *Implementing the Precautionary Principle. Perspectives and Prospects*, Elgar, Cheltenham, 2006; E. Fisher, *Opening Pandora's Box: Contextualising the Precautionary Principle in the European Union*, Oxford Legal Studies Research Paper No 2/2007, available at papers.ssrn.com/sol3/papers.cfm?abstract_id=956952, pp. 1-43; A. Alemanno, *The Shaping of the Precautionary Principle by European Courts: From Scientific Uncertainty to Legal Certainty*, Bocconi Legal Studies Research Paper No 1007404, 2007, available at papers.ssrn.com/sol3/papers.cfm?abstract_id=1007404, pp. 1-13;

meantime, legal research on disasters still focuses on the function of civil protection and its capacity to provide a parallel system of intervention, which can act adequately as a surrogate for the ordinary administrative tasks and competences in a special and derogatory manner[5]. Furthermore, literature on standards only exists in a few and fundamental parts of more general studies on regulation[6], whereas American research on these topics has been developed along with the core questions of administrative law since 1980[7].

By developing previous studies on catastrophic risk regulation[8], this paper focuses on the specific case of the ATM system in the European legal order, with the aim to address the main legal challenges related to the enhancement of safety in this sector. After having reconstructed the basics of EU regulation on ATM – meant as both the institutional foundation (§ 2.1) and the functioning (§ 2.2) – and the need to speed up its development in the light of the recent volcanic ash crisis (§ 2.3), I analyse the legal instruments to improve safety. I address precautionary safety standards and liability remedies as the key issues to tackle those risks of catastrophic impact related to the failure of the ATM system. On the one hand, the standardisation of safety is considered to be an attempt to rationally manage uncertain risks; safety performance standards in ATM (§ 3) are therefore framed in the European model of standard-based risk regulation of disaster risks (§ 4). On the other hand, liability is considered to be a means to transfer the risk of failure of this rational management of uncertainty (§ 5). In this light, I analyse liability related to both the implementation of safety standards (§ 5.1 and § 5.2) and to the standard setting (§ 5.3), aiming to show that the clarification of the liability framework can help enhance ATM performance. On the grounds of this analysis, in the final remarks I assess the European ATM system as an illustration of the reasons and the difficulties of the on-going integration between EU Member States.

1. The ATM system in the European regulatory framework

Air Traffic Management consists of both human and technological procedures and resources necessary to safely guide aircrafts both flying in the skies and operating on the ground. From an operational point of view, this fundamental function is divided into some distinct tasks aimed at maximising the utilisation of the available airspace, building efficient skyways (airspace management), providing a safe, orderly and expeditious flow of air traffic so that its capacity is utilized to the maximum extent compatible with the safety of flights (air traffic flow and capacity management), checking that aircrafts are safely separated in every operational process (air traffic control) and correctly informed about their position (air navigation service provision).

ATM is under the jurisdiction of states as airspace, and its management is a fundamental part of national sovereignty. In order to make international fights possible, international conventions aim to coordinate the national performances of this function. In this regard, the Convention on International

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J.Dutheil de la Rochere, *Le principe de precaution*, in J.B. Auby - J. Dutheil de la Rochère (eds.), *Droit Administratif Européen*, Bruylant, Bruxelles, 2007, pp. 459-471.

[5] On civil protection in the EU see SIPRI, *The Effectiveness of Foreign Military Assets in Natural Disaster Response*, SIPRI; Stockholm, 2008; S. Wiharta, *European Civil Protection Force: A step towards a more effective disaster and humanitarian response?*, in *European Security Review*, 42/2008, pp. 1-4; C. Wendling, *Explaining the Emergence of Different European Union Crisis and Emergency Management Structures*, in *Journal of Contingencies and Crisis Management*, 2/2010, pp. 74-82.

[6] See R. Baldwin - M. Cave, *Understanding Regulation. Theory, Strategy and Practice*, Oxford University Press, Oxford, 1999; A. La Spina - G. Majone, *Lo Stato regolatore*, Il Mulino, Bologna, 2000; for the English experience, see E. Fisher, *Drowning by Numbers: Standard Setting in Risk Regulation and the Pursuit of Accountable Administration*, in *Oxford Journal of Legal Studies*, 1/2000, pp. 109-130; for more recent work see B. Hutter, *In catastrophe's shadow*, in *Risk&Regulation*, 19/2010, p. 3; Id., *Risk regulation and the anticipation of natural disasters*, *ibidem*, pp. 6-7.

[7] S. Breyer, *Regulation and Its Reform*, Harvard University Press, Cambridge, Mass., 1982.

[8] M. Simoncini, *La regolazione del rischio e il sistema degli standard. Elementi per una teoria dell'azione amministrativa attraverso i casi del terrorismo e dell'ambiente*, Editoriale Scientifica, Naples, 2011.

Civil Aviation, also known as the Chicago Convention, has established rules for the safe use of airspace and it has grounded the responsibility for ATM on the contracting states[9].

In Europe this traditional fragmentation has however turned out to be a clear hindrance, in terms of efficiency, to the increasing volume of air traffic[10]. The increasing traffic, related to the growing mobility of both people and goods, needs increased coordination, and a common approach to ATM could help the implementation of that same coordination to EU economy.

The European integration process highlights the free movement of people and goods throughout Europe. In order to make the common single market actually work amongst Member States, all the fundamental freedoms of movement – laid down in the Treaties – should be implemented in every sector-specific field of service regulation, and in particular in the domain of air traffic. From this point of view, liberalisation of public utilities has played a key role in setting up and implementing a competitive European market. Since this liberalisation process has interested the areas of shared competence between European Union and Member States, EU intervention in national air laws has been fragmented and driven by the rule of shared competence[11]. Like in other sectors (ICT, energy, other forms of transport), at first the creation of a competitive market through liberalisation policies affected the delivery of services,[12] only then did it interest the infrastructural network (basically the assignment of slots)[13].

Later on, EU regulation focused on the technical functioning of the (internal) air market in order to implement effective air transport as far as safety needs, future capacity and regularity of air services are concerned[14]. In this way, the search for a common European ATM framework aims to improve the efficiency of European flights and to make the movement of people and the exchange of goods more effective in the European Union.

The very nature of the European integration process therefore requires air law to become also a supranational issue. To this end, the EU has developed regulation in air law through the establishment of the Single European Sky (SES), a common European regulatory area for air navigation services (ANS). This framework aims to improve the management of air space as a scant European resource by developing consistent regulation. However, since the ATM competence is still national, this European regulatory framework is still based on the functional cooperation of different national, supranational and international institutions. As a consequence, common rules are the outcome of a complex interaction between different levels of government. The following paragraphs are intended to illustrate the main profiles of the SES, by pointing out who the institutional parties involved in its setting and implementation are, and which fundamental novelties this new regulatory framework has introduced. In order to address the complexity of this integration project and its importance in the management of safety risks, its functioning is also analysed in the light of the recent volcanic ash crisis.

1.1 The Single European Sky: the institutional framework

In order to understand the nature of EU policies in ATM correctly, it is important to consider who the main actors engaged in the construction of this legal system are. A trilateral relationship takes place

[9] See, in particular, art. 28 of the Convention on International Civil Aviation (1944). In this regard see J. Huang, *Aviation Safety through the Rule of Law. ICAO's Mechanisms and Practices*, Kluwer Law International, the Netherlands, 2009, p. 34 ff.

[10] Eurocontrol assessed that with over 40,000 daily flights a day predicted for 2020, the current ATM system could cope with this volume of traffic in an efficient manner.

[11] See art. 80 (2) ECT.

[12] See in particular Council Regulation (EEC) No 2408/92 of 23 July 1992 on access for Community air carriers to intra-Community air routes; Council Regulation (EEC) No 2409/92 of 23 July 1992 on fares and rates for air services.

[13] See Council Regulation (EEC) No 95/93 of 18 January 1993 on common rules for the allocation of slots at Community airports

[14] See Communication from the Commission to the Council and the European Parliament COM (1999) 614 of 6 December 1999, *The creation of the Single European Sky*; High Level Group, Single European Sky. Report, 2000.

between national, supranational, and international institutions which affects the current state of ATM integration and air traffic efficiency in Europe. Currently, the development of the European regulatory framework requires coordination between Member States, the EU and Eurocontrol in its capacity as the main international organisation responsible for air safety at the European transnational level [15].
In the setting up of a European regulatory framework in ATM the distribution of functions between these relevant actors has been many-sided and by and large the EU plays a fundamental regulatory function, states cooperate with this regulation and its implementation, and Eurocontrol provides the necessary methodologies to assess technical safety issues. Basically the relations between the EU and states are based upon the competences provided in the Treaties and Eurocontrol has a key role in the improvement of EU efficient policies in this area.

More precisely, the European Commission holds fundamental rule-making powers for the implementation of an efficient ATM regulation, playing a leading role in the examination and evaluation of air navigation performances by drawing upon the existing expertise of Eurocontrol. Besides, many agencies at EU level perform assisting tasks for the Commission. In particular, the Single Sky Committee[16] ensures the appropriate consideration of the interests of all categories of users involved in the regulatory process and gives its opinion on many significant issues in the implementation of ATM network functions[17], whereas the European Aviation Security Agency (EASA) is charged with technical tasks in the field of airworthiness and environmental certification[18]. The increasing commitment of EASA in developing these tasks[19] should not overlap with the role of Eurocontrol, since they are meant to work in partnership in order to achieve an efficient regulatory system. Eurocontrol has helped the European Commission draft the regulatory framework and provides support to rule-making standards as well as safety and environmental legislations.

At the national level the enforcement of EU regulation is carried out by National Supervisory Authorities, which are independent agencies entrusted with fundamental powers of control. Air navigation service providers (ANSP) are public or private entities authorised and designated by national supervisory authorities in the name of states in order to deliver air navigation services (ANS) on an exclusive basis[20].

The effective improvement of such a regulation needs the expertise of Eurocontrol, which cooperates closely with states and the EU with the aim to enhance safety in ATM and to ensure the effective management of air traffic. In this task Eurocontrol avails itself of a Performance Review Commission, which provides advice to the governing bodies on all aspects of ATM including policy

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[15] Eurocontrol (established by six original nations – Belgium, France, the Federal Republic of Germany, Luxembourg and the Netherlands – and now made up of 39 participating states) was charged at first with the responsibility to provide upper air traffic management services for its member nations and to collect route changes from airlines. To this end, Eurocontrol established the Maastricht Upper Area Control Centre (UAC) in 1972, which was the first air traffic control centre to manage air traffic of more than one state (covering Belgium, Luxembourg, the Netherlands, and northen Germany). As technological development made air traffic more global and more coordination was requested, it started expanding its tasks (see Protocol consolidating the Eurocontrol Convention, 1997) over further aspects of European flights in ATM by availing itself of a Central Flow Management Unit (CFMU) which assists air traffic managers in ordinary as well emergency situations.

[16] Art. 5 of Regulationof the European Parliament and the Council (EC) No 549/2004 of 10 March 2004. The Single Sky Committee is composed of two representative of each Member State and is chaired by a representative of the Commission.

[17] See art. 17 of Commission Regulation (EU) 677/2011 of 7 July 2011. For example, it gives its opinion on the designation of the Network Manager and of the chairperson and the voting members of the Network Management Board and on the Network Strategy Plan (especially, on the objectives of this plan at an early stage).

[18] See Regulation of the European Parliament and the Council (EC) No 216/2008 of 20 February 2008, repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC, as amended by the Commission Regulation (EC) No 108/2009 of 5 February 2009.

[19] It is worth noting that EASA was established in 2002 (Regulation of the European Parliament and the Council (EC) No 1592/2002 of 15 July 2002) with the specific aim to assist the EU Commission in the implementation and the control of safety measures and environmental protection.

[20] See artt. 7 and 8 of Regulation of the European Parliament and the Council (EC) No 550/2004 of 10 March 2004.

and planning, safety management at and around airports and in the Single European Sky airspace, as well as financial and economic aspects of services rendered[21]. This strong exchange of expertise has persuaded the EU to foster cooperation by integrating Eurocontrol within its legal framework. On this basis, the EU joined this international organisation[22], in order to integrate it within its legal order, with the aim to benefit from its expertise in taking control of the entire European ATM; as a result, Eurocontrol recommendations can be mandatory in European Member States through their implementation by the EU.

Furthermore, in accordance with the opinion of the Single Sky Committee, the EU Commission designated Eurocontrol as the European ATM Network Manager, that is an impartial and competent body who should perform fundamental regulatory tasks related to the optimisation of the use of European airspace[23]. This means that under the supervision of a Network Management Board (composed of representatives of regulators and regulated entities), Eurocontrol should monitor, report and forecast the performance of the European ATM network based on the agreed performance targets; act as a central unit for air traffic flow management across Europe; ensure the European airspace can accommodate the additional capacity needs, and seamlessly integrate airports into the network; give Member States and partners access to common resources; and support the deployment of technological improvements across the European ATM network.

Finally, the EU and Eurocontrol boosted their cooperation by creating a new institutionalised partnership aimed at implement a common ATM system for Europe: the SESAR (Single European Sky ATM Research) Joint Undertaking[24] aims to concentrate and coordinate all relevant research and development activities in Europe.

1.2 The Single European Sky: the regulatory framework

The first regulatory package developing a European policy in ATM was introduced in 2004. It pursued its goals to enhance the safety and efficiency of air transport in Europe; to reduce delays by improving the use of scarce airspace and airport resources; to improve air navigation services (ANS) and to decrease passengers costs by reducing the fragmentation of the air traffic management in Europe through the coordination of the decision-making process; in addition, it aims to improve the integration of military systems into the European air traffic management system. In this way, European air communications would become more efficient and competitive on the global market.

By and large, this package provides common rules for the efficient management of the EU countries' airspaces and it consists of four basic regulations, aimed at addressing the gaps in European ATM and reinforcing safety, by restructuring European airspaces and air navigation services[25]. This basic regulatory framework has been amended many times in order to tackle efficiency issues[26] and the first

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[21] It was established by the Eurocontrol Commission in 1998, in accordance with the ECAC Institutional Strategy (1997).

[22] See decision of the Council No 2004/636/EC of 29 April 2004 on the conclusion by the European Community of the Protocol on the accession of the European Community to the European Organisation for the Safety of Air Navigation.

[23] See Commission decision of 7 July 2011, on the nomination of the Network Manager for the air traffic management (ATM) network functions of the Single European Sky, which is based on Art. 3 ff. of Commission Reg. (EU) No 677/2011.

[24] Council Regulation (EC) No 219/2007 of 27 February 2007.

[25] See Framework regulation (EC No 549/2004) – laying down the framework for the creation of the Single European Sky; the Service provision regulation (EC No 550/2004) – on the provision of air navigation services (ANS) in the Single European Sky; the Airspace regulation (EC No 551/2004) – on the organisation and use of airspace in the Single European Sky; the interoperability regulation (EC No 552/2004) – on the interoperability of the European Air Traffic Management network.

[26] On air navigation services see Commission Regulation (EC) No 2096/2005 of 20 December 2005, laying down common requirements for the provision of air navigation services; Commission Regulation (EC) No 1794/2006 of 6 December 2006, laying down a common charging scheme for air navigation services, further amended by Commission Regulation (EU) No 1191/2010 of 16 December 2010; Commission Regulation (EC) No 1315/2007 of 8 November 2007, on safety oversight in air traffic management and amending Reg. (EC) No 2096/2005; Commission Regulation (EC) No 482/2008

report on the implementation of SES I was delivered in 2007[27], presenting the achievements and the new challenges for the construction of the Single European Sky. Based on the findings of this report, a second Single Sky legislative package (SES II), amending the former legislation, was adopted in 2009[28], with the aim to face the growing demand for air transport by enhancing the capacity of infrastructure in traffic control[29]. Both safety needs and the coordination of ATM, together with the reduction of the environmental impact of air traffic, are the key issues of the new regulatory framework. In the pursuit of these safety goals, this regulation assigns specific tasks, to the European Aviation Safety Agency (EASA), while regular consultation with the relevant stakeholders (e.g., air navigation services providers, airport operators, airspace users, manufacturing industry and staff) is promoted in order to enhance both the legitimacy and the effectiveness of the regulatory measures.

The main achievement of this regulation is, however, the introduction of a new regulatory concept of airspace, which overcomes the traditional territorial recognition with an operational identification: regardless of national boundaries, Functional Airspace Blocks (FABs) are established by defining operative regions (between European States) where air navigation services should be delivered with a view to the optimization of their performance, through either the cooperation among air navigation services providers or the establishment of an integrated provider[30]. This is the first regulatory initiative to create a unique European airspace by integrating neighbouring national airspaces into a bigger operational region and it shows the introduction of a new regulatory perspective, based on efficiency assessment and no longer on territorial jurisdiction. This does not means that states have lost their role; on the contrary they work closely on the implementation of FABs and they maintain responsibility for its correct functioning. Currently, National Supervisory Authorities should cooperate closely to ensure adequate supervisions of ANS providers and can delegate its functions only to qualified entities, whose characteristics are set out in the same regulation[31].

Moving from this operational perspective, another relevant goal of this second package is the improvement of performance in the key areas of safety, capacity, cost-efficiency and environmental

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of 30 May 2008, establishing a software safety assurance system to be implemented by air navigation service providers and amending Annex II to Reg. (EC) No 2096/2005; as the use of air space is concerned see Commission Regulation (EC) No 2150/2005 of 23 December 2005, laying down common rules for the flexible use of airspace; Commission Regulation (EC) No 730/2006 of 11 May 2006, on airspace classification and access of flights operated under visual flight rules above flight level 195; for the enhancing of interoperability see Commission Regulation (EC) No 1033/2006 of 4 July 2006, laying down the requirements on procedures for flight plans in the pre-flight phase for the Single European Sky; Commission Regulation (EC) No 1032/2006 6 July 2006, laying down requirements for automatic systems for the exchange of flight data for the purpose of notification, coordination and transfer of flights between air traffic control units; Commission Regulation (EC) No 633/2007 of 7 June 2007, laying down requirements for the application of a flight message transfer protocol used for the purpose of notification, coordination and transfer of flights between air traffic control units; Commission Regulation (EC) No 1265/2007 of 26 October 2007, laying down requirements on air-ground voice channel spacing for the Single European Sky.

[27] See Communication from the Commission to the Council and the European Parliament COM(2007) 845 of 10 January 2007, *First Report on the implementation of the Single Sky Legislation: Achievements and the way forward*.

[28] Regulation of the European Parliament and the Council (EC) No 1070/2009 of 21 October 2009, amending Regulations (EC) No 549/2004, (EC) No 550/2004, (EC) No 551/2004 and (EC) No 552/2004 in order to improve the performance and sustainability of the European aviation system.

[29] See also Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions COM (2008) 389 of 25 June 2008, *Single European Sky II: towards more sustainable and better performing aviation*.

[30] Art. 2 of Reg. (EU) No 1070/2009, introducing art. 9a to the Reg. (EC) No 550/2004. Note that Commission Regulation (EU) No 176/2011 of 24 February 2011 laid down the information to be provided before the establishment and modification of a functional airspace block, with particular reference to safety, air traffic flows, consistency with the European route network, costs, transfer of responsibility for air traffic control, compatibility between the different airspace configurations, regional agreements and performance targets.

[31] Art. 2 of Reg. (EU) No 1070/2009. In addition, the states belonging to the same functional airspace block can designate a system coordinator, who shall facilitate the overcoming of difficulties in the negotiation process and who shall report to the EU Commission, Single Sky Committee and EU Parliament every three months.

impact. In particular, in March 2010 new common rules on air traffic flow management (ATFM) were introduced with the aim to optimise available capacity in the use of airspace and enhance ATFM process[32]. Furthermore, in July 2010 on the grounds of art. 11 of Reg. (EU) No 1070/2009, the performance schemes for air navigation services and network functions were established: by availing itself of a system of measurable standards and alert thresholds, the regulation identifies Key Performance Indicators (KPIs) and binding targets on the key areas of safety, environment, capacity and cost-efficiency[33]. Performance plans, containing incentives to achieve the safety, cost-efficiency, capacity and environmental targets, should be adopted either at national level or at the functional block airspace block level, by the competent National Supervisory Authorities, in accordance with the general performance targets provided by the EU after a consultation with stakeholders and EASA (European Union-wide performance targets)[34]. In this framework Eurocontrol has been designated as the Performance Review Body to assist the Commission with its technical competence in the implementation of the performance scheme, the EASA in the development of safety measures and the National Supervisory Authorities in their regulatory functions[35].

In the first implementation phase, the main regulatory effort has been concentrated on the enhancement of safety through the definition of standards aimed at securing technological integration and efficiency. With the aim to further develop safety KPIs the Commission established a Working Group consisting of representatives of EASA, Eurocontrol and the Commission itself, which produced a technical report on the metrics for an effective safety management. This report, as improved on the basis of the feedback received by stakeholders, constituted the "technical concept" of the 2011 Commission implementing regulation on performance schemes[36].

1.3 Safety at risk: the volcanic ash crisis in the complexity of the Single European Sky

In April 2010 the implementation of SES II was accelerated by the volcanic ash crisis, which demonstrated the urgent need for coordination in European ATM[37], since the application of the ICAO international rules to the emergency situation at stake cost about 4.7 billion $ on the global GPD[38]. Since such a national approach to a transnational issue produced significant problems for airlines and their business as well as to the free movement of passengers and goods, the EU Commission proposed a coordinated approach to the case.

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[32] See Commission Regulation **(**EU**)** No 255/2010 of. 25 March 2010 laying down common rules on air traffic flow management; but see also Commission Regulation (EU) No 73/2010 of 26 January 2010 laying down requirements on the quality of aeronautical data and aeronautical information for the single European sky.

[33] See Commission Regulation **(**EU**)** No 691/2010 of 29 July 2010 laying down a performance scheme for air navigation services and network and in particular Annex I on key performance indicators (KPI).

[34] Artt. 9-10 of Reg. (EU) No 691/2010. Note that the EU Commission is charged with the task of assessing the consistency of performance plans with its EU-wide performance targets, monitoring the implementation of performance plans and periodically reviewing its wide targets and setting and supervising the functioning of the alert mechanism; see artt. 13-19.

[35] Commission decision on the designation of the Performance Review Body (PRB) of the Single European Sky C (2010) 5134 final of 29 July 2010; on the tasks and responsibilities of the PRB see Art. 3 Reg. (EU) No 691/2010. This designation is for a fixed term consistent with the reference period and ends on 30 June 2015, but nothing is included about the possibility of renewing the designation. On the tasks and responsibilities of the PRB see Art. 3 Reg. (EU) No 691/2010.

[36] Commission Implementing Regulation (EU) No 1216/2011 of 24 November 2011, amending Commission Regulation (EU) No 691/2010 laying down a performance scheme for air navigation services and network functions.

[37] Council of European Union, Extraordinary meeting. Transport, Bruxelles, 4 May 2010, on the EU response to the consequences of the volcanic ash cloud for air transport. In particular, the Council stressed the need to accelerate the implementation of the functional airspace blocks, the nomination without delay of the Functional Airspace Blocks coordinator, appointment of a European network manager before the end of 2010, the adoption of the performance scheme, the implementation of EASA's competences on ATM, the creation of a crisis coordination cell, and the adoption of the SESAR deployment strategy before the end of 2010.

[38] See Oxford Economics, *The Economic Impact of Air Travel Restrictions Due to Volcanic Ash*, available at http://www.oxfordeconomics.com/samples/volcanic%20update.pdf.

The spread of the Icelandic volcanic ash induced European States to enforce ICAO guidelines for these events[39] and introduced emergency blocks of their airspaces, pursuing a precautionary approach, regardless of ash concentration and the economic impact of the ban on flights. In the general unrest against that measure, the EU Commission proposed and coordinated an intergovernmental extraordinary meeting of European Ministers of Transport, which provided a plan based on a technical assessment by Eurocontrol, aimed at regulating the possibility of flying according to the degree of ash contamination[40]. By mapping European airspaces by dividing it into three zones, a common European framework of emergency traffic management was established: in the first area ("located in the central nucleus of the emissions", as the declaration of the EU Ministers of Transport put it) with the highest degree of ash concentration, the safety goal was achieved only by maintaining the ban on flights ("a full restriction of operations"); in the second area, where there were "still amounts of ash" (a grey zone), the possibility of pursuing air traffic operations should be decided "in a coordinated manner" by Member States; the third zone, being "not affected by the ash", was subject to no restriction.

In this way, the search for a transnational response to this crisis meant a substantial relocation of the safety function in an emergency situation from states to the EU (even if following an intergovernmental pattern) and moved forward the implementation of Single European Sky. Basically, this emergency contributed to the improvement of disaster management by boosting both the organisation and the functioning of ATM. Looking at the organisational framework, the emergency stimulated the establishment of a Network Crisis Management aimed at directing the response to network crisis. Under the coordination of the Network Manager (Eurocontrol), supported by a new body, the European Aviation Crisis Coordination Cell (EACCC)[41], this new body develops mitigating measures at network level and helps Member States develop contingency plans.

From an operational standpoint, the volcanic ash crisis accelerated the introduction of ATM, implementing regulations concerning the traffic management's performance in terms of safety, cost-efficiency, capacity and environmental impact. By promoting the integration process in air traffic without delay, this case highlights the complexity of the development of ATM regulation from both functional and institutional perspectives. The definition of safety standards enforced over the entire EU seems to be the key instrument to develop a common policy without compromising the distribution of current competences in the EU[42]. This means that the involved safety risk is tackled through a rational system of protection. This rationality is therefore achieved through a cooperative process of national, supranational and international European institutions.

2. ATM and the standardisation of safety

Performance standards should be set upon the basis of the KPIs and the EU-wide safety performance targets, through the cooperative process which involves all the relevant actors of the European regulatory framework.

Basically, the EU should provide wide safety performance targets and on these grounds Member States should lay down specific performance schemes in the elaboration of either national or FAB performance plans. For the first reference period for the implementation of SES II (2012-2014[43]), however, no wide safety performance targets are going to be delivered at the EU level and Member States may set targets corresponding to the safety KPIs provided in the Reg. (EU) No 1216/2011. This regulation aims to improve the safety performance scheme by developing an ATM risk management

[39] See section 3.4, *ICAO Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds*, 2007.

[40] Extraordinary meeting of EU Ministers of Transport, 19 April 2010.

[41] See artt. 18-19 of Reg. (EU) No 677/2011.

[42] In this regard, see A. Fioritto - M. Simoncini, *If and when: towards standard-based regulation in the reduction of catastrophic risks*, in A. Alemanno (ed.), *Governing Disasters. The Challenge of Emergency Risk Regulation*, Elgar, Cheltenham, 2011, pp. 120 ff.

[43] Art. 7 of Reg. (EU) No 691/2010.

system based on the continuous measuring, monitoring, and reporting of three main indicators (safety KPIs): the management objectives, the risk severity and the safety culture.

More specifically, the first safety KPI assesses the effectiveness of safety management by measuring it with a methodology based on the ATM Safety Maturity Survey Framework (SMS standard). This standard has been developed by Eurocontrol as an instrument aimed at improving a positive and proactive safety culture. Adjusting this means to the mandatory requirements of the performance scheme, EU regulation makes that methodology the basis of its management objectives: safety policy and objectives, safety risk management, safety assurance, safety promotion, and safety culture[44].

By availing of the Risk Analysis Tool methodology, the second safety KPI assesses the severity of three main categories of occurrences: namely the separation minima infringements (which concern the minimum distance between aircrafts required to reduce the risk of collision, as well as to prevent accidents due to wake turbulence); the runway incursions (which regards the incorrect presence of an aircraft vehicle or person on the protected area of a surface designated for the landing and take off of aircraft); and the ATM-specific occurrences at all Air Traffic Control Centres and at airports. Covering all the operations (at airports, during departure and landing procedures and in flight), this assessment provides a scale of increasing gravity of possible accidents, from "no safety effect" to "serious incident", moving across the classifications of "significant incident" and "major incident" and also taking into account the possible case of "not determined" accident due to insufficient information or evidence available[45].

The third safety KPI refers to the objective of just culture: through questionnaires prepared by EASA in consultation with Eurocontrol in its capacity of Performance Review Body, the level of safety culture is assessed[46].

It is worth noting that it is Eurocontrol the institution that should provide the methodologies necessary for the development of these three safety KPIs, through information delivered to the EASA, which then has to pass on the acceptable means of compliance and the guidance materials for their implementation before the start of the first reference period[47]. Furthermore, in its capacity of Network Manager, Eurocontrol has been entrusted with the supervision of network plans aimed at achieving the performance targets in the long term[48]. This means that from a technical point of view, the implementation of the SES is based on Eurocontrol's safety expertise and this institution plays a key role in the management and the development of a European ATM system.

National Supervisory Authorities elaborate the performance plans, the performance oversight and the monitoring of both plans and targets for the relevant airspace by availing themselves of the assessment criteria set out in Annex III of the Reg. (EU) No 691/2010[49]. These provisions lay down that safety standards cannot be lower than the EU-wide targets, and only within this limit is it up to the involved Member States to define the adequate safety level.

Beyond the performance targets, the performance plans shall also contain the traffic forecasts, the determined costs for air navigation services and a description of investment necessary to achieve the performance targets[50]. Based on this, the performance plans identify the different entities that are accountable to meeting the targets and their specific contribution, and include incentive mechanisms and measures to be applied to the various accountable entities to encourage the achievement of the

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[44] Annex 1, Sec. 2, point 1 a), of Reg. (EU) No 691/2010 as amended by Reg. (EU) No 1216/2011.

[45] Annex 1, Sec. 2, point 1 b), of Reg. (EU) No 691/2010 as amended by Reg. (EU) No 1216/2011.

[46] Annex 1, Sec. 2, point 1 c), of Reg. (EU) No 691/2010 as amended by Reg. (EU) No 1216/2011.

[47] Annex 1, Sec. 2, point 1 e) and f), of Reg. (EU) No 691/2010 as amended by Reg. (EU) No 1216/2011.

[48] More precisely, according to the artt. 4-6 of Reg. (EU) No 677/2011, network plans divide into network strategy plan which operates in the long term as an instrument to implement performance schemes and more specific network operation plans which develop the strategy plan in the short and medium terms along with the EU wide performance targets.

[49] Annex 3, points 1 and 2, of Reg. (EU) No 691/2010.

[50] See Art. 10 and Annex 2 of Reg. (EU) No 691/2010.

targets. The incentives on safety targets, in particular, cannot be financial in nature and should consist in action plans, provided on a non-discriminatory and transparent basis and in an effective and proportional way as part of the regulatory environment[51]. These incentives should, in particular, drive the behaviour of the stakeholders subject to the target setting, and primarily the aviation industry. This means that the performance plans will assess the basic safety content of the ATM instruments. The accuracy level of action plans, however, can leave out some margin of discretion and in principle cannot exclude the possibility of allocating liability to the stakeholders.

Finally, plans should provide a description of the measures to be taken by the National Authority to monitor the achievement of the performance targets, by implementing the safety programmes and the business plans even in the case that standards are not met during the reference period[52]. The performance plans should also be communicated to the EU Commission, which assesses their consistency with the EU-wide targets and recommends revisions where needed[53].

The EU-wide targets can be revised only on the evidence that they cannot achieve the safety goals, both before the beginning of the reference period if the initial data, assumptions and rationales of their setting are demonstrated to be no longer valid, and during the reference period as a result of the application of alert mechanisms[54]. These mechanisms aim to prevent the occurrence of a disaster and adjust the safety goals to the new data. The alarm system is based on a threshold model which rationally sets critical levels of safety beyond which urgent and appropriate actions are required (within three months), in order to restore adequate safety to ATM[55].

This regulatory model is actually based on the continuous monitoring of the safety performances and the tacit reliability of the risk monitoring systems, so that continuous watching can detect occurrences and can contain uncertainty. Gaps in the scientific assessments are, however, to be considered, especially in cases where a non-linear relationship between causes and effects – which is typical of complex systems – can affect the understanding of phenomena and can thus influence the appropriateness of the response. The nature of the risk at stake is catastrophic and the potential of accidents as a result of ATM failure should therefore take into account the uncertainty of risk assessment (identifying the probabilities of disaster risks is considered the greatest difficulty).

3. The model of standard-based risk regulation

EU policy in ATM can be framed in its more general strategy against disaster risks. These risks are a sensitive challenge for legal orders, since they are related to a high level of uncertainty and to elevated consequences in terms of casualties and losses when they occur. On the one hand, the elevated consequences call for some level of regulation; on the other hand, the uncertainty of their occurrence makes it difficult to review the evidentiary scientific justification, the assessment of costs and benefits and the means by which the goals are going to be pursued through administrative law standards familiar from the regulation of other, non-catastrophic risks. The low probability of catastrophic risk suggests not reacting to those risks, because in the face of the potential costs of the risk and its regulation, the benefits of protection are only just possible (since precautions may be made ineffective due to the unpredictable appearance of catastrophes[56]) and rarely achievable (because of the low probability of the risk). However, it is absolutely clear that the severity of the consequences of catastrophic events cannot be ignored by states and the international community, not only in the short run, in their role of political actors charged with the issue of guaranteeing collective security, but also in the long run, as institutions responsible for the respect of an inter-generational pact aimed at

[51] Art. 11 of Reg. (EU) No 691/2010.

[52] Art. 17 of Reg. (EU) No 691/2010.

[53] Art. 13 of Reg. (EU) No 691/2010.

[54] Art. 16 of Reg. (EU) No 691/2010.

[55] Art. 18 of Reg. (EU) No 691/2010.

[56] On the notion of catastrophic risks as "virgin risks" see C. Kousky - J. Pratt - R.J. Zeckhauser, *Virgin Versus Experienced Risks*, available at http://www.hks.harvard.edu/fs/rzeckhau/kousky-pratt-rjz-revised.pdf.

assuring a sustainable development and use of scant resources. This applies with even greater force to multilevel legal orders such as the EU where different regulatory philosophies may clash and the consequences of catastrophes may be distributed unequally throughout the territory.

The search for a suitable response to both the uncertainty of these risks and the current distribution of competences between the EU and its Member States has persuaded EU institutions to set standards of protection against catastrophic risks, aimed at outlining an acceptable management of their possible occurrence. This involves building disaster regulation on the notion of "significant" risk, that is the threat due to be regulated according to the assessment of the toll of victims and the damage accepted in a determined time and in a settled space[57]. This means that faced by the impossibility of eliminating disaster risks, regulation should engage in the reduction of their possible impact to the extent to which the costs do not exceed the benefits. By providing a due level of protection only against those threats whose actuality could produce intolerable effects for the relevant community, the call for caution is driven by the balancing of the different interests at stake and the consequences of every regulatory decision. Therefore, in a case by case analysis, risk regulation should consider the severity of the threat for human health, the degree of reversibility of its effects, the possibility of delayed consequences and the perception of the threat based on available scientific data[58]. As a result, the concept of tolerable risk does not fit with a mere mathematical or statistical analysis of its probability, but it is a regulatory concept that concerns the effectiveness of the regulation.

In line with this reasoning, the EU Commission has been working on mitigating the impact of these uncertain risks through the setting of standards aimed at controlling the whole disaster management cycle, by improving the organisation and procedure of both risk regulation and emergency planning. In this way the prevention of catastrophes should be pursued by integrating emergency intervention and risk management, namely by implementing their coordinated activity in the multilevel legal system.

In order to achieve this goal, the EU legal order is shifting from a functionalist approach to a more comprehensive approach to disaster risks. In particular, from sector specific initiatives – like the so-called Seveso directives concerning the prevention of major accident hazards in some chemical industrial plants[59] – the regulatory framework has been developing a thematic approach to catastrophes and it aims to manage the whole disaster cycle (from risk assessment to emergency management).

This thematic approach has been implemented in key legislation about floods, which tackles their catastrophic impact by using standard-based methodologies[60]. This directive identifies significant flood risks through a process of mapping, building flood risk management plans on maps of hazard and risk, according to statistics and previous experiences. At present this model provides the most workable instruments for protection, whose *rationale* can also be employed to tackle other disaster-related issues. It is not by chance indeed that these methodologies were implemented in the management of the volcanic ash crisis, which was tackled by a coordinated use of mapping and ash concentration thresholds.

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[57] On the notion of significant risk see, in particular, C.L. Comar, *Risk: A Pragmatic De Minimis Approach*, in *Science*, 4378/1979, p. 309; P.F. Ricci - L.S. Molton, *Risk and Benefit in Environmental Law*, in *Science*, 4525/1981, pp. 1096-1097; S. Breyer, *Breaking the Vicious Circle. Toward Effective Risk Regulation*, Cambridge, Mass., 1993, pp. 11-19; G. Majone, *Dilemmas of European Integration*, Oxford University Press, Oxford, 2005, pp. 133-135; A. Alemanno, *The Shaping of European Risk Regulation by Community Courts*, Jean Monnet Working Paper No 18/2008, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1325770, pp. 33-36.

[58] In this regard, see C.R. Sunstein, *Irreversible and Catastrophic*, in *Cornell Law Review*, 4/2005-2006, pp. 893-894.

[59] See Directive of the Council No 82/501/EEC of 24 June 1982 on the major accident hazards of certain industrial activities (Seveso I Directive); Directive of the Council No 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances (Seveso II Directive); Directive of the European Parliament and of the Council No 2003/105/EC of 16 December 2003 amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances (Seveso III Directive).

[60] Directive of the European Parliament and of the Council No 2007/60/EC of 23 October 2007 on the assessment and management of flood risks.

By implementing this approach, the EU aims to go beyond it and manage all the different catastrophic risks within a common strategic framework. This means developing clear methodologies of risk standardisation which can rationalise the management of these low probability, high impact risks. In order to achieve this goal, first of all this strategy strengthens both the existing EU legislation, policies and programmes and the research and development on disaster risks[61]. Along with these two objectives, in the long term the EU Commission is thinking about the introduction of a framework directive for natural disaster prevention, as a further pillar of disaster management that would integrate preventive action and civil protection with the aim to prioritise hazards, map risks and manage emergency plans[62].

ATM safety standards can easily be framed in this general disaster adverse strategy, since they aim at setting safety thresholds which should be respected and implemented in the entire European Union. This way, the risk of aircraft collision is rationally addressed, by aiming at an acceptable trade off between the growth of air traffic and safety needs. From this point of view, since technological progress can significantly enhance the level of safety and the control of risks, it plays a key role in the implementation of aviation safety and, as a consequence, it makes standards more and more reliant on technology. This interaction between standard-setting and technology is at the heart of risk regulation and it sets the acceptable trade off between risk and safety.

Since this model is based on rational risk reduction, it is clear that it cannot ensure the effectiveness of its solutions. On the contrary, technology can fail, determining the consequent inefficiency of standards with (possible) catastrophic effects. Standards as well can fail in assessing the risk correctly, misunderstanding the reliability of technology. Precautionary risk management cannot therefore be the only means of protection and further remedies should be provided to offer protection in the aftermath of a disaster's occurrence. This means that risks that cannot be prevented should be transferred onto those parties who are in the best position to spread them. The allocation of liability thus represents a key legal remedy to ensure both tort reparation and a fair and efficient distribution of burdens in a legal order[63]. In this particular case, it works basically as a means of risk allocation and an incentive to the correct functioning of the preventive measures[64]. However, European regulation of ATM does not address this fundamental regulatory issue in an extensive manner and it prefers to rely upon a fragmented liability framework, made by both national rules and international conventions.

4. Liability profiles in the Single European Sky

In the Single European Sky safety needs are addressed through the implementation of a system of safety standards which aims to provide a common level of protection throughout the European ATM. The complexity of this legal framework makes it very difficult to allocate liability in case the system of standards fails to address safety issues and an accident happens. The level of involvement of the

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[61] See Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions COM (2009) 82 of 23 February 2009, *A Community approach on the prevention of natural and man-made disasters*. By setting disaster prevention in the short term, this communication implements EU strategy against disasters by focusing on the development of knowledge based disaster prevention policies at all levels of government – basically, through the creation of an inventory of information on disasters (§ 3.1.1.), the circulation of best practices (§ 3.1.2), the development of guidelines on hazard and risk mapping (§ 3.1.3) and the promotion of research (§ 3.1.4) – the coordination among the relevant actors and policies throughout the disaster management cycle (§ 3.2) and the effective improvement of the already existing policy instruments (§ 3.3).

[62] European Commission DG Environment, *Assessing the Potential for a Comprehensive Community Strategy for the prevention of Natural and Manmade Disasters, Final Report*, 2008, pp. 18-19 and 85-90.

[63] See S. Rose-Ackerman, *Product Safety Regulation and the Law of Torts*, in J.R. Hunziker - T.O. Jones (eds.), *Product Liability and Innovation. Managing Risk in an Uncertain Environment*, National Academy Press, Washington D.C., 1994, p. 153 ff.; G. Brüggemeier, *Common Principles of Tort Law. A Pre-Statement of Law*, BIICL, London, 2004, pp. 3 and 22.

[64] In this regard see G. Calabresi, *The Cost of Accidents. A Legal and Economic Analysis*, Yale University Press, New York, 1970.

different institutions endorsed with technical tasks, regulatory functions and monitoring responsibilities is so intricate, that the clear identification of who is liable in a specific case could become a very tricky issue. In fact, standardisation can rationalise the search for safety in a risk context such as the ATM, but it may excessively simplify the analysis of the situation at stake through indicators and inferences based on technical data and scientific information. Furthermore, this rational standardisation can lawfully produce damage to those parties who experienced the failure of safety standards. In order to understand who is charged with liability in case of failure of the safety measures, not only should the implementation of safety standards be analysed, but the rule-making process should also be addressed. As described, the parties basically involved in ATM are public authorities belonging to different levels of government, operators and the aviation industry, and their lawful interaction in standard setting can produce possible damage of a catastrophic impact.

The ground upon which this regulatory process is developed and the liability that should therefore be framed is indeed catastrophic risk regulation: this means that the probability of the occurrence of safety related risks with a disastrous impact are uncertain and that the impact of this occurrence overcomes the foreseeable damage caused by the collapse of single safety measures, since risks resulting from the complexity of ATM system cannot be captured by summing up the risk that its parts collapse separately. In addition, if every actor involved in the safety regulation plays its role correctly, the prevention of accidents is not assured, because of the complexity of the system in question. Establishing the liability framework therefore means allocating risk between different parties, in order to share the possible gaps in the search for safety and make a risk system like ATM work.

Liability plays a fundamental regulatory function by influencing individual conduct and it can work as an incentive against unsafe behaviour. Law and economics' literature has thoroughly investigated the deterrent function of liability as a remedy of private law, which can contribute to the achievement of public policy goals and which is actually complementary to *ex ante* public regulation[65]. Accident avoidance is pursued with a remedial system which aims to discourage unsafe conduct by allocating the legal and economic consequences of the damage onto who caused it. In this way, precautionary conducts are indirectly stimulated by the remedial system and safety is promoted with a backward approach. How liability is allocated therefore is a fundamental issue that the regulatory framework should address in order to achieve safety goals to the best level. Since liability rules can significantly contribute to reduce harm by imputing their costs on the relevant parties, an unbalanced liability mechanism is able to increase social costs and produce more harm. The choice of who might be liable and for what therefore assumes a key role in the avoidance of accidents and as a consequence it affects the correct functioning of the risk system[66].

A fundamental weakness of the European ATM safety regulation thus lies in the absence of common provisions on liability rules. In this way, not only is the efficient allocation of safety-related risks not coordinated in the European regulatory framework, but this legal fragmentation also affects the potential in the development of technological research on safety, making liability a remarkable issue in the enhancement of aviation safety. The following paragraphs examine these issues by focusing on the delivery of air traffic services as the implementation phase of safety policies and on the standard setting as the rule-making phase.

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[65] R. Coase, *The Problem of Social Cost*, in *Journal of Law & Economics*, 1960, pp. 1 ff.; G. Calabresi, *The Costs of Accidents. A Legal and Economic Analysis*, Yale University Press, New York, 1970; S. Shavell, *Economic Analysis of Accident Law*, Harvard University Press, Cambridge, Mass., 1987, p. 5 ff.; S. Shavell, *Liability for Harm versus Regulation of Safety*, in D.A. Wittman (ed.), *Economic Analysis of the Law. Selected Readings*, Blackwell, Mass., 2003, p. 59 ff.; J.P. Brown, *Economic Theory of Liability Rules*, in D.A. Wittman (ed.), *Economic Analysis of the Law. Selected Readings*, cit., p. 34 ff.; S. Shavell, *Foundation of Economic Analysis of Law*, Harvard University Press, Cambridge, Mass., 2004, p. 177 ff.; A.M. Polinsky - S. Shavell, *Handbook of Law and Economics*, Elsevier B.V., Amsterdam, 2007, p. 142 ff.

[66] On the different consequences of different liability systems see G. Calabresi, *First Party, Third Party, and Product Liability Systems: Can Economic Analysis of Law Tell Us Anything About Them?*, in *Iowa Law Review*, 1983-1984, p. 834 ff.

4.1 Liability for delivering service provision: the subjective requirements of providers

Air navigation service providers need a certification issued by the competent National Supervisory Authority, which attests that they satisfy all technical and operational requirements[67]. This administrative measure aims to preserve the public interest in the safe performance of ATM by first checking the subjective characteristics of the possible providers. Certificates therefore specify the rights and obligations of service providers with particular regard to safety[68], with the aim to assign ATM tasks only to well-established entities, which can ensure – among the other requirements – safety beforehand, and both liability and insurance cover in the aftermath of any accident.

Since these requirements are common to Member States, the validity of these certificates is mutually recognised all over Europe, so that within the necessary limits of the safety requirements the free movement of these particular services can be guaranteed in the EU[69]. In order to pursue this goal, National Supervisory Authorities need to monitor the providers' consistent compliance with the requirements and the conditions fixed in the certificates, and to take the appropriate measures (including the revocation of certificates) in cases where compliance is no longer satisfied and safety is compromised[70]. In this way the administration has the final word on the adequate level of safety that should be assured in air navigation services.

The effective achievement of free movement of services within the EU through the mutual recognition system, however, asks for the harmonisation of this certifying function. From this point of view, the implementation of safety standards can play a fundamental role in the identification of the appropriate level of safety that should be ensured: if prospective providers demonstrate they have the means and resources to achieve these standards, they can aim at being designated as ANSPs.

It must also be pointed out that the charges that airspace users refund to service providers for the service related costs, "shall encourage the safe, efficient, effective and sustainable provision of air navigation services with a view to achieving a high level of safety and cost-efficiency and meeting the performance targets[71]". This means that by financing the costs of service, operators indirectly cooperate in the achievement of the safety goals and they could therefore complain if this service is not provided correctly.

Furthermore, the guarantees of liability and insurance cover that service providers can offer should be (at least) equivalent all over Europe, so that the compensation of possible damage does not become a legal barrier to the circulation of services. This obligation on air navigation services reflects the liability rules laid down in the directive on services in the internal market, according to which the

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[67] See recital 2 and art. 7 of Reg. (EC) No 550/2004. These certificates can be issued individually for each type of air navigation service (namely, communication, navigation and surveillance services, meteorological services for air navigation, and aeronautical information services) or for a bundle of such services.

[68] See art. 7 (2) and Annex II of Reg. (EC) No 550/2004. Certificates, assessing the applicant's conformity with the requested requirements, specify the period of validity (considered that they are reviewed on a regular basis) and according to Annex II (2), these can also provide further conditions related to "(a) non-discriminatory access to services for airspace users and the required level of performance of such services, including safety and interoperability levels; (b) the operational specifications for the particular services; (c) the time by which the services should be provided; (d) the various operating equipment to be used within the particular services; (e) ring-fencing or restriction of operations of services other than those related to the provision of air navigation services; (f) contracts, agreements or other arrangements between the service provider and a third party and which concern the service(s); (g) provision of information reasonably required for the verification of compliance of the services with the common requirements, including plans, financial and operational data, and major changes in the type and/or scope of air navigation services provided; (h) any other legal conditions which are not specific to air navigation services, such as conditions relating to the suspension or revocation of the certificate".

[69] See recital 12 and art. 7 (8) of Reg. (EC) No 550/2004.

[70] Art. 7 (7) of Reg. (EC) No 550/2004.

[71] Art. 15 (3 f) of Reg. (EC) No 550/2004.

authorised service providers are required to be covered by appropriate professional liability insurance on the basis of the nature and extent of the risk they run by supplying specific services [72].

Introduced with the aim to standardise the supply of services in EU, this obligation leaves substantially unchanged both EU and national liability regimes, since it pursues harmonisation through means of private law. While this insurance model can protect service providers against the possible losses due to their conduct and it can therefore promote the movement of services, it is, however, very difficult to cover those risks of a catastrophic nature which stem from the very failure of safety standards[73]. In this case, in principle liability cannot be blamed on the air service provider, since it has carefully complied with safety regulations and damage is the result of the chosen acceptable level of protection. At the same time, the resort of obligatory insurance instruments to cover the catastrophic nature of the risk that safety standards aim at mitigating is not economic (and therefore effortlessly feasible), since damages exceed the means of a single insurance company. Only insurance pools can therefore insure against catastrophes and contribute to make this provision effective[74], but this presupposes the legal and economic assessment of uncertainty and its hypothetical consequences. This reasoning therefore requires further reflection, both legal and economic, on the traditional functioning of insurance systems.

The actual implementation of safety into the Single European Sky asks for the introduction of more specific means addressing the liability issue from a public law perspective. This means designing common rules to share disaster risks among all the relevant parties, since on the one hand it can be assumed that their occurrence is a failure in standard setting, and on the other hand the involved costs cannot be paid off by a single entity.

4.2. Liability for delivering air service provision: the designation of providers

The fragmentation of liability regulation in the SES represents a fundamental hurdle to legal certainty in the development of an integrated European ATM[75]. For the first time, Eurocontrol pointed out this problem in 2005 with regard to the establishment of EU Functional Airspace Blocks (FABs) and the supply of air navigation services, underlining the necessity to clarify the liabilities of states, service providers, organisations and individuals involved in the ATM regulatory framework[76].

Like in the EU regulations of other services of general interest, SES has introduced the separation at the functional level at least between service provision and supervision[77], in order to enhance transparency and clarify the responsibilities of both service providers and the national supervisory authorities.

As far as air traffic services (ATS) are concerned, the first relevant issue is that designation of air service providers is performed by National Supervisory Authorities (NSAs) according to national and international law. This designation is an administrative measure by which a state (through its competent authority) entrusts a certified service provider with the right and obligation to provide air navigation services (ANS) within a specific portion of national airspace on an exclusive basis. A state,

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[72] See Recitals 98-99 and art. 23 of the Directive of the European Parliament and of the Council No 2006/123/EC of 12 December 2006, on services in the internal market. Note that this directive explicitly excludes its applicability to services in the field of transport: see recital 21 and art. 2 (2d).

[73] On insurability problems see D.R. Connolly, *Insurance: The Liability Messenger*, in J.R. Hunziker - T.O. Jones (eds.), *Product Liability and Innovation. Managing Risk in an Uncertain Environment*, cit., p. 132 ff; P.W. Huber, *Junk Science in the Courtroom: The Impact on Innovation*, in J.R. Hunziker - T.O. Jones (eds.), *ibidem*, p. 148.

[74] This is the case of Germany, where the insurability of catastrophic risk is addressed by constructing an insurance pool which include reinsurers. In this regard, see G. Brüggemeier, *Common Principles of Tort Law. A Pre-Statement of Law*, cit., p. 271.

[75] This is the reason why clarification and harmonisation have been asked for in the revision and improvement of the SES package. See High Level Group for the future of European Aviation Regulatory Framework, *European Aviation. A framework for driving performance improvement*, July 2007, p. 20.

[76] Eurocontrol, *Mandate on Support for Establishment of Functional Airspace Blocks (FABs), Final Report*, May 2005, § 7.5.

[77] Art. 4 (2) of Reg. (EC) No 2004/549.

however, can appoint a foreign provider to perform these tasks, on the basis of bilateral interstate agreements. Therefore, either domestic law in case a national air service provider is designated or bilateral interstate agreements for cross-border service provision defines the legal framework for alleging liability[78]. In this latter event, a state (the delegating state) transfers the competence for performing ATS functions within a specific area of its airspace to another state (the provider state), establishing a relationship between states, and excluding any formal agreement between the delegating state and the designated service provider[79]. The primary liability can alternatively be charged on the state in whose territory the damage occurred and irrespective of the effective service provider (*territorial state doctrine*); on the state providing the ATS (*provider state doctrine*); on the effective foreign service provider charged before the delegating state, which retains however a subsidiary liability (*effective service provider doctrine*).

Framing liability in the European airspace means applying cross border service provision in a new context, which is based on the operational performance of FABs rather than on national sovereignty. Therefore, the international model of ATS delegation as a state-to-state agreement is transposed in a different legal framework, which asks for operational coordination throughout the whole of European airspace. The enforcement of different liability models can affect the same performance of service provision among FABs. The Eurocontrol Performance Review Commission advised the EU Commission to address sovereignty and liability issues in order to meet difficulties in the implementation of FABs and the cross-border provision of air traffic services[80].

From this point of view, the experience of Eurocontrol in the establishment of the Maastricht Upper Air Traffic Control (MUAC) is very interesting; this is an integrated model of cross-border service provision within the upper air space for Belgium, the Netherlands and Germany that can be considered a first example of FAB, as it has been subjected to SES regulation since 2004. As far as the liability regime is concerned, Eurocontrol endorses the provider state doctrine in its Model Agreements on ATS delegation[81] and it applies it to its own liability for damage arising from the MUAC activity[82].

This model has been also suggested to the EU, but the regulation on common requirements for air navigation services continued to apply the choice of the liability model to the agreements between the involved parties[83]. The absence of a common (top-down delivered) model in liability regulation demonstrates that the approach to ATM is still grounded on the international pattern, even though its management aims at being unified in a supranational legal framework.

In particular, Reg. (EC) 1070/2009 devolves the supervision of air navigation service providers to the agreement between Member States, and the arrangement for the handling of cases involving non-compliance with the applicable common requirements on ANS and, in particular, on liability to cooperation among National Supervisory Authorities[84]. This regulatory model aims to promote a more flexible approach based on agreements between delegating states and air service

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[78] According to the art. 28 of the Chicago Convention, however, states must retain liability for air navigation service provision over their territory. It should be considered that since this Convention has been concluded among states it does not give private parties any right to claim compensation for damage related to ATM.

[79] Annex 11, sec. 2.11, of Chicago Convention.

[80] See Performance Review Commission, *Evaluation of Functional Airspace Block (FAB) Initiatives and their contribution to Performance Improvement*, October 2008, Recommendation 17. In particular, it suggests analysing legal impediments to the development of SES and to provide guidance on the appropriate legal framework for liability of states, National Supervisory Authorities and remove any restriction on the designation of service providers based in other Member States.

[81] Annex A, art. 5, *Common Format Letter of Agreement Between Air Traffic Services Units*, 2005.

[82] See art. 25, Eurocontrol International Convention relating to Co-operation for the Safety of Air Navigation, Bruxelles, 1960, as amended by the Multilateral Agreement relating to Route Charges, Bruxelles, 1981, and the Protocol consolidating the Eurocontrol Convention (the "Revised Convention"), 1997 (whose ratification is still ongoing).

[83] See Annex 1, § 7, of Reg. (EC) 2096/2005.

[84] Art. 2 (3) and (4) of Reg. (EC) 550/2004, as amended by Reg. (EC) 1070/2009.

providers, by designating a foreign service provider directly (without delegation)[85], and through the mechanism of joint designation by the interested states of a single service provider, whereas a FAB extends over the territory of more than one Member State[86]. Moreover, sub-delegation of tasks by the interested air service providers can be applied[87].

This search for flexibility, however, does not establish new mechanisms to allocate liability. In the event of direct designation of a foreign service provider, liability is governed by the laws of the designating state who applies one of the mentioned international doctrines; in case of joint designation the liability regime depends on the location where damage occurred. If it happens in the sovereign airspace of a country, liability is still governed by national laws; but when a cross-border service provision dimension exists, the agreement should charge liability either on contracting states (so that every state is liable over its territory), or on the designated service provider itself (recognizing a subsidiary liability of concerned states), but it also has the possibility to establish a special regime substituting the common rules of the concerned national laws.

Finally, in the case of sub-delegation, the sub-delegation contract should provide compensation clauses to ensure that the designated air service provider will be indemnified for all the cost reimbursed to the territorial state in respect of damages caused by the sub-contractor. This means that even though the SES outlines a common regulatory framework for ATM, the liability regime in ATS is governed by contractual decisions based on national rules.

4.3. Open issues on liability for safety standard setting

The pursuit of safety standards is based on the assumption that catastrophic risks can only be mitigated on a rational basis and the introduction of fixed thresholds of protection cannot therefore eliminate the possible occurrence of these risks. The rational management of catastrophic risks then requires that liability can be distributed among the relevant actors of this regulatory framework, so that the still possible damage and the actual burdens stemming from this lawful rule-making do not affect some parties in a disproportionate way.

Liability for standard setting can be addressed either from a negligence standpoint or from a strict liability perspective. In the first case, public standard setters can be considered liable for faulty supervision if the due care standard is violated with regard to the management of foreseeable risks. Negligence therefore consists in the avoidable creation of foreseeable risks by missing the duty of care which is directly related to the mitigation of these risks. This is the case of Italy, where the state has been held liable for omitted vigilance on blood products and transfusions with regard to the transmission of infections on the basis of a causal link, only since the time when the infection risks were known to medical science[88].

When looking at the same issue from the perspective of strict liability, the need to compensate damage is related to the effects of specific conduct and not to the misbehaviour of the actor. This means that the focus is on the level of acceptability of a specific risk regardless of the unlawfulness of its effects. The aim of this particular kind of liability is to compensate the exceptional harm on individual parties and to restore an equal distribution of public burdens in the achievement of public goals. This conception can be framed in the remedy available in French law, the *responsabilité sans*

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[85] Art. 8 (2) of Reg. (EC) 550/2004, as amended by Reg. (EC) 1070/2009. In particular, it provides that national legal systems must not prevent the designation of air traffic service providers on the ground of national requirements, such as the ownership of the Member State or its nationals, its registration or operation in the territory of the concerned Member State, or the use of facilities only in that Member State.

[86] Art. 8 (5) of Reg. (EC) 550/2004, as amended by Reg. (EC) 1070/2009.

[87] Art. 10 of Reg. (EC) 550/2004. These agreements between service providers setting out their specific duties and functions should be notified to national supervisory authorities.

[88] Supreme Court of Cassazione, III, civ., 31 May 2005, n. 11609. But note that this decision has been challenged by the following case law of lower courts, on the basis of the necessity to compensate the damage to psycho-physical integrity, coming also from unforeseeable risks, since due care is related to the correct development of safety controls before the blood transfusion (regardless of the specific virus in question). See Tribunale di Roma, II, civ., 3 January 2007.

faute, which pursues the solidarity principle in the allocation of risks[89]. The public standard setter therefore provides compensation to those intolerable risks as the last resort to compensate victims. This model has also been applied in blood product cases, where blood transfusions infected patients, by introducing fair compensation.

In the current ATM legal framework, liability for fault is basically blamed on states and the achievement of safety goals seems to rest upon the National Supervisory Authorities, who are engaged at different levels in their definition. On the one hand, these administrations have a constant regulatory dialogue with the European parties involved, both in the definition of the performance targets and indicators (EASA, Eurocontrol, and the EU Commission), and in the monitoring of the national/FAB plans (Eurocontrol and the EU Commission). On the other hand, these national authorities designate the certified air service providers who should provide air navigation services and they implement, in collaboration with the relevant stakeholders of the ATM, concrete plans aimed at mitigating safety risks. This central role of the national authorities makes the current liability framework under the SES fragmented, since it is grounded on a traditional state-based approach to aviation regulation in the absence of a strong top-down coordination at the supranational level.

As far as extra-contractual liability is concerned, EU institutions[90] as well as Eurocontrol[91] are actually subjected to their relative liability for fault clause, which covers damage stemming from unlawful conduct. In the case law, however, there is no relevant case about the negligence in safety standard setting in the sector of ATM, since only medical practice offers examples in this regard. Furthermore, strict liability for standard setting cannot be included in the current liability framework. In particular, the EU legal order – unlike its Member States – does not provide general rules on strict liability, since liability for rule-making is considered a bond to the exercise of public power which is acceptable only when a rule conferring individual rights is infringed[92]. Strict liability therefore can be introduced in the EU legal framework only on a legislative basis, which assumes that a different distribution of burdens can help to respond to the public interest and namely the safety goal in ATM.

In addition, the current legal framework does not address liability issues related to the implementation of safety through the interaction of human beings and technology in the performance of ATM tasks. ATM related accidents can be the result of human error, technological failure and defective interaction between these two systems[93]. The so-called socio-technical systems (which correct functioning is related to the correct interaction of human operators and technology) therefore

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[89] See J. Rivero, *Droit administratif*, Dalloz, Paris, 1975, p. 279; J. Moreau, *La responsabilité administrative*, PUF, Paris, 1996, p. 99; A. Lazari, *Modelli e paradigmi della responsabilità dello Stato*, Giappichelli, Torino, 2005, pp. 149-151. Note that strict liability regime has been implemented also in Spain (see art. 139 (2) of *Ley de Régimen Juridico de las Administracionés Públicas y del Procedimento Administrativo Común*, of 26 November 1992) as a means of protection against public action, regardless of the qualification of the conduct and the damage (*responsabilidad objectiva global*), but its extent has been reduced progressively. See O. Mir Puigpelat, *La responsabilidad patrimonial de la administración hacia un nuevo sistema*, Civitas, Madrid, 2002. The roots of strict liability can also be found in German law, even if in this case the premise of compensation is not the solidarity principle, but the liberal claim to restore individual proprietary rights (intended not only as property rights, but also as rights to life and health, according to the German Constitutional Court's case law. See BVerfG of 14 July 1981, *Pflichtexemplar-Entscheidung*, and of 15 July 1981, *Naßauskiesung-Beschluß*) affected in their very heart: since the achievement of public goals imposes a special sacrifice on the proprietary rights of specific parties, compensation should be provided in order to keep on protecting these fundamental rights of individuals. See P. Badura, *Fondamenti e sistema della responsabilità dello Stato e del risarcimento pubblico nella Repubblica federale di Germania*, in *Rivista trimestrale di diritto pubblico*, 1988, pp. 400 and 404-406.

[90] Art. 340 (2) TFUE (*ex* art. 288 (2) TEC). According to EU case law, this clause is referred only to liability for unlawful conduct. See ECJ, C-46/93 and C-48/93, *Brasserie du pêcheur SA and Factortame*, 2006, §§ 28-29; ECJ, C-120/06 P and C-121/06 P, *FIAMM and FIAMM Technologies and Fedon&Figli s.p.a. v. Council and Commission*, 2008, §§ 168-179.

[91] Art. 25 of Eurocontrol Convention (which bases liability on negligence).

[92] See ECJ, C-46/93 and C-48/93, cit., § 45; ECJ, C-352/98 P, *Bergaderm SA e Goupil v. Commissione*, 2000, §§ 41-42; ECJ, C-282/05 P, *Holcim (Deutschland) AG v. Commission*, 2007, § 47.

[93] Consider that ATM related accidents can arise directly from the functioning of the ATM system (direct contribution of ATM to the causal chain producing the damage) or they can contribute indirectly to the event, by increasing the severity of the damage (indirect contribution). Furthermore, incidents can be relevant for ATM system, even if this system does not contribute to their occurrence. See EASA, *Annual Safety Review*, 2010, pp. 48-49.

need special attention as complex structures the safe functioning of which cannot merely result from the correct functioning of its parts. Liability therefore should be distributed between human and automated operations, having regard to this procedural system as a whole[94].

Even if ATM operators are involved in the regulatory process with advisory tasks, the current legal framework, however, provides only some scattered liability rules in this regard and it does not address the problematic interaction between humans and software driven appliances. Basically, as far as human operators are concerned, the Chicago Convention charges the ultimate responsibility for the flight to the aircraft commander, even if the commander has to follow the instructions of the control tower[95].

Despite the enhanced automation of ATM systems, software liability is not specifically tackled and it remains subject to the liability rules of the related product or service. This means that if software is associated with a product, strict liability applies; on the contrary, when software works in the framework of a service, negligence applies the reference for liability.

On the grounds of the European regulation concerning product liability[96], the software industry ends up bearing the main risk of technological developments in ATM, since manufacturing producers are strictly liable for defective products. This regulation can be applied to both manufacturing defects and design defects, although it is much more difficult to prove a design defect for injured users since this regulation was introduced for the protection of consumer safety in the contracts of sale.

If this regulation has been introduced to encourage the production of safe products[97], its application in ATM has to be adjusted to standard-based safety regulation, operating in the potentially catastrophic environment. This means that those exemptions to liability provided in the product regulation should be applied in this specific regulatory area and therefore further guarantees should be introduced in order to provide effective remedies to safety failures. In particular, exemptions to liability should be harmonised in a consistent legal framework. For instance a balance should be struck between the possibility of exempting the producer from liability when the defect is due to the compliance of the product with mandatory regulations issued by the public authorities[98], and the possibility for states to maintain the liability of the producer for risks unknown at the time of production[99]. Since the technologies used in aviation are not excluded from the application of this regulation, the burden of progress should be shared among relevant actors by clarifying the applicable rules in order to prevent the "collision" between the search for safety and the pursuit of technological innovation[100].

Legal uncertainty increases when software is considered as a service[101]: in this case, liability is related to service provision and service providers need to be covered with liability insurance, which should be appropriate to the nature and the extent of the risk. Currently, in the private sector the

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[94] From this point of view, the accident over Überlingen in 2002 is very significant; conflicting information between (human) controllers and automated systems led to the mid-air collision of two civil aircrafts. This accident has become a relevant case study on the functioning of socio-technical systems. See S. Bennett, *The 1st July 2002 mid-air collision over Überlingen, Germany: a holistic analysis*, in *Risk Management*, 1/2004, pp. 31-49; G. Contissa, *Addressing Liability of Automated Systems in Air Traffic Management*, cit., p. 5.

[95] See Annex II to Chicago Convention, setting the "rules of the air".

[96] See Directive of the Council No 85/374/EEC of 25 July 1985, as amended by Directive of the European Parliament and of the Council No 1999/34/EC of 10 May 1999, on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products.

[97] See F.E. Zollers - A. McMullin - S.N. Hurd - P. Shears, *No More Soft Landings for Software: Liability for Defects in an Industry That Has Come of Age*, in *Santa Clara Computer & High Tech. L.J.*, 4/2005, pp. 768-773.

[98] Art. 7 (d) of Directive No 85/374/EEC. On the still uncertain effects of the "regulatory compliance defence" see G. Brüggemeier, *Common Principles of Tort Law. A Pre-Statement of Law*, cit., pp. 68-69.

[99] See art. 15 (1b) of Directive No 85/374/EEC.

[100] See B.A. Cosgrove, *Innovation, Engineering Practice, and Product Liability in Commercial Aviation*, in J.R. Hunziker - T.O. Jones (eds.), *Product Liability and Innovation. Managing Risk in an Uncertain Environment*, cit., p. 114 ff.

[101] See G. Contissa, *Addressing Liability of Automated Systems in Air Traffic Management*, cit., p. 5.

possibility of insuring against risks is related to the nature of the risk at stake: only if risk is foreseeable and measurable (meaning that the amount that parties are willing to pay to transfer the risk of loss to an insurer exceeds the premium needed to cover the expected costs of providing coverage), can it be insured. This means that uncertainty about the risk makes it very difficult to forecast future losses when setting premiums and therefore to identify the advantage in risk bearing compared to the party that is exposed to loss. The potential catastrophic impact of software malfunctioning in ATM, therefore, seems to undermine this remedial system, since insurance runs into significant issues of effectiveness in the framework of catastrophe. In this case, insurance companies have no means to afford these risks on their own and this is the reason why insurance pools have been established in Germany in the fields of airlines, atomic power plants, and pharmaceuticals[102].

The absence of a coherent and clear legal framework addressing these liability issues in European ATM regulation can however become a real hurdle to the general implementation of sophisticated software that can potentially enhance the capacity and the efficiency of air traffic management. This means that technological innovation is not encouraged if no guarantee exists that possible losses can be distributed[103]. The only way new safe technologies can be effectively implemented is in a clear legal context about who is liable for what and in what conditions[104].

The reorganisation of ATM in Europe therefore asks for a proportional redistribution of the related liabilities, in order to make the whole legal framework cope with the efficiency goals. When deciding who is charged with what liability, the further knot to be undone is, what is the relationship between standardisation of protection and the charge of liability. Through a post-event intervention, it would be possible to compensate damage and to pursue *ex post* an equal distribution of risks and individual burdens. From this point of view, a fund financed by all the parties involved in the regulatory process would help cover the failures of safety standards.

5. Final remarks

In society today safety cannot be address as the absence of any danger, but it is instead to be considered as the reasonable control of unacceptable risks[105]. Safety therefore is the result of the rational risk management in the attempt to reduce the impact of adverse effects on the relevant community. This trade off between risk and safety is mediated by technology, since the progress of scientific knowledge can move the boundaries between these undetermined concepts and it therefore affects both the instruments and the content of risk management[106]. From a legal point of view, this triangular relationship between risk, technology and safety consists in the definition of precautionary measures and remedies aimed at implementing the safety goals. These legal solutions can be highly diversified according to the nature of the risks at stake and the state of the art of scientific knowledge in the specific field of interest.

The ATM system represents a remarkable case study, since the primary goal of this activity is to assure aviation safety, and failures can have a catastrophic impact. In order to mitigate this trade off between risk and safety, automation has been implemented with the aim to support human activity in improving risk management. Addressing the legal issues of this specific regulatory area, this paper has focused on safety standards as precautionary measures aimed at the rational management of disaster

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[102] See G. Brüggemeier, *Common Principles of Tort Law. A Pre-Statement of Law*, cit., p. 271.

[103] See R.M. Morrow, *Technology Issues and Product Liability*, in J.R. Hunziker - T.O. Jones (eds.), *Product Liability and Innovation. Managing Risk in an Uncertain Environment*, cit., p. 23 ff.

[104] In this regard, it is noteworthy that in the workshop organized by DG Tren and the Department for Transport in the UK, industrial stakeholders discussing FABs pointed out the necessity to define common rules on safety, liability and cooperation between National Supervisory Authorities. See DG Tren, Functional Airspace Block workshop, *Summary Report*, 12 January 2006.

[105] On the notion of the risk society see U. Beck, *Risk society. Towards a New Modernity*, by M. Ritter (trans.), Sage, London, 1992; G. Leloudas, *Risk and Liability in Air Law*, Informa, London, 2009, p. 11 ff.

[106] P. Huber, *Safety and Second Best: The Hazards of Public Risk Management in the Courts*, in *Columbia Law Review*, 2/1985, p. 277.

risks and on liability as a direct remedy to redistribute and compensate the catastrophic consequences of potential accidents.

Safety and risk management in ATM assumes a particular importance since the European Union has demonstrated that it cares about it as a means to enhance the efficiency of air traffic throughout Europe and therefore to develop the competitiveness of air services and to achieve a further integration of the EU economy.

By implementing the project of the Single European Sky, the EU has followed its strategic approach to catastrophic risk regulation and it has therefore boosted the search for aviation safety through the development of standards of protection. This rational approach to uncertain risk management has the clear advantage to prevent uncertainty becoming an obstacle to the progress of society, it is however based on the tacit assumption of reliability of risk-monitoring systems.

Since scientific knowledge is fallible and it needs to be continuously updated, the substantial gaps in precautionary protection should be addressed from a legal point of view, by providing specific legal remedies against safety failure. Besides contingency plans, which tackle the uncertain reliability of technology by managing emergencies, further legal remedies should be provided, in order to compensate *ex post* the (possible) damage.

The European regulatory framework is thus weak as it does not deliver a clear and homogeneous system of remedies and above all, it does not address liability issues in a direct way, but instead it relies on national regimes. The absence of common provisions on liability rules for collapse in the ATM system, however, has a significant impact on the same implementation of the Single European Sky, because the different actors involved in ATM do not have legal certainty about the consequences of their conduct and their interaction with automated systems.

The fragmentation of liability rules lies in the traditional national approach to ATM, which is not brought into question by the EU. The integration process which is affecting air law in Europe, however, cannot ignore the necessity to harmonise national regimes on the one hand, and to introduce new liability rules addressing specific needs on the other. This means that the international approach to ATM that is based on agreements between states cannot last, since airspace is no longer going to be governed on a territorial basis (that is, national airspaces) and it is going to be managed with an operational approach (as FABs demonstrate). Even if Member States remain the main parties in ATM, new instruments to manage air traffic in a more coordinated and integrated way should be introduced in order to implement ATM efficiency in the long run. Furthermore, the standardisation of safety asks for remedies that can redistribute public burdens in case the standard setting fails when assessing the risk/safety trade off. This involves the introduction of strict liability rules in disaster risk regulation that are not consistent with the current framework of liability in EU.

This fragmentation of the current legal framework in ATM reveals the legal difficulties in the integration of the European skies. This gap in legal protection depends on the distribution of competences in the EU between Member States and EU institutions; and ATM is an extraordinarily useful illustration from this point of view, in so far as air law has its roots in the same concept of national sovereignty. However, the pressing needs stemming from disaster risk regulation could become a key factor to pursue in the progress of EU integration.


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