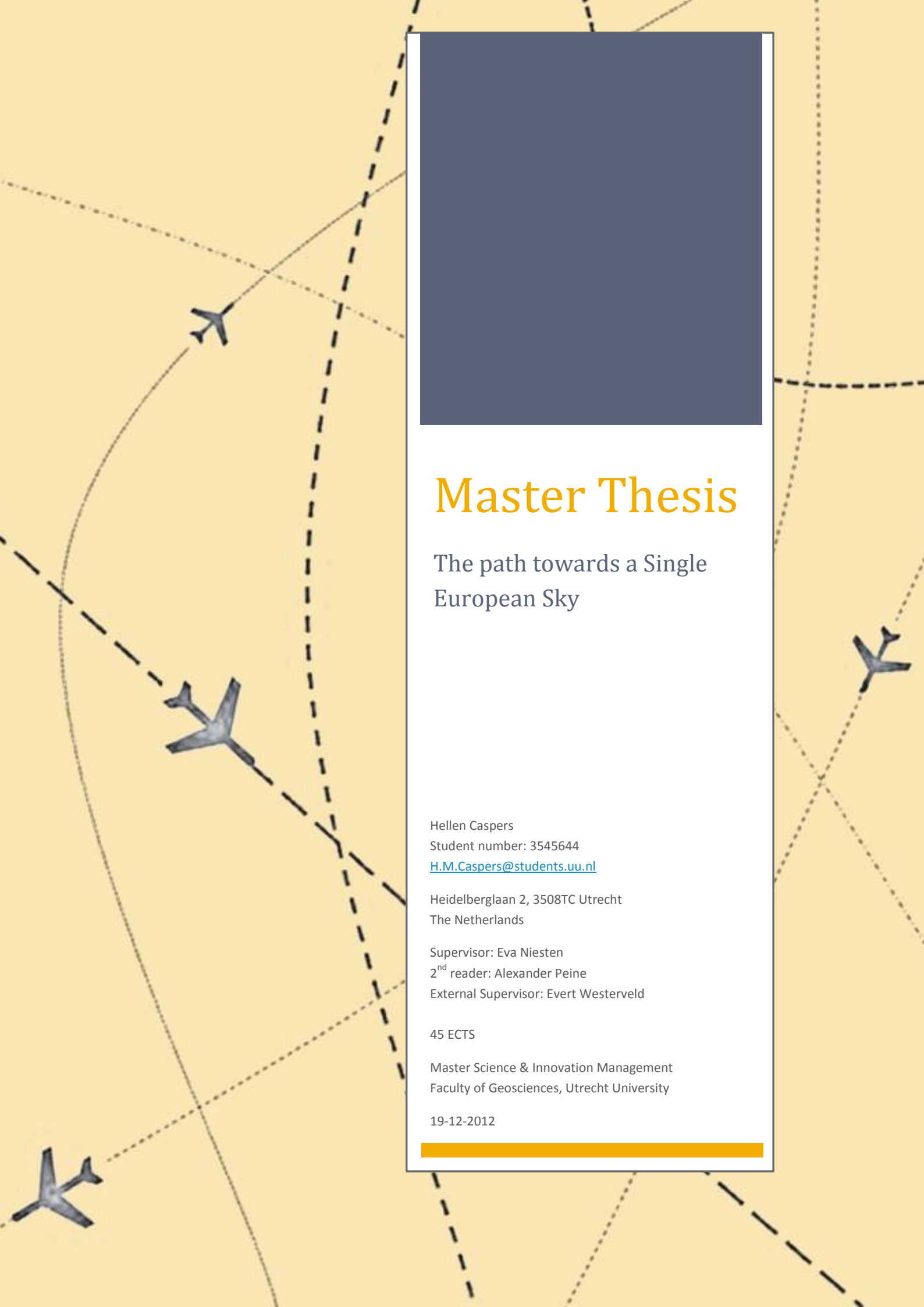

Master Thesis

The path towards a Single European Sky

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PREFACE

Before I started the master Science & Innovation Management at Utrecht University I finished my bachelor in Aviation Studies at the Amsterdam University of applied sciences. Even though this master is oriented at science and technology related innovations in a very broad way, I remained fascinated by the aviation sector. Despite of the fact that the aviation sector doesn't appear as innovative as it did in its infancy years, it is still evolving by means of innovations. As I oriented myself for a thesis topic in the aviation sector, I ran into a project referred to as the Single European Sky. I immediately became fascinated by this project, due to the fact that it appeared to be too ambitious in its aims to create a paradigm shift. Namely, the current aviation sector is a world-wide network with many interdependent participants which makes it increasingly complex to implement innovations, which requires the cooperation and collaboration of multiple participants. Namely, this innovative project encompasses innovations and changes that involve a large part of that world-wide system.

Because a large part of that world-wide system is currently working to create a Single European Sky, I found myself a proper thesis topic which is in line with both my bachelor-, as well as my master studies.

GLOSSARY

A

AAS – Amsterdam Airport Schiphol

AEA – Association of European Airlines

AMAN – Arrival Management

ANSPs – Air Navigation Service Providers

ATC – Air Traffic Control

ATM – Air Traffic Management

C

CANSO – Civil Air Navigation Services Organization

D

DLR – German Aerospace Center

E

EASA – European Aviation Safety Agency

EC – European Commission

eRIA – early Regulatory Impact Assessment

EUROCONTROL – European Organization for the Safety of Air Navigation

EU – European Union

F

FAB – Functional Airspace Block

FABEC – Functional Airspace Block Europe Central

G

GHG – greenhouse gas

I

IATA – International Air Transport Association

ICAO – International Civil Aviation Organization

K

KDC – Knowledge Development Centre

KLM – Royal Dutch Airlines

KNMI – Royal Netherlands Meteorological Institute

KPAs – Key Performance Areas

L

LTS – Large Technical System

LVNL – Air Traffic Control the Netherlands

M

MLA – Militaire Luchtvaart Autoriteiten

MUAC – Maastricht Upper Area Control Centre

N

NLR – National Aerospace Laboratory of the Netherlands

NSA – National Supervisory Authority

P

PAB – Public Administrative Body

PRB – Performance Review Body

R

R&D – research & development

S

SARP- Standard And Recommended Practice

SES – Single European Sky

SESAR – Single European Sky Air Traffic Management Research

SJU – SESAR Joint Undertaking

SSC – Single Sky Committee

T

TUD – Delft University of Technology

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ABSTRACT

The European aviation sector can be seen as a large technical system, which is currently creating a path towards the Single European Sky (SES). This is an ambitious initiative aiming to reduce the costs, increase the airspace capacity, reduce the aviation's share in environmental pollution and increase the safety level. In order to accomplish this, the entire aviation sector has to cooperate and collaborate with each other. This thesis' aims are threefold. First, to investigate how the existing infrastructure is influencing the aviation sector in its approach towards the SES. Second, how the current approach, taken by the actors in the aviation sector, is influencing the progression towards the SES. And third, how the institutional organizations, such as the European Commission (EC), SESAR Joint Undertaking (SJU), EUROCONTROL and the Dutch government, are influencing the aviation industry in their activities towards the SES. The large technical system's theory and the theory of path creation form the basis of this research. Combined their explanation of progression is tested by means of a single case study. To be more precise, qualitative research methods, like semi-structured interviews and scientific documents are used to gather the data. The analysis of the gathered data is conducted based on a scientific qualitative data analysis technique called coding. These techniques help reveal insights from the case under investigation. Based on this method, this research shows that both the LTS and the interplay between the institutions and the industry are causing some bottlenecks that need to be overcome by the European aviation sector. Furthermore, it is important for the Dutch aviation industry to stay involved in the realization towards the SES to ensure the national interests are not left behind along the path creation process.

Keywords: Large technical systems, Path creation, Single European Sky

1. Introduction

1.1 Background

The aviation sector can be described as the facets involved with the making of-, and the use of aircraft for transportation. The aviation sector is a global business and can be seen as a Large Technical System (LTS). Innovation literature describes an LTS as a socio-technical network, which stretches geographical areas (Geels, 2007; Gras, et al., 1995, p. 11). The aviation sector is such a network which started with the invention of the aircraft and evolved into a worldwide LTS.

Once an invention evolves into a LTS, it starts to develop in a particular direction with a certain velocity shaped by the consequences of the historical events that shaped the LTS, i.e. technological trajectory or path (Davies, 1996; Ewertsson & Ingelstam, 2004, p. 295; Markard & Truffer, 2006; Geels, 2007, p. 124).

As this LTS grew, the need arose for an organized system of Air Traffic Control (ATC), which got introduced to the aviation sector in 1929 (Nolan, 2011, p. 5). This organized system of ATC services, airspace management and air traffic flow and capacity management composes the Air Traffic Management (ATM) system. This ATM system (Figure 1) grew along, and became a part of the LTS (Figure 2[1]) (La Porte, 1988).

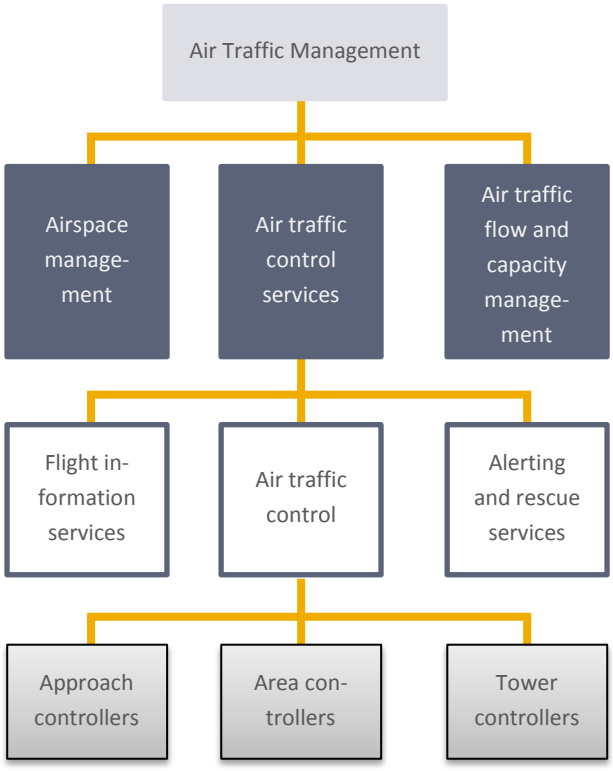

Figure 1 - ATM system

[1] Adopted from German Aerospace Center (DLR).

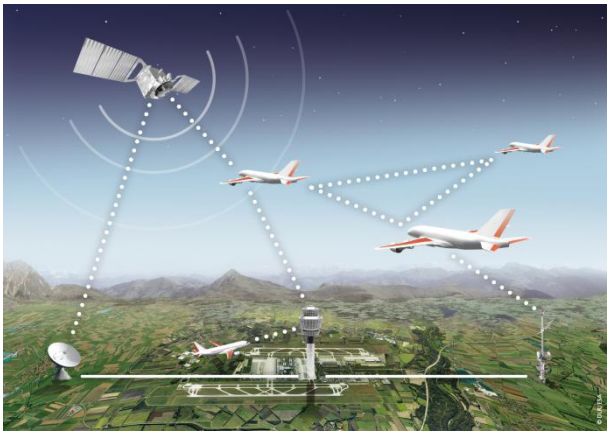

Figure 2 - Part of the aviation sector as a LTS.

The ATM system provides separation assurance, navigation, weather and flight information, traffic management to minimize costly congestion and delays, and landing services for the aircraft on the ground and in the air (Nolan, 2011; EUROCONTROL, sd). The European ATM system is the part of the LTS that is under investigation in this research.

ATC services have always been a national responsibility (Dutch government, 2011). This caused fragmentation of the ATM system between European nations. A fragmented system can be defined as a system consisting of a relatively large number of organizations, which suffer from some sort of disconnectedness or some disaggregation of parts that should be connected (Shair-Rosenfield, 2008).

This fragmented, European ATM system has almost reached its maximum performance level. It is expected that the European LTS will not be capable of dealing with the future demand in air traffic, because of this fragmented system. The expectations are that with an average annual growth rate between 1.6% and 3.9%, the amount of flight movements in 2030 will reach an amount between 13.1 and 20.9 million flights in Europe. This is 1.4-2.2 times the amount of flight movements in 2009 (EUROCONTROL, 2010). This is more than the current European LTS can digest, which will result in capacity, safety, financial and environmental issues.

- To be precise, between 5% and 19% of the expected flight movements will not be accommodated due to limited airspace- and airport capacity (Corner, 2011; EUROCONTROL, 2010).
- Safety is a prerequisite for air transport (International Air Transport Association, 2012). Society has an increasing sensitivity to risks, which pressures the LTS to, either decrease or stabilize the number of accidents with the expected growth number.
- Financial issues are there regardless of the expected growth. The European ATM costs an additional €2-3 bil-

lion every year compared to other similar ATM systems in the world (EUROCONTROL, 2011). In addition, current delays are costing the airlines between €1.3-1.9 billion a year. These delays are only expected to increase based on the expected annual growth rate.

- Due to the average annual growth rate environmental concerns are growing. This concerns both greenhouse gas (GHG) emissions and noise pollution (European Aviation Safety Agency, sd).

As a result of these growth expectations and issues, European airlines argued for action to solve these issues of the European LTS. Accordingly, institutions[2] and industry organizations[3] of the European LTS started to work on a reconfiguration of the European ATM system under the provision of an organization called the European Organizations for the Safety of Air Navigation (EUROCONTROL).

However, EUROCONTROL has been working on a reconfiguration of the European ATM system since its constitution in the 1960s (EUROCONTROL, 2011). In 2002 EUROCONTROL started a collaboration with the European Commission (EC) (Calleja Crespo & Fenoulhet, 2011). Together they started creating a path towards a concept, which they introduced as the Single European Sky (SES) in 2004, i.e. SES project. This initiative aims to reconfigure the European skies by trying to achieve the following goals;

- enabling a threefold increase in capacity,
- improving safety by a factor of 10,
- cut ATM costs by half, and
- reduce environmental impact by 10% (SESAR Joint Undertaking, 2011).

This initiative includes four pillars, namely updates to existing regulations, the safety pillar, the capacity pillar, and the technological pillar. The technological pillar exists of the Single European Sky Air Traffic Management Research (SESAR) program (European Union, 2008). SESAR is an ambitious and complex program aiming to achieve the previous mentioned goals by 2020. In order to accomplish this, the entire European LTS needs to be involved (Schneider, 2011). Delivering these goals is a team effort and it involves a complex value chain with critical dependencies (Calleja Crespo & De Leon, 2011). If one party is not participating, the entire implementation process could stall.

The strategy taken by the LTS organizations also plays an important role in accomplishing these goals. The only way to achieve these goals is to have an aligned strategy (Calleja Crespo & De Leon, 2011). An aligned strategy will provide the organizations with a sense of direction. It will also help to increase the rate of innovation. This is important because this LTS has a slow rate of innovation (Lee & Mo, 2011; Hirsch-Kreinsen & Jacobsen, 2008, p. 132).

The current strategy is executed by institutions and the European aviation industry, which both carry out activities to deviate from the existing technological trajectory, i.e. path. The institutions are the EC, EUROCONTROL, and an intermediary organization, launched by the previous mentioned institutions, called SESAR Joint Undertaking (SJU). SJU was founded to coordinate and concentrate all relevant research and development (R&D) efforts of the European aviation industry towards the creation of the SES (SESAR Joint Undertaking, 2012). The European aviation industry includes airport operators, airlines, Air Navigation Service Providers (ANSPs), military, research centers, laboratory and aircraft suppliers. The current strategy can be described as an interplay between the institutions and the industry, in which the institutions set the rules of the game for the industry. Because this interplay is influencing the outcome of this SES project, it is interesting to investigate how this interplay is influencing the progression towards the SES. But also how this interplay is being influenced by the characteristics of the current LTS and how the institutions and the industry are influencing each other in their SESAR related activities towards the SES. Progression towards the SES is defined as

> Identified improvements of the European ATM system towards the SES compared to the introduction of the SES project in 2004.

Due to the size of the SES project, this research will focus on the Dutch aviation industry. However, the SES project is a European project and therefore the European context will be included.

1.2 Research questions

The LTSs' network consists of technical, legal, scientific and organizational components working in collaboration towards a common infrastructural goal. This is also referred to as a seamless web (Geels, 2005). A seamless web explains how the organizations of a LTS end up evolving along a certain technological trajectory. This is because investment in skills, regulations and infrastructures, and the fact that knowledge and technology is integrated into cultural capital ties the organizations to this particular technological trajectory (Hughes, 1983; Hughes, 1986; Hughes, 1987; Joerges, et al., 1988). This also limits the incentive for major changes (Sutherland, et al., 2012).

[2] Governmental organizations.

[3] Airlines, airspace users, air navigation service providers, airports, suppliers, regulators and administrators and research laboratory.

Previously conducted innovation research has addressed, the emergence and development of LTSs (Hughes, 1983; Hughes, 1986; Hughes, 1987; Joerges, et al., 1988; Geels, 2007). An evolving LTS eventually results in a stable system continuing to evolve along a certain technological trajectory (Joerges, et al., 1988; Markard & Truffer, 2006; Geels, 2007). Also, the LTS dynamics and societal implications have been addressed (La Porte, 1994; van der Vleuten, 2004; van der Vleuten, 2007). Furthermore, research has been done to get a better understanding of LTS transformations whereby it has been acknowledged that path dependency and evolutionary economics play important roles (Geels, 2005). Proponents argue that path dependency plays an important role in case of two competing technologies, as the first leading technology benefits from increasing returns to adoption eventually leading to a lock-in (Geels, 2005; Arthur, 1989; David, 1997). Evolutionary economists argue that routines result in a narrowed view of change actors, because they only look in particular development directions (Geels, 2005). Which is in line with path creation advocates, who argue that the present and future development options are conditioned by the developments made in the past (Arrow, 1963; Garud & Karnøe, 2001). In other words, once a development direction, i.e. technological trajectory, is chosen among alternatives, one can't go back to follow a different development direction. On the other hand, little research has been done on deliberate transformations of existing LTSs.

The LTS theory alone, doesn't address how one can deliberately transform the LTSs' technological trajectory towards the SES. While the theory of path creation does provide the concepts, which, when combined with the LTS theory, can explain how one can deliberately change the technological trajectory. Namely, the theory of path creation argues that organizations can intentionally change from the existing technological trajectory, fully aware they may be creating inefficiencies in the present, but also aware that such activities are required to create new futures (Garud & Karnøe, 2001, p. 6). In this research these theories are combined to be able to study the process to realize the SES. The LTS theory enables to explain how the existing infrastructure is of influence, while the theory of path creation is necessary to explain how the Dutch aviation sector is trying to realize the SES.

Accordingly, this research addresses the following question;

How does the existing Large Technical System, and the interplay between the institutions and the Dutch aviation industry, influence the progression towards the Single European Sky?

In addressing this question, the following sub-questions are investigated;

- **How does the existing Large Technical System influence the institutions, and the Dutch aviation industry in their activities towards the realization of the Single European Sky?**
- **What activities are taken by the Dutch aviation industry to change the technological trajectory towards the Single European Sky?**
- **What activities are taken by the institutions to facilitate changes towards the Single European Sky?**
- **How do the institutions and the Dutch aviation industry influence each other in their SESAR related activities towards the Single European Sky?**

The theoretical contribution of this research is to extend the LTS theory with the theory of path creation to explain infrastructural innovation. The practical contribution of this research lies in the relational insights. By means of this research, influences between organizations will appear, and whether they are considered as an advantage or a weakness of the innovation process. These will help the Dutch aviation industry to identify factors that are hampering or fostering the path creation process towards the SES. Furthermore, this research also aims to explain how the Dutch aviation industry could align their mission, vision and strategy with the mission, vision and strategy of the SES project.

This research is structured as follows. First, a critical literature review of both the LTS-, and the path creation theory is provided in section 2. Followed by the introduction of the relevant concepts for this research. Section 3 elaborates on the scope by introducing the institutions and the industry organizations. Section 4 elaborates on the research method used to gather the data. Followed by the results of the gathered data in section 5. The conclusion is presented in section 6, followed by the discussion in section 7.

2. Theoretical framework

2.1 Large Technical systems

Innovation theories help to address problems regarding new products, -knowledge and -practices. LTS theory is an innovation theory, which falls under the category called sociological and historical theories of innovation. This category of innovation theories emphasizes the relationship between technology and society, and how these influence each other. The focus lies on interactions and agency, social groups, interests and power.

In 1983, Thomas Hughes introduced the LTS concept as infrastructure networks (Hughes, 1983). These socio-technical

networks consist of technical, organizational, scientific, and legal components, which stretch over a large geographical area. These components are interdependent, and together they are responsible for the LTS' functioning.

This definition is in line with the reality of the aviation sector. Namely, airports[4], ATC systems[5], weather stations and aircraft are all technical components of the LTS as we are familiar with today. The organizational components are represented by airport operators, ANSP's, meteorological institutes, authorities, laboratory, universities and consultancy companies. The latter three provide the system with scientific components, like books, reports, scientific articles, experiments and university teaching. Furthermore, the legal components are provided by the authorities. These are organizations like the International Civil Aviation Organization (ICAO), the European Aviation Safety Agency (EASA), the EC and the national authorities. However, a component needs to be added here, as humans also represent a component of the LTS. Humans steer the aircraft and humans separate air traffic on the ground and in the air (SESAR Joint Undertaking, 2012). This is a component Hughes doesn't discuss in his LTS theory.

Such a complex infrastructure network isn't formed overnight. Previous research identified several evolution phases an LTS goes through (Hughes, 1987, p. 56; Rhoades, 2008). However, there is no fixed order in which these phases occur during the evolvement of a LTS (Hughes, 1987) (Figure 3).

At the start of each LTS lies a radical invention, which is the start of the invention phase. This doesn't mean inventions only arise during this phase. Only, inventions made during other phases are mostly referred to as conservative inventions, i.e. an improvement in an ongoing system. These inventions become components in the existing LTS and are needed for the system to expand and evolve (Hughes, 1987; van der Vleuten, 2007; Bijker & Pinch, 2012). The LTS theory argues that the developments of radical inventions influence the society. Namely the invention of the aircraft enabled the society to transport goods, and people in addition to the existing rail-, and road infrastructure. However, society also influences the evolving and expanding LTS. During the development phase of a LTS a workable construction is created around the radical invention (Hughes, 1987; Geels, 2005; Bijker & Pinch, 2012).

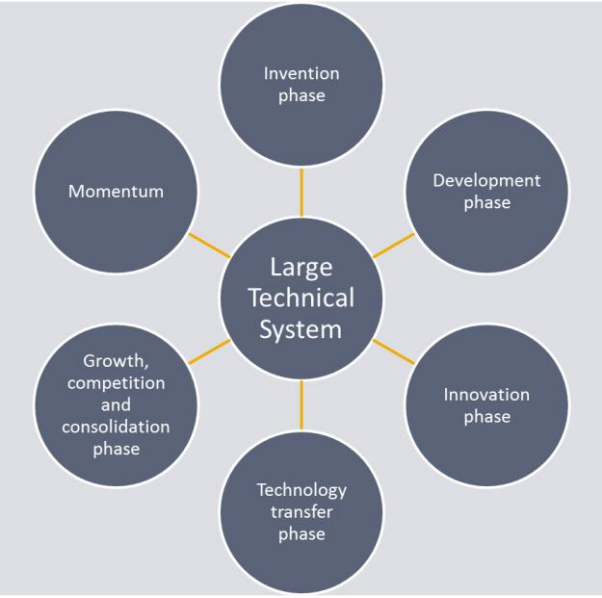

FIGURE 3 - EVOLUTION PHASES OF A LTS

During the development phase new components could be added to the LTS, i.e. conservative inventions. A driving force behind development is what Hughes introduced as a system builder. A system builder can be an inventor, but also an organization (Ewertsson & Ingelstam, 2004; Geels, 2007; Bijker & Pinch, 2012). System builders attempt to steer the development of an invention or LTS in a positive direction by working on technical objects, people, texts, regulations and markets (Geels, 2007). Steering the development of a LTS becomes more difficult as it increases scale and complexity, because it becomes more difficult to control activities (Joerges, 1996). Financial resources, political support, but also the society plays an important role in the development process (Hughes, 1987, p. 62; van der Vleuten, 2007; Bijker & Pinch, 2012). The invention needs financial resources to develop and survive. Political support helps gaining access to those resources. But political support is not provided if there isn't an opportunity or societal demand for it.

During the innovation phase, additional technological, organizational, scientific and legal components are merged or added into the LTS (Hughes, 1987, p. 64; Bijker & Pinch, 2012). These components are part of a LTS with a common goal. This keeps the different components organized and focused in their activities (Hobday, 1998). Examples of different components from the aviation sector are runways, airports, ATC, navigation aids and standards. These additional components are usually a response to an evolving and expanding LTS. Namely, evolution and expansion is associated with critical problems and reverse salients (Hughes, 1987, p. 66). A critical problem and a reverse salient that are holding a LTS back in its performance become stimulating factors for innovations to solve the critical problem and the reverse salient (Hughes, 1987; Markard & Truffer, 2006).

[4] Including lighted runways, -taxiways, gates, terminals and baggage handling systems.

[5] Examples of ATC systems are surveillance systems; automation, simulation and communication systems; navigation aids; and aeronautical information management systems.

A REVERSE SALIENT IS A COMPONENT OR SET OF COMPONENTS WHICH IS OUT OF PHASE, OR LAGS BEHIND, OTHER COMPONENTS IN AN EXPANDING SYSTEM (DAVIES, 1996, P. 1147).

A LTS can progress through a technology transfer phase at any point in time (Hughes, 1987; Bijker & Pinch, 2012). Aspects triggering the beginning of such a phase are geographical expansion of a LTS and changes in regulation, social-, scientific-, or technical settings. (Hughes, 1987; van der Vleuten, 2007; Bijker & Pinch, 2012). In a technology transfer phase the LTS has to adapt to different environments. In the early periods of the evolution and expansion of a LTS it is easier to adapt to different environments, than when the LTS is characterized by complex interrelated components (Hughes, 1987; Bijker & Pinch, 2012).

An example from the aviation sector is the development of mainport Schiphol. In the early phases of the evolving LTS it wasn't an issue to install four runways at mainport Schiphol (Geschiedenis24, 2011). The airport was adapting to an environment with an increasing demand in air traffic. However, mainport continued to grow. As it evolved along with the LTS, discussions regarding noise, environmental effects with the residents and the environmental groups arose (Keuning, 2011). This made it more difficult for mainport Schiphol to develop according to the demand. Simply because it is getting more complex and they are influenced by the residents and the environmental groups, who are looking after their own interests.

Every nation, like the Netherlands with mainport Schiphol, has to deal with their own environments and circumstances. Mainport Schiphol was able to develop towards an airport with six runways. London Heathrow, on the other hand, only has two. Due to these circumstances a different trade-off was made by the English ANSP compared to the Dutch ANSP, i.e. LVNL. The ANSP at London Heathrow developed the habit to buffer arriving air traffic in the air in what is called stacks. Stacks are fixed circling patterns in which aircraft fly whilst they wait to land (Heathrow, sd). The English ANSP does this so they can achieve a maximum runway capacity at London Heathrow with the two parallel runways they have. This habit is at the expense of the efficiency of the airspace users arriving at London Heathrow. LVNL has a different style, because Schiphol has more runways available. However, LVNL doesn't use stacks to increase the capacity, LVNL chose to allow only as much traffic in their control area as they can handle.

These differences are a result of the LTS adapting to differences in environments and circumstances. These operational differences are described as technological styles in the LTS literature (Hughes, 1987; Bijker & Pinch, 2012).

TECHNOLOGICAL STYLE REFERS TO THE DIFFERENCES BETWEEN GEOGRAPHICAL- AND TIME RELATED INFRASTRUCTURAL OPERATIONS.

In other words, the variation in shape and style of a LTS is shaped by local- and time related environmental circumstances (Ewertsson & Ingelstam, 2004).

Then, at some point in time the LTS also progresses through a phase called growth, competition and consolidation. Important drivers for growth of a LTS are; reverse salients, competition and load factors (Hughes, 1987; Bijker & Pinch, 2012). The load factor is the ratio of average output to the maximum output during a specified period (Hughes, 1987; Bijker & Pinch, 2012). A high load factor indicates that the system is more efficient than a system with a low load factor. For example, if an ANSPs´ maximum output is capable of controlling approximately 70 aircraft per hour, and they would have a load factor of 0.2. Then that would mean that their average output was 14 aircraft in that hour. A load factor of 0.8 would mean an average output of 56 aircraft per hour. Accordingly, the system must be able to supply at least the highest peak of the load factor. If not[6], it could become a driver for growth (Hughes, 1987; Bijker & Pinch, 2012), as appears to be expected in the European LTS as described in section 0.

When the LTS gets consolidated, it gets merged into society, with industry norms, values and regulations getting in place for it to function. After a LTS merged into society it acquires momentum (Hughes, 1987, p. 76).

MOMENTUM IS THE STAGE IN WHICH LARGE TECHNICAL SYSTEMS HAVE BECOME EMBEDDED IN SOCIETY, RESULTING IN MANY LINKAGES BETWEEN ORGANIZATIONS, REGULATORY BODIES, DEPARTMENTS IN EDUCATIONAL INSTITUTIONS, AND RESEARCH LABORATORIES (GEELS, 2007).

Characteristics of a LTS that has acquired momentum are dominant system goals, like rationalization, efficiency and capital intensification (Joerges, 1988, p. 12). These result in a LTS that is characterized by a high degree of stability and inertia (i.e. resistance to change[7]). Accordingly, the LTS starts to develops along a particular technological trajectory. This is dependent upon the consequences of the historical events that have shaped the system (Hughes, 1987; Davies, 1996; Ewertsson & Ingelstam, 2004; Markard & Truffer, 2006; Geels, 2007; Joerges, 1996; Bijker & Pinch, 2012). A LTS is

[6] In case the load factor transcends 1.0.

[7] Adopted from http://www.thefreedictionary.com/inertia

difficult to change once it has acquired momentum due to vested interests, existing networks, fixed assets, sunk costs and the fact that the LTS is adapted to the society (Hughes, 1987; van der Vleuten, 2007; Bijker & Pinch, 2012). Despite the momentum of LTSs and the inertia of motion, critical events, such as wars, push systems in new development directions (Hughes, 1983, p. 16).

The previously discussed LTS theory is the perspective of Hughes and his supporters. However, there is also another perspective criticizing some aspects of this view on LTSs. Namely, Hughes argues that a LTS acquired momentum can be broken based on historical cases. But he doesn't argue how momentum can be broken (Geels, 2007). Summerton (1994) shifted the attention to the transformation of the existing LTS. According to Summerton (1994) a LTS reaches closure, and in order to reconfigure a LTS, one needs to open the LTS up for changes. There are three reconfigurations possible;

1. A territorial expansion and interconnection of similar systems across political borders;
2. the crossing of functional system boundaries;
3. and, reorganization as a consequence of liberalization and the end of former monopolies (Murphy, 2007).

It has also been argued that (further) development of a LTS isn't simply a matter of going through the, by Hughes, clearly formulated evolution phases (Summerton, 1994). Inherent to changing existing LTSs is chaos, challenges, conflicts, and a high level of uncertainty (Summerton, 1994). It has also been criticized that Hughes' distinction between the system and its environment is rather vague as he allows rather fluid boundaries between systems and its environments (Olsson & Sjöstedt, 2004, p. 305).

I would like to add to this criticism that the LTS theory is not capable to explain how characteristics of the current LTS influence the innovative activities conducted to further develop the LTS. The theory provides an explanation of how the LTS concepts, like a reverse salient, technological style and momentum arise. But when the environment requires the LTS to adapt, it fails to explain two phenomena. First, how these concepts influence the activities taken by the LTS to adapt to those requirements. Second, how to deliberately bring about those changes for the system to adapt.

The following sections will elaborate on the three LTS concepts influencing the LTS' possibilities for further development directions.

2.1.1 Reverse Salient

A reverse salient can be a driver of an existing LTS' further development (Hughes, 1987). It indicates that that part of the LTS provides the lowest level of technological performance in relation to other parts of the LTS (Dedehayir & Mäkinen, 2011).

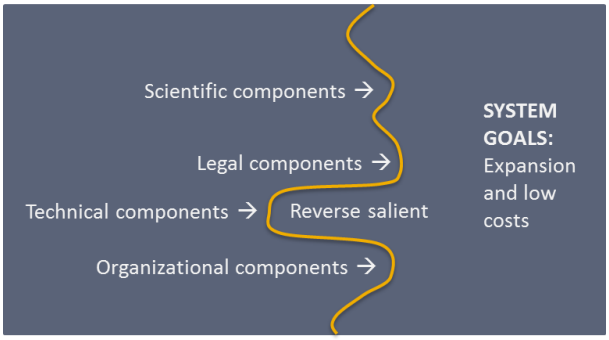

Figure 4 - Reverse salient
Source: (Hugh, et al., 2007)

Because a LTS exists of components operating as a seamless web, the presence of a reverse salient automatically hampers the rest of the system in its performance (Ewertsson & Ingelstam, 2004). Namely, the operations of the components are interdependent and low performance in one component can negatively influence the other components in their performance. In case the environment demands the systems' optimum performance level, it becomes urgent to find a solution to solve the reverse salient. Urgency is required in taking actions needed to solve the reverse salient (Kotter, 2008, p. 13). But first the reverse salient or critical problem needs to be identified.

The identification of a reverse salient causes the system to focus its attention on resolving it. When this can't be done within the context of the existing LTS, the reverse salient could trigger radical solutions (Hughes, 1987). As argued before, a radical solution could result in a new LTS. Resolving a reverse salient could also trigger a reconfiguration of the existing LTS. This could also result in radical solutions. However, this will be the result of a series of incremental changes over time (Summerton, 1994).

2.1.2 Technological Style

During the evolution and expansion of an existing LTS, it had to adapt to different environments. This culminates in differences in style (Bijker & Pinch, 2012, p. 61). Namely, the environment differs per location and time, and historians and sociologists use the concept technological style to suggest that system builders can creatively make the LTS adapt to those different environments (Bijker & Pinch, 2012, p. 62). Technological style is not about the amounts of air traffic (in this case) generated and/or distributed throughout the LTS. It is about the way it is generated, transmitted and distributed (Bijker & Pinch, 2012). The following circumstantial factors have been identified as influential in shaping a LTS' techno-

logical style (Ewertsson & Ingelstam, 2004; Bijker & Pinch, 2012).

- **Geography**
  Geography shapes technological style because it deeply influences technology (Bijker & Pinch, 2012, p. 63). For example, the geographical surface around an airport influences the way in which the airport is constructed and hence how air traffic is handled. Another example is the division in airspace between civil aviation and military aviation. These are based on the locations of the military airports.

- **Available resources**
  Available space, finances, technologies, manpower, raw materials etc. are shaping a LTS' technological style. In other words, lack of resources changes the way in which a LTS generates, transmits and distributes its goods or services. An example can be old technologies of the ANSPs. Due to lack of financial means, ANSPs can't invest in new, safer technologies and are sometimes forced to stick with old procedures while there is newer technology available which make those procedures unnecessary.

- **Legislation**
  Legislation influences a LTS' technological style by constraining or steering the system builders in taking certain actions (Bijker & Pinch, 2012). Legislation can be described the making of-, or enacting laws (Oxford Dictionary, 2012). At Schiphol airport, for example, they often switch runway configurations. This is due to legislation constraining the amount of noise pollution per runway.

- **Economics**
  The financial situation is also influencing the technological style. In good economic times the LTS has more opportunities for development as the government, organizational components of the LTS as well as the society have more money to spend, and hence are more willing to invest in the system. On the other hand, economic recessions have the opposite effect.

- **Social conditions**
  The social conditions influence the LTS's technological style by constraining or allowing certain processes to be executed by the system builders. For example, residents around an airport could complain about the amount of noise or pollution coming from the departing or arriving air traffic. By means of lobbying for changes that benefit them in that regards, they can influence the LTS' technological style. Lobbying can be understand as the activities designed to influence the institutions (Nestle, 2007), but also other organizations such as ANSPs, airports, airlines, intermediaries, research institutes and interest groups.

- **Cultural conditions**
  Cultural conditions encompass the society's norms and values. As society shapes technology, the way in which the goods or services are generated, transmitted and distributed throughout the LTS are in line with the cultural conditions ruling that society.

- **Regional and national historical experiences**
  Experiences like the 9/11 attack in New York influenced the way in which the aviation sector handled safety. Ever since that attack the world-wide aviation sector became stricter in passenger and baggage handling. Accordingly, these kinds of experiences influence the LTS' technological style.

These circumstantial factors determine the features of a LTS' technological style. Even within a LTS as the European aviation sector several different technological styles can arise due to the different nations such a LTS encompasses.

2.1.3 Momentum

As LTSs grow they acquire momentum, due to the presence of ruling industry norms, -values and -standards. This means that the direction, in which a LTS develops, is determined by activities conducted in the past by its system builders (Ewertsson & Ingelstam, 2004; Bijker & Pinch, 2012). Features of a LTS that has gained momentum are a high degree of stability and inertia, and a fixed development direction with a certain velocity (Davies, 1996). In other words, progression of technological developments, once under way, is inevitable, unavoidable and irreversible (Chandler, 2000). Further features are increased control issues over the system's daily operation due to increased system complexity (Hughes, 1987, p. 56), the LTS is seemingly immune to change, and it functions without continuous human interventions, i.e. autonomous technology (Ewertsson & Ingelstam, 2004). However, this last feature doesn't always apply. In the aviation sector continuous human interventions are needed in order for the LTS to function. Continuous human interventions are needed, because critical tasks, like air navigation services, are carried out by humans (SESAR Joint Undertaking, 2012). Air navigation service is a prerequisite for the LTS to be able to operate and because this is not automated, continuous human intervention is needed (Shorrock & Kirwan, 2002).

The descriptions of these latter three concepts, i.e. reverse salient, technological style, and momentum, indicate that

these concepts influence future development options of the system builders. The system builders are represented by the institutions and the Dutch aviation industry. How these concepts, i.e. variables, influence future development options is part of this research and will be elaborated upon in section 6. The following section aims to fill in the theoretical gap the LTS theory can't explain.

2.2 Theory of Path Creation

The LTS theory is not able to explain how system builders are capable of deliberately breaking through the LTSs' momentum phase, without the presence of a critical event. The theory of path creation offers the additional theoretical explanation needed for that complete explanation.

The theory of path creation is the counterpart of the path dependency theory. Path dependency theory argues that the process towards innovation evolves as a consequence of the process's own history (David, 1997). This suggests that this process is self-reinforcing by events that happen in a certain order over time with little human intervention involved. In other words, chance influences the outcome of innovation (Garud & Karnøe, 2001, p. 7). However, the theory of path creation argues that some sort of human intervention is needed to achieve innovation, to overcome resistance which is inherent to change (O'Toole, 1995; Kotter, 1996). Whereby the organizations, deliberately deviating from the existing technological trajectory, are fully aware that their actions can be creating inefficiencies in the present, but may also be worthwhile in the future (Garud & Karnøe, 2001). Namely, new trajectories come with destabilization of the old trajectories (Anderson & Tushman, 1991; Meyer & Schubert, 2007; Heiskanen, et al., 2011; Lovio, et al., 2011). Destabilization requires collective action to overcome resistance. As stated by Garud and Karnøe (2001, p.14) most deviations come with apathy at best and resistance at worst. And to overcome resistance, the new idea requires supporters to create a critical mass which can overcome resistance.

For example, in its efforts to achieve a SES, the majority of the European aviation industry is collectively taking actions. One industry organization wouldn't be able to achieve a SES by taking actions on its own. It needs the involvement of other organizations as well. This increases the risk, as their resistance could hamper the process. On the other hand the involvement of other organizations could make the institutions lose control over the innovation process (Lovio, et al., 2011). To reduce the risk inherent to collective action, social skills are required to create a collective space among the involved organizations (Lovio, et al., 2011, p. 279). Path creation thus emphasizes agency which may refer to an entity controlling path creation processes conducted by the involved organizations.

To accomplish path creation, the industry should shift its emphasis to alternative approaches that possibly have greater promise than the current technological trajectory (Garud & Karnøe, 2001; Tushman, et al., 2006). Furthermore, path creation requires the system builders to identify the factors that create dependency on the current technological trajectory. In other words, system builders have to understand the features of the current technological trajectory. Hence, the industry can take action to deliberately break through the existing technological trajectory (Lovio, et al., 2011). In doing so, it is important that the system builders are able to translate the emerging innovation in a way that makes sense to and captures the interests of industry organizations that aren't involved (Garud & Karnøe, 2001; Lovio, et al., 2011). It is also important that consecutive tests of the emerging innovation are conducted. It allows the other organizations to provide feedback and hence increase the innovation's validity.

Strobel & Duschek (2007) introduced the notion of path management. Path management is according to them understood as managing the activities to exploit the old path, while at the same time managing the activities conducted to create a new path (March, 1991). Path management encompasses three phases through which a new path is shaped, namely path creation, path extension and path deviation (Sydow, et al., 2005; Heiskanen, et al., 2011; Strobel & Duschek, 2007). By means of these phases an explanation will be provided of how one can deliberately deviate from the existing path. An explanation which can't be provided by the LTS theory.

The following sections will elaborate on the three phases of path management and how an industry deliberately breaks through LTSs' momentum.

2.2.1 Path creation

Path creation includes particular activities conducted by the system builders to shape the future in their favor (Heiskanen, et al., 2011). Path creation activities are carried out in order to get the project off the ground. In this research, activities are defined as work performed to convert inputs into outputs[8]. In the path creation phase, the system builders pursue a certain goal while also mobilizing other organizations to support their mission (Sydow, et al., 2005). Activities involved in this phase are the winning of first adopters, political action such as lobbying, and the building of consortia (Heiskanen, et al., 2011). Lobbying activities in this regard should be interpreted in the broad sense of the word, namely deliberately influencing other organizations, institutions or parties in the field for a certain purpose (Nestle, 2007).

[8] Adopted from http://www.businessdictionary.com/definition/activity.html

Consortium building is necessary to create an environment in which collective action can be taken. It also reduces the risks and innovation costs (Heiskanen, et al., 2011), which accordingly could stimulate other organizations to support the mission. This is achieved by system builders, which translate the emerging innovation in a way that makes sense to, and captures the interests of industry organizations that aren't involved. This is referred to as boundary spanning (Garud & Karnøe, 2001; Lovio, et al., 2011). Boundary spanning helps to overcome resistance and indifference between the organizations involved in the process of path creation, by generating a shared space, i.e. working consensus (Garud & Karnøe, 2001; Bartel & Garud, 2009). Altogether, these activities aim to create a critical mass supporting a common mission to de-embed from the existing path and to re-embed into a new path (Sydow, et al., 2005). Namely, as argued before innovation doesn't happen by means of solely conducted activities, but as a result of collective activities.

2.2.2 Path extension

Path extension refers to the fact that a certain form of irreversibility must exist in order for the path to continue after its creation (Bassani & Dosi, 2001; Sydow, et al., 2005). In order to create a certain form of irreversibility, actions need to be taken by the system builders. These actions consist of, prioritizing the emerging innovation among all organizations involved, defending the emerging innovation, preparing the sector for the emerging innovation, interactive learning through continuous exchange of information and knowledge, enhancing the credibility and legitimacy of the innovation, and providing feedback (Sydow, et al., 2005; Heiskanen, et al., 2011; Schienstock, 2005; Heiskanen, et al., 2011).

All involved organizations need to have approximately the same sense of urgency to create this new path for the collective actions to be taken. The system builders don't have unlimited access to the resources required to create a new path for a certain innovation to arise. This means that this innovation has to compete with other innovations when those system builders need to decide which innovation they would rather spend their resources on. This is why it is important to defend the innovation towards the system builders and keep them convinced of the benefits that particular innovation has to offer.

Preparation of the sector is required to reduce the resistance and indifferences among the system builders and the outsiders. Related to the case of the SES, the LTS needs to be prepared regarding the regulations, the resources, but also the technologies in order for this path to succeed.

Furthermore, knowledge sharing is important because in a broader context knowledge sharing appears to result in a higher innovative performance than knowledge sharing in a local context (Spencer, 2003). Enhancing the credibility and legitimacy of the innovation is done by conducting trials. Trials and simulations are necessary to be able to prove the use of technologies, processes and procedures in practice. But also to provide evidence of safety, and notice the bottlenecks of the technologies, processes and procedures. Identifying the bottlenecks allows the industry to find a solution to them in order to improve the technologies, processes and procedures. This is required for the technologies, processes and procedures to eventually be realized in practice leading to a better performance level (Shorrock & Kirwan, 2002).

Furthermore, feedback is important because it helps to improve the path management process (Töpfer, 2011). Feedback helps to build confidence in the path that is created, as feedback can be motivating and energizing (Full circle feedback, 2008; Marshall, 2010). Feedback can be used to engage with other participants in the SES project, and it also helps to get organizations on the right path (Full circle feedback, 2008). Feedback is a powerful tool for influencing behavior (Resnick, 2008). Receiving and using feedback is part of the path extension phase.

These path extension activities contribute to the validation of the innovation once the feedback is turned into positive action.

2.2.3 Path deviation

The last phase of the path management process is the path deviation phase. Path deviation involves activities that lead to create a momentum for the emerging path. Examples of such activities are destabilizing the existing path by discrediting previous experience and received truths (Heiskanen, et al., 2011), monitoring other system builders' activities, exchange of information and knowledge, turning the received feedback from the system builders into positive action, and steering. Steering can be described as a purposive attempt to bring a system from one state to another by exerting influence on its dynamics of development (Voss, et al., 2007). These activities indicate that the system builders reinforce their commitment to the new path because of their accumulated investments (Garud & Karnøe, 2003).

Altogether this research proposes an extension of the LTS theory with the notion of path management, derived from the theory of path creation. The next section provides an overview of the variables, derived from this theoretical framework, which are expected to explain how the current strategy influences the progression towards the SES.

2.3 Conceptual model

The LTS theory combined with the theory of path creation, as previously described, highlights the relevant concepts. These

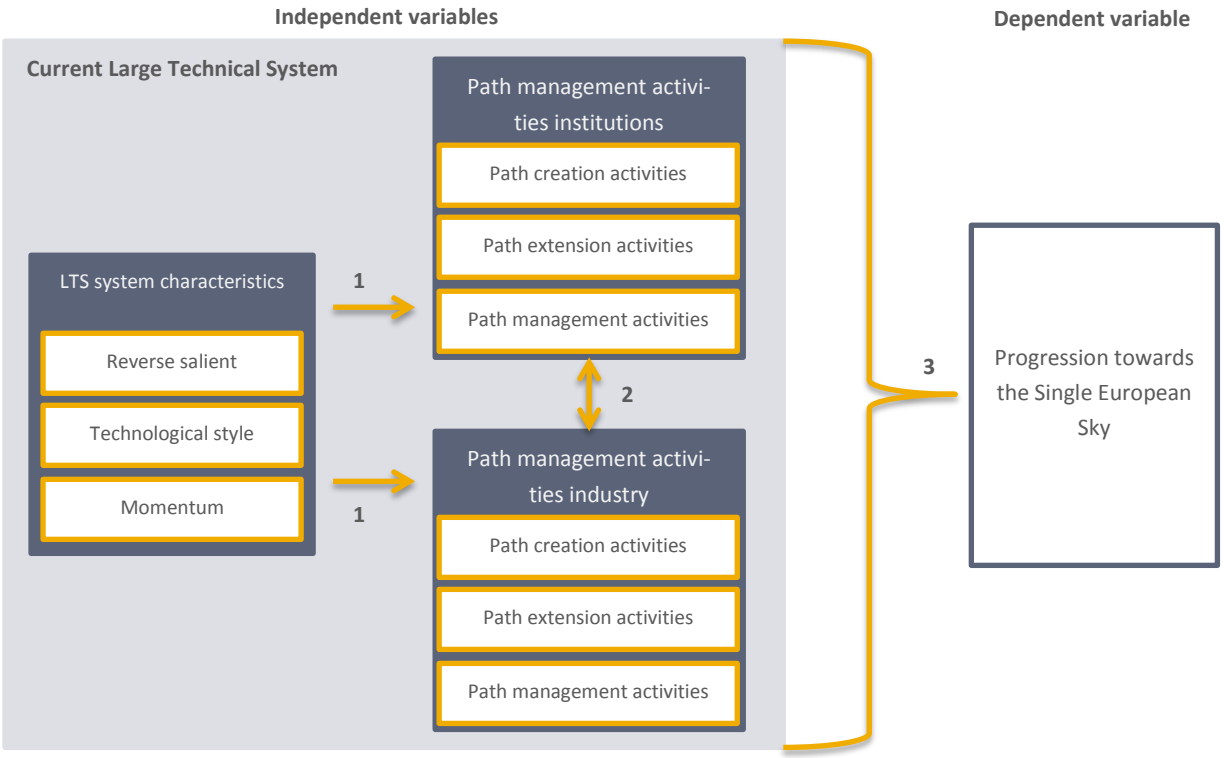

FIGURE 5 - CONCEPTUAL MODEL

concepts are expected to influence the progression towards the SES. These expectations are called theoretical patterns.

Which independent variables are expected to influence what dependent variables is represented in the following conceptual model (Figure 5). As both theories acknowledge, one can't simply ignore the existing technological trajectory of the system. Namely, the existing system is the point of departure for innovation. That means that the characteristics of the current LTS concepts, i.e. the characteristics of reverse salient, technological style, and momentum, influence the system's future development options and hence the path creation, -extension, and -deviation activities carried out by both the institutions and the industry.

PROPOSITION 1: THE CURRENT LTS CHARACTERISTICS OF THE AVIATION SECTOR HAVE A CONSTRAINING INFLUENCE ON THE ACTIVITIES THAT THE INSTITUTIONS AND THE DUTCH INDUSTRY CARRY OUT.

To break through these path dependent LTS developments, which are reinforced by these system characteristics, the institutions in collaboration with the industry have to carry out activities. To be able to successfully carry out activities, the institutions and the industry have to function in harmony. A common vision and mission helps to achieve that, by guiding the development directions of both the institutions and the industry in a similar direction. The institutions have the authority to control the industry in their activities, by releasing regulations. Nonetheless, the institutions only restrict or force activities upon the industry when those activities foster the development of the aviation sector within the boundaries set by society, and if the industry organizations have the resources available to execute these activities. This emphasizes the importance of harmonization between the institutions and the industry. In this interplay the institutions are guiding the industry towards the realization of the SES, while the industry drives, and carries out, the activities to create the technological trajectory. However, destabilization of the old trajectory comes with apathy and resistance at worst. It is expected that along the path management process, involved industry organizations will resist the deviation guided by the institutions. It will therefore be more difficult for the institutions to guide the development of the industry. And the institutions will guide the industry into a certain direction, which the industry isn't always ready for.

PROPOSITION 2: THE INSTITUTIONS AND THE DUTCH INDUSTRY INFLUENCE EACH OTHER IN THEIR PATH CREATION-, PATH EXTENSION- AND PATH DEVIATION ACTIVITIES.

The Dutch aviation industry also started to contribute by carrying out activities to help create the technological trajectory towards the SES. They carry these activities out based on their own initiatives, but they are also steered by the institutions, i.e. EC, SJU and EUROCONTROL. This interplay has changed over the years, in the sense that the EC and the SJU joined EUROCONTROL to exert pressure on the industry to carry out activities towards the SES. This approach aims to

increase the speed with which the path towards the SES is created.

PROPOSITION 3: THE PATH MANAGEMENT ACTIVITIES CARRIED OUT BY BOTH THE INSTITUTIONS AND THE DUTCH INDUSTRY FOSTER THE PROGRESSION TOWARDS THE SES.

The propositions, derived from the conceptual model, are tested by means of this research. The method used to test these, is described in the following sections.

3. CASE INTRODUCTION

The propositions represent expectations in a given context. This context is the case under investigation; the Dutch aviation sector and the surrounding institutions.

3.1 CRITICAL CASE STUDY

The Dutch aviation sector and the surrounding institutions represents a single critical case which is used as research design (Yin, 2003, p. 40; Hancké, 2009, p. 68). A critical case can often be identified as a case that can make a point quite dramatically (Patton, 2002, p. 236), or a case that is of a particular interest and with strategic content in relation to the research questions (Holland & Herstad, 2000). A critical case study allows the researcher to yield the most information (Cohen & Crabtree, 2006), because it has strategic importance in relation to the general problem (Flyvbjerg, 2006). The Dutch aviation sector is chosen as the critical case for this research, because it represents a LTS with all its facets, aiming to create a path towards a SES. As the plan to create a path towards a SES includes a part of an entire sector[9], it is considered an ambitious revolutionary initiative (SESAR Joint Undertaking, 2011). The Dutch aviation sector also has the densest and most complex airspace in the world (EUROCONTROL, 2012). This is caused by the fact that the Dutch aviation sector also has mainport Schiphol as one of the four busiest airports in Europe (European Commission eurostat, 2012). The Dutch aviation sector is therefore part of the core area where the reverse salient and critical problems will appear first (de Jonge & Seljee, 2011). Due to the complex runway arrangements and the corresponding procedures, mainport Schiphol is considered to be a critical airport. In other words, if procedures, technologies and processes will work at mainport Schiphol, they will most likely also work at other airports (interview#1, LVNL, 2012).

Together these organizations aim to create a path towards a common goal, which is a priori acknowledged to be a difficult path to create (Calleja Crespo & De Leon, 2011). It is therefore able to make a point quite dramatically and for this reason the Dutch aviation sector and the surrounding institutions represent a critical case, in which the relations, if found in this context, are most likely also to be found in other, similar, cases.

3.2 SCOPE

Even though the path towards the SES involves the entire LTS, the scope of this research is limited to the Dutch aviation sector. However, I will also take into account the European perspective when it concerns the institutions. Reason for this is that most of the institutions influencing the Dutch aviation sector are operating at a European level.

The Dutch aviation sector exists of the following organizations;

- Maastricht Upper Area Control Centre (MUAC)
- Air Traffic Control the Netherlands (LVNL)
- Ministry of Defense (MLA)[10]
- National Aerospace Laboratory of the Netherlands (NLR)
- Royal Dutch Airlines (KLM)
- Amsterdam Airport Schiphol (AAS)[12]
- Royal Netherlands Meteorological Institute (KNMI)[12]
- Delft University of Technology (TUD)
- Civil Air Navigation Services Organization (CANSO[11])
- International Air Transport Association (IATA)[12]

And the following institutions;

- European Commission[12]
- EUROCONTROL
- SESAR Joint Undertaking[12]
- Ministry of Infrastructure and Environment

All these organizations are involved with the SES project and possess knowledge regarding the influences onto -, within -, and of the current strategy.

4. METHOD

4.1 RESEARCH DESIGN

The aims of this thesis are twofold. First, to empirically test whether the proposed theories are able to explain how a

[9] Participants are the ANSPs, airport operators, individuals, airspace users, regulators and administrators, suppliers, and airlines, airports and air traffic navigation staff (SESAR Joint Undertaking, 2011).

[10] As the interviewee within the Ministry of Defense is seen as a representative of the military, the Ministry of Defense is seen as part of the industry.

[11] CANSO is not a Dutch party, but a global interest organization of ANSPs. It is seen as a Dutch player, because it also represents the Dutch ANSP.

[12] These organizations aren't interviewed due to busy agenda's. In order to fill this gap up I used scientific papers, publications, interviews and online articles, and information coming from their websites as recorded in Appendix V.

sector can deliberately innovate an existing LTS. Second, to explain how the relations found in practice, are influencing the path towards the SES. This calls for a deductive approach. A deductive approach begins with a theory about how things work in general. From this theory testable propositions are derived of how it should work in practice. Accordingly, these are tested by gathering, and analyzing data. The results of this data can either validate or reject the stated propositions (Bryman, 2008; Bordens & Abbott, 2011; Crossman, sd). Validated propositions support the theory, and rejected propositions weakens the theory (Bordens & Abbott, 2011).

Furthermore, this thesis is of explanatory nature. In the beginning, the reverse salient and technological style are defined within the aviation sector. Also whether the aviation sector has acquired momentum. Hence, an explanation is given of how these LTS characteristics are influencing the path management activities carried out by the industry and the institutions. Subsequently, an explanation is given of how the industry and the institutions are interacting. Finally, an explanation is provided of how the LTS characteristics, path management activities, and the interaction between the industry and the institutions are influencing the progression towards the SES.

In order to provide those explanations, quantitative and qualitative data is used. Quantitative- and qualitative data are gathered by means of semi-structured interviews, and case-related documents. Semi-structured interviewing is a method whereby the researcher prepares the interview questions prior to the interview. This method allows for a certain degree of flexibility, as the researcher can add questions during the interview based on things said by the interviewee (Bryman & Bell, 2007). The interview questions are based on the theoretical concepts and propositions. In addition case-related documents, websites, magazines, scientific articles, presentations and recordings are also used to gather qualitative data.

Quantitative data is obtained by means of the same methods. Questions are asked to indicate whether the aviation sector has acquired momentum based on a Likert Scale. A Likert Scale is a five (or seven) point scale which is used to allow the interviewees to express their opinions and observations (Trochim, 2006).

4.2 Operationalization

This section applies the LTS theory and the notion of path management to the European aviation sector, with a focus on the Dutch aviation sector and its surrounding institutions.

4.2.1 LTS System characteristics

An analysis of the European aviation sector is performed to identify the LTS system characteristics (Figure 5), and to what degree these are influencing the path management activities, taken by the institutions and the industry.

Reverse salient

Based on the literature review the European ATM system can be pointed out as the reverse salient of the LTS (Figure 6).

FIGURE 6 - REVERSE SALIENT OF THE LTS

The fragmentation of the European ATM system caused the aviation sector to operate close to its limits (Furbisher, 2012). This leaves little room for the European aviation sector to growth and keep up with the demand, due to increasing route capacity problems (de Wit & Zuidberg, 2012). This created the need to innovate (SESAR Joint Undertaking, 2012). The SES project aims to do that by attempting to reform the ATM system (SESAR Joint Undertaking, 2011; EUROPA, 2011).

Another component of the LTS holding the aviation sector back in its development is airport capacity. With the expected growth rate in air traffic it is expected that 10% of the demand will be unaccommodated due to congested European airports[13] (Airports Council International, 2012).

To indicate the presence of these reverse salients, the following statement is used in the semi-structured interviews; The way the ATM system is arranged constrains the European aviation industry to grow. The interviewees are free to adjust the statement to their own perspectives. Furthermore, the interviewees are also asked whether, and how, the reverse salient influences their organization to execute activities for the purpose of the SES (Appendix I – Semi-structured interview questions).

Technological style

In this case, technological style is about the way aircraft are handled per nation. Most activities are prescribed by European regulations. However, there is still room per nation to

[13] It needs to be mentioned that mainport Schiphol has a volume restriction of 510.000 movements per year (Dutch government, 2009). So if the airlines would have the opportunity to grow, the growth of mainport Schiphol would still be restricted by this restriction published by the Dutch government.

adjust the European regulations to their own circumstances. Of course this happens within the boundaries of the European regulations. The adjustment to nations' circumstances create variations in technological style. Here, one can think of the differences in environmental regulations, civil/military collaborations, geography, airspace arrangement and cultural backgrounds per nation. These variations can create difficulties for the creation of the path towards the SES. Namely, the differences in technological style could constrain the collaboration with other nations. A reason for this is that multiple technological developments, related to the SES, require the collaboration of multiple nations to get successfully implemented. Furthermore, the possibilities for further development towards the SES can also be constrained by these differences in technological style. This is because there are many interdependent relations between, e.g. the way the LVNL is handling air traffic (technological style) and the amount of kerosene an aircraft is using during a flight (a possible development direction could be a kerosene reduction).

Technological style is measured by asking the interviewees whether they see any differences in style per nation. And how they perceive these differences in style to influence the process of realizing a SES (Appendix I – Semi-structured interview questions.

Momentum

Momentum can be measured by using several indicators. A LTS that has acquired momentum is characterized by a high degree of stability, a high degree of inertia, and a high degree of complexity. Applied to this case, this means that the aviation sector is considered as stable when the current operational situation will not change significantly without intervention. A high degree of inertia is indicated when changes are difficult to accomplish within the aviation sector. And complexity is measured by means of interdependencies. Interdependencies make the LTS complex, because when one aspect changes, others are automatically influenced as well due to those interdependencies. During the momentum phase it is also difficult for the institutions to control activities taken by the aviation sector. And once a new technological development is coming it is considered as difficult to reverse it (Chandler, 2000).

These characteristics are used as the indicators to measure momentum. These indicators are measured based on a 5-point Likert Scale (Appendix I – Semi-structured interview questions), whereby 1 equals 'completely not' and 5 'very much'. When the average outcome per indicator is rated over 3.0 it is assumed that that particular indicator is present in the status quo of the LTS. Because an indication of 3.0 or lower doesn't give an obvious indication of the indicators' presence. If the total average is rated over 3.5 and at least three out of the four indicators appear to be present it is assumed that the LTS has acquired momentum.

In addition to this Likert Scale, statistical data regarding the accident rate of the aviation sector is used to indicate stability in terms of safety (FAA, 2008).

4.2.2 Path management activities

This section elaborates on how the path management activities are applied to the case under investigation. Furthermore, this section also elaborates on how the presence of the path management activities carried out by the Dutch aviation industry and the surrounding institutions are indicated.

Path creation activities

Path creation activities are the activities that are carried out to get the project off the ground. First, the aviation industry has to be actively involved, as they have the knowledge and expertise to build SES. Activities indicating the involvement are performing research, developing new concepts and technologies, investigating new possibilities for their organization to develop towards the SES, and the creation of an aligned strategy.

Second, the aviation industry and institutions shall have to lobby for support, as they need to acquire a critical mass to enable the implementation of new concepts and technologies. Part of that lobbying process is the translation of the SES project in such a way that it makes sense for the industry to join the project.

And third, consortia have to be build, because industry organizations and institutions can't achieve the SES on their own.

These activities are measured by asking the interviewees whether they carry out these activities, and for what purpose (Appendix I).

Path extension activities

Path extension activities are the activities carried out to reach a certain form of irreversibility in the path management process towards the realization of the SES. These activities include emphasizing the importance of the SES by prioritizing the SES technologies among the organizations involved, to keep the organizations focused at what is required.

Furthermore, phasing out old technologies, ensuring that that resources are available, and making initial investments. Making investments indicates that organizations are committed, which enforces the irreversibility of the path management process as these organizations have something to lose when the SES project fails.

In addition, interactive learning by sharing information and knowledge is also perceived as a path extension activity. Just as enhancing the credibility and legitimacy of the SES project by conducting trials with the developed SES technologies.

Trials are conducted to gain critical feedback from participants of the SES project, but also to prove its use in practice. These activities are also measured by asking the interviewees whether they carry out these activities, and what their reasons behind it are (Appendix I).

Path deviation activities

Path deviation activities are taken to actually deviate from the path. Path deviation activities include releasing regulations, ensuring that the industry organizations comply with these regulations, and monitoring other organizations' activities contributing to the SES.

Furthermore, using feedback and turn it into positive action is also considered a path deviation activity.

Another path deviation activity is making accumulated investments for the SES project with manpower, money and other resources. This indicates that the organizations are increasingly committed to this project.

Path deviation activities appear quite similar to the path extension activities described before. The difference is that the path extension activities are carried out to make sure that the organizations are prepared to leave the old technological trajectory behind for a new, enabling technological trajectory. These activities also make sure the organizations can't go back to that old technological trajectory.

An overview of the questions asked to identify the presence of these activities are presented in Appendix I.

4.2.3 Progression towards a SES

The progression towards the SES needs to be measured to be able to indicate whether there is a relation between the current strategy and the progression. As the strategy changed in 2004, when the EC and the SJU came into play (as explained in section 0) progression is measured by comparing the period after 2004 with the period before 2004, when EUROCONTROL was still reconfiguring the European ATM system. Identifying progression of the European ATM system since 2004 is done by asking whether organizations find it easier to gain the needed resources to carry out their activities, whether organizations perceive there is a more collective approach towards the SES, whether organizations have more confidence in the SES project, and whether organizations have noticed progression towards the SES in general (Appendix I – Semi-structured interview questions. Interview questions regarding the latter include asking about examples of actual achievements, e.g. technologies, procedures or processes implemented. In addition to these interview questions, online documentation, such as progression reports, assessments and articles, and magazines are used to measure progression of the SES project (European Commission, 2007; SESAR Joint Undertaking, 2011; Gysen, 2012; CAPA Centre for Aviation, 2012; Air Traffic Management, 2012).

The following section elaborates on the actual data collection regarding these concepts and how the data is processed to come to a conclusion.

4.3 Data collection & analysis

The execution consists of two parts. The first part involves conducting semi-structured interviews with members from the organizations mentioned in section 3 (Table 1). The second part involves the analysis of the results of the conducted interviews.

Table 1 – Overview interviewees

Interview	Organization
#1	Air Traffic Control the Netherlands
#2	Air Traffic Control the Netherlands
#3	Air Traffic Control the Netherlands
#4	Air Traffic Control the Netherlands
#5	CANSO
#6	Air Traffic Control the Netherlands
#7	Air Traffic Control the Netherlands
#8	Air Traffic Control the Netherlands
#9	Air Traffic Control the Netherlands
#10	National Aerospace Laboratory*
#11	National Aerospace Laboratory
#12	KLM Royal Dutch Airlines
#13	Ministry of Defense
#14	Ministry of Infrastructure & Environment*
#15	Maastricht Upper Area Control Center
#16	Maastricht Upper Area Control Center*
#17	Technical University Delft
#18	EUROCONTROL

* These interviews were group interviews with either two or three interviewees.

The organizations mentioned in section 3 serve as the research population. The members within these organizations are approached via LVNL, within which this research is conducted. To ensure reliable information was gathered via these interviews, the members were selected based on their expertise within the SES project.

SESAR is the technological pillar of this project and also the main focus to measure the activities in. It is therefore important that the interviewees' functions are directly related to SESAR. Direct relation with SESAR is important, because their direct involvement allows them to observe and experience the influences, activities and progression related to the SES.

Furthermore, the European airspace is currently divided in 27 sovereign airspaces. To decrease the step from 27 sovereign airspaces to just one (i.e. the SES), the EC decided to introduce the Functional Airspace Blocks (FABs) by first merging these 27 sovereign airspaces into 9 airspaces (Figure 7) (Dutch government, sd).

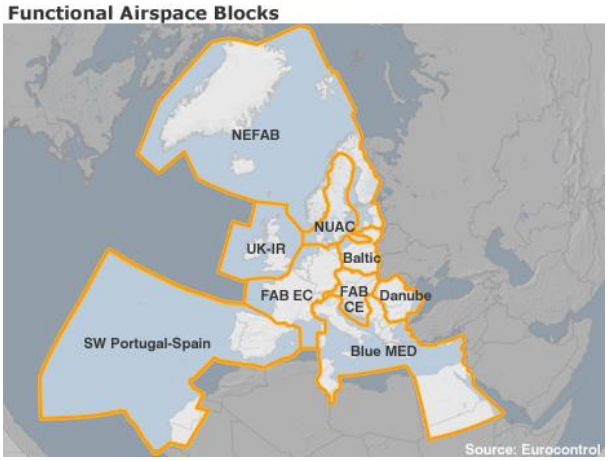

FIGURE 7 - AN OVERVIEW OF THE FABS
SOURCE: EUROCONTROL

FABs are considered as an important part of the SES project by aiming to enable increased cooperation and integration, leading to a more rational organization of airspace and service provision in order to meet the industries' expectations (European Commission, 2012). Therefore, a FAB experts is also interviewed as that allows for a more complete picture of the LTS organizations trying to create a path towards the SES.

The questions presented in the previous section are tested by means of pilot interviews (Appendix II) to determine whether the interview design has flaws, limitations, or other weaknesses. These are held with two SES experts within the LVNL. They are both ATM experts, familiar with the SES project. So the interview design for the industry is tested. However, the interview design for the institutions isn't tested, because there weren't any interviewees available. However, as the interview design for the institutions is almost the same as the interview design for the industry, the insights gained from the conducted pilot interviews are also used to adjust the interview design for the institutions.

The pilot interviews pointed out that it is important that the intended definition of a concept, used to formulate questions, coincides with the definition the interviewee has of that concept. Due to the complexity of the questions, the interviewees needed time to, not only understand the questions, but also think about an answer to them. Second, the pilot interviews took almost 80 minutes, which is perceived as too long. In addition, some questions, which appeared to be unnecessary, are erased, also to decrease the duration of the interview.

Consequently, the interview design changed according to the previously mentioned flaws, limitations and weaknesses, identified during the pilot interviews. The interview design for the official interviews is presented in appendix III and IV.

The semi-structured interviews are structured in such a way that the interviewees have the opportunity to add activities or information which isn't asked about, but considered important by the interviewee.

After the data collection phase, the data is analyzed. The quantitative data is analyzed by means of the average outcome of the Likert scale. When the data indicates that the system didn't acquired momentum it is assumed that the aviation sector is still in one of the evolution phases (Figure 3). In that case characteristics highlighted during the interviews will be used to determine the phase the aviation sector is most likely in. Quantitative data is also gathered as a category variable, namely when it comes to the path management activities. They are either present in this critical case, or not.

Qualitative data serves to provide explanations. First, it serves to explain what the role of the institutions are, when it comes to the activities executed by the industry. Second, it helps to explain how the industry is influencing the institutions. It also serves to explain how the current LTS is influencing the activities executed by both the industry, and the institutions. The final purpose of the qualitative data is to indicate whether progression has been made because of the activities executed by both the industry and the institutions.

To be able to provide an explanation based on the qualitative data, this research used an analysis method called coding. This is a method whereby the chunks of text are linked to a short phrase or word. Coding is about condensing large texts by saying this chunk of text represents this (short phrase or word). It is a process in which the data is revisited until the researcher sees and understands patterns and explanations (Richards, 2009; Strauss & Corbin, 1990). In other words, the relevant qualitative data is analyzed and accordingly summarized in a few words. It is important that during the coding process no data loss will occur, as qualitative coding is about data preservation. In this research, coding is used to reveal empirical patterns (i.e. relationships). Examples of qualitative data that can be coded are behaviors, events, activities, strategies, states, meanings, participation, relationships, conditions, consequences and settings (Lewins, et al., 2005).

Richards (2009) described the process of qualitative coding using the following concepts;

- descriptive coding,
- topic coding,
- and analytical coding.

Descriptive coding involves storing facts about the case under investigation (Richards, 2009). These include aspects as, the interviewee's function and the duration of employment. These aspects help assess the value of the answers given by

the interviewee. An interviewee who has been involved with the subject for a longer period of time usually has a better picture of the situation, than someone who just recently got involved.

Descriptive coding is followed by topic coding. This can be described as placing the relevant chunks of text under a certain topic, i.e. label (Richards, 2009). During topic coding the researcher assesses where the qualitative data is about and labels it accordingly. This process of topic coding repeats itself whenever an interview is added to the process. The labels are constantly compared with the interviews and whenever a new label arises, previous interviews are reviewed to check whether that interview has chunks of text that can also be placed under that label.

After topic coding, analytical coding is used to group labels under categories. This is also referred to as axial coding (Strauss & Corbin, 1990; Merriam, 2009, p. 180). Namely, this type of coding analyses the data regarding what's actually being said about those topics and places them under categories (Richards, 2009). This type of coding helps to provide the explanations, as discussed earlier in this section. By means of constant comparison patterns are observed, which are validated with the available literature regarding the SES.

The method applied in this research is visualized in Figure 8.

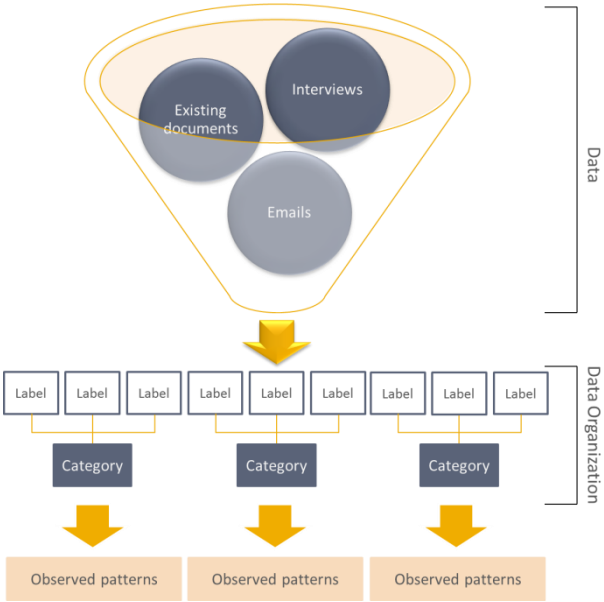

FIGURE 8 - CODING PROCESS

This thesis focuses on the LTS's influences, the activities conducted by both the institutions and the industry, and the progression of the SES. These are the topics used as the initial categories in the coding process. Based on the collected data categories can be added, or the names of existing categories can change. Furthermore, qualitative coding is also used to provide an explanation regarding the relation between the concepts under investigation. These explanations are derived from the information under the labels, underneath the categories, and are called empirically observed patterns.

One of the aims of this research is testing the proposed theoretical framework. In order to be able to compare the empirically observed patterns with the theoretical framework, a technique called pattern-matching is used. This technique compares these empirical observed patterns with the theoretical patterns. The theoretical patterns are derived from the theoretical framework described in section 2 and are presented as the propositions in section 2.3. A visual representation of this technique is presented in Figure 9[14] below. The upper part of Figure 9 represents section 2 of this research paper. The lower part of Figure 9 refers to the process previously described and visualized in Figure 8. If both the upper and the lower part result in similar patterns, confidence in the theoretical framework, as discussed in section 2, increases (Yin, 2003). Otherwise, the theoretical framework needs some adjustments in order to provide an alternative explanation that is in accordance with the empirically observed patterns.

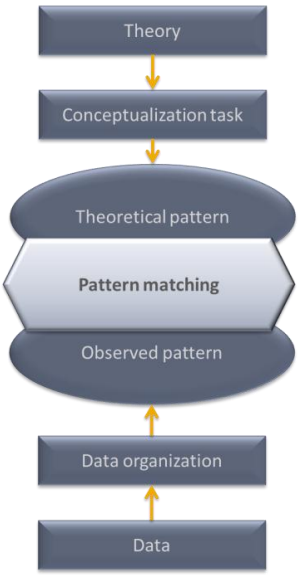

FIGURE 9 - PATTERN MATCHING

4.4 RESEARCH QUALITY

The quality is an important aspect in conducting research. In empirical social research four tests have been commonly used to establish the quality of such research (Yin, 2003, p. 33). Because this case study design is also a form of empirical social research, these tests are also used in this research. The

[14] Adopted from http://www.socialresearchmethods.net/kb/pmconval.php

tests and associated case study tactics are represented in Table 2[15] below.

TABLE 2 - CASE STUDY TACTICS FOR FOUR DESIGN TESTS

Tests	Case Study Tactic	Research phase
Construct validity	Use multiple sources of evidence.	Data collection
	Establish chain of evidence.	Data collection
	Have key informants review draft case study report.	Report writing
Internal validity	Do pattern-matching.	Data analysis
	Do explanation-building.	Data analysis
	Address rival explanations.	Data analysis
	Use logic models.	Data analysis
External validity	Use theory in single-case studies.	Research design
	Use replication logic in multiple-case studies.	Research design
Reliability	Use a case study protocol.	Data collection
	Develop a case study database.	Data collection

Not all case study tactics can be applied in this research. Since this research doesn't apply a multiple-case study, replication logic isn't applied.

4.4.1 CONSTRUCT VALIDITY

A researcher constructs validity by ensuring that proper measurements are used for the concepts being studied (Yin, 2003). It is important that correct indicators are used to measure the concepts under investigation. Otherwise, the derived results aren't considered as valid. Construct validity is especially necessary in qualitative research, because this process is exposed to the researchers' interpretations and (biased) mindset. There are three tactics a researchers can use to improve construct validity, which are represented in Table 2.

The first case study tactic introduced here is using multiple sources of evidence. Namely, multiple sources of evidence indicating the same results form a relatively solid basis, compared to results based on a single source of evidence (Yin, 2003; Hancké, 2009). The most commonly used sources of evidence in performing case studies are; documentation, archival records, interviews, direct observations, participant-observation and physical artifacts (Yin, 2003, p. 85). For the case study presented in this thesis the main sources of evidence are the semi-structured interviews, carried out with the organizations introduced in section 3. In addition to the interviews, additional data is used from previously conducted interviews or written articles for (scientific) magazines to support the findings based on the semi-structured interviews. The SESAR magazine, airspace journal[16], air traffic management magazine[17] and the journal of air transport management[18] are examples of such magazines. Furthermore, archiving documents, reports and email discussions regarding the SES are used to increase the validity of the results.

The second case study tactic, establish a chain of evidence, refers to the fact that a good research paper is written in such a way that the reader perceives its course as obvious and logical. In other words, an external observer should be able to trace the steps carried out in a research (Yin, 2003). The third and last case study tactic to increase construct validity is to have this thesis read and reviewed by peers, participants and informants in the case. They are free to disagree with the conclusions and interpretation. However, when they disagree with the stated facts of the case, the researchers needs to search for further evidence (Yin, 2003, p. 159). This thesis is read and reviewed by my external supervisor, which is also a participant in the case. Furthermore, this thesis is also reviewed by a participant who hasn't been involved in the research design phase. Finally, this thesis is also read by someone who is not familiar with the innovation literature nor the case to make sure the reader perceives its written course as obvious and logical.

4.4.2 INTERNAL VALIDITY

Explanatory case study research is subject to inferences. A problem related to making inferences is whether these are correct or not, i.e. internal validity. Namely, a researcher can infer that A is influencing B, based on interviews and documents, instead of direct observations, which can be biased. This process includes a certain degree of uncertainty, due to the indirect inferences. To reduce this uncertainty Table 2 offers four relevant case study tactics. These are all related to the data analysis phase of this research.

The first is called pattern-matching, which is described in section 4.1. Pattern-matching increases the internal validity when the empirically observed patterns match with the theoretical patterns, i.e. propositions.

Second, explanation-building is a different type of pattern-matching. Explanation-building means that an explanation is derived based on the data of the case under investigation. An advantage of this tactic over pattern-matching is that it solely focuses on the case and not the theory. This opens up the possibility to include patterns which aren't described in theory (Yin, 2003; Saunders, et al., 2007, p. 490). Explanation-building is applied by explain how and why the independent variables are, or aren't, influencing the dependent variables.

[15] Adopted from (Yin, 2003).

[16] http://www.canso.org/airspace

[17] http://www.airtrafficmanagement.net/sesar/

[18] Access via UU library.

The third tactic, rival explanations, includes the researchers' awareness that there are other possible influences besides the ones taken into account in the propositions (Yin, 2011). This is taken into account when carrying out the interviews. The interviewees are not just questioned regarding the theoretical expectations, but also regarding the other possible influences.

The fourth and last mentioned tactic in Table 2 is about illustrating a sequence of cause-and-effect relationships. In other words, this tactic addresses the problem related to inferences. Logic models help to illustrate relations between multiple factors by linking the problem (situation) to the intervention (inputs and outputs) and the impact (outcomes) (McCawley, 2002). This is applied by questioning the interviewees, either directly or indirectly, about the consequences of their activities. Logic models support the inferences made in this research. It is taken in account during the data collection phase, and applied in the data analysis phase of this research. In this phase empirically observed events, derived from the interviews, are logically linked to each other as a pattern that occurred over time.

4.4.3 External validity

External validity refers to the problem related to generalization. When a single case study is carried out, the conclusions are based on the results of that single case. That doesn't necessarily mean that the conclusions drawn are valid for other cases as well (Yin, 2003). To increase external validity this research used generalizing to theory, i.e. analytical generalization (Yin, 2003, p. 37). This means the researcher attempts to link findings from a particular case to a theory. Namely, instead of limiting the conclusions of this research to this case, it can be linked to the theory which may have a much wider applicability than this particular case under investigation (Maxwell, 2007).

4.4.4 Reliability

Reliability means repeatability or consistency. It's about measuring the concepts (Trochim, 2006). Namely, an independent researcher should be able to get the same results when conducting this research all over again. In order to achieve reliability in this research a case study protocol is used (Appendix V) as well as a case study database (Table 2). A case study protocol is a detailed version of the procedures followed to gather the data for this thesis. This increases the reliability by allowing the independent researcher to carry out this research all over again. The case study database includes the original data gathered by the researcher. This allows the independent researcher to independently assess the raw data for inspection.

5. Results

The results are based on the code system presented in Appendix VI – Code system. In the following sections, each category (i.e. LTS characteristics, path management, interplay and progression) as shown in Figure 10 will be discussed separately. Its labels are explained more in depth. The properties of those labels are presented, and how these influence and characterize the category they belong to. The results are linked back to the theory via pattern-matching, by comparing the results with the theoretical framework and the propositions as presented in section 2.3).

5.1 LTS characteristics

The specific labels and their properties that belong to the category LTS characteristics, derived from the collected data, are represented in Figure 11. These labels and their properties characterize the Dutch aviation sector.

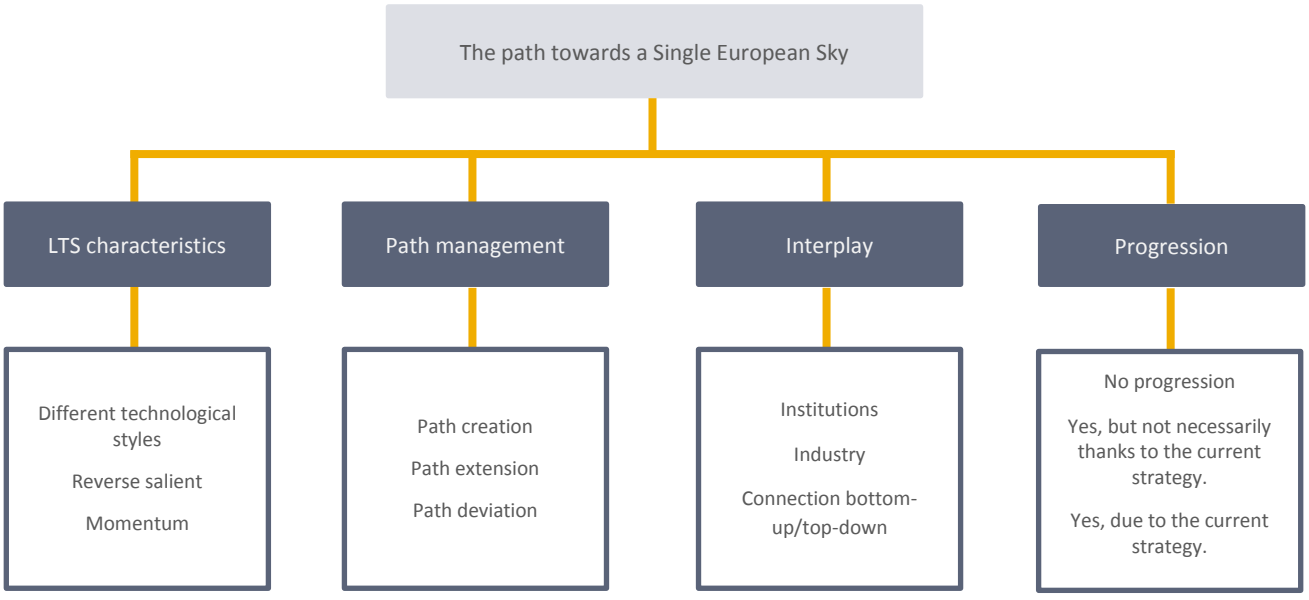

Figure 10 - Concepts explaining the creation of a path towards the Single European Sky

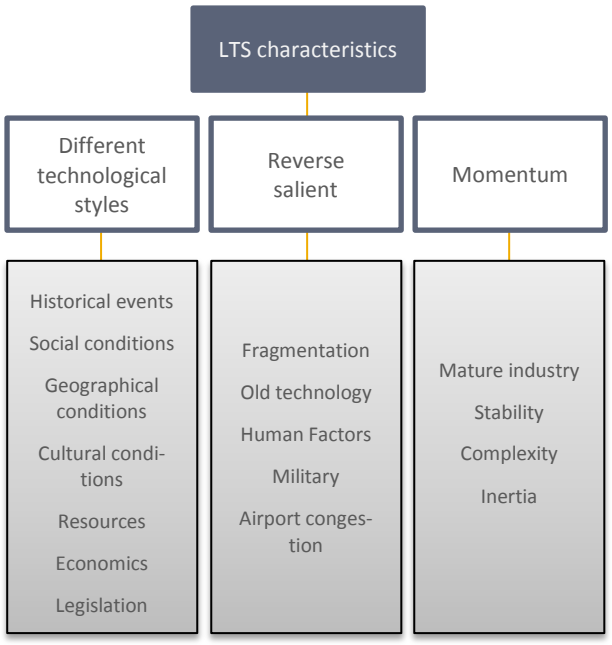

FIGURE 11 - LTS CHARACTERISTICS AND ITS PROPERTIES

5.1.1 DIFFERENT TECHNOLOGICAL STYLES

The fact that the aviation sector has a global infrastructure, requires that the different critical technical components[19] of the system need to be interoperable all over the world (EUROCONTROL, 2011). ICAO played an important role in ensuring global interoperability, through the provision of Standards And Recommended Practices (SARPs). However, there are still many technologies, procedures and processes of the LTS that are locally installed.

["It is true that there are local differences between the nations, concerning the way in which their airspace is structured, the way in which the ANSPs collaborate with the military, and their airport. […] Plus every nation has their own technical infrastructure, of different ages and made by different suppliers."]
interview #8, LVNL

The Dutch aviation sector is such a nation that is characterized by local circumstances.

["There have to be exceptions. For example, we don't have any mountains, while the circumstances in Austria and Norway are completely different in that regard. So I believe that we need the freedom to adjust to our local circumstances."]
interview #5, CANSO

These local circumstances differ between the nations involved in the SES project. The local circumstance lead to issues which require specific technologies, procedures and processes as a solution.

[19] Communication, navigation and surveillance systems.

Another reason that many technologies, procedures and processes get locally installed is because it allows for a fast solution to such an issue. Developing a solution that relies on a global standard is a slow process. It involves a lot of different complex interdependent system relations. In order to achieve global innovation, a consensus has to be reached first whereby each stakeholder has equal weight and is defending its own interests. A local solution for a local problem, therefore, offers a better alternative in these cases. These locally installed technologies, procedures and processes characterize a nation's technological style, i.e. the way air traffic is handled. During the data analysis it became obvious that the European LTS is characterized by the different technological styles per nation.

["Aviation is arranged per state."]
interview #16, MUAC

Based on the data I found that technological style is characterized by seven properties; *historical events, social conditions*, *geographical conditions*, *cultural conditions*, *resources*, *legislation* and *economics*. These properties influenced the evolving Dutch aviation sector in establishing a particular Dutch technological style. This section demonstrates how these properties were of influence. It also elaborates on how these different technological styles are influencing the Dutch aviation sector in their contribution in the SES project.

Historical events

Innovation evolves as a consequence of historical events as argued by the path dependency theory (David, 1997). This means that an event in the past, influences the opportunities one has in the future. For example, the decision to construct a military airport at the northeastern part of the Haarlemmermeer back in 1916 (Figure 12), allowed for the city of Amsterdam to see opportunities for the development of their city (van Eeten, 2000, p. 43). They expected the airport to act as a magnet for attracting firms and activities to Amsterdam (El Makhloufi & Kaal, 2011). That's why the Amsterdam municipality took over Schiphol in 1926 and started to invest in its future development (El Makhloufi & Kaal, 2011).

After the second World War the airport was rebuild and used for mail, freight and even passengers (Weits, 2012; Gordijn, et al., 2008). Around this point in time the status of Schiphol moved from a military to a civil airport (Sprangers, 2012). This historical event was, among other factors[20], also an enabler for the Dutch aviation sector to evolve in what it is today (El Makhloufi & Kaal, 2011). The status-shift to a civil airport enabled Schiphol to transform into an international airport, connecting the Netherlands with more than 260

[20] The relationships between Royal Dutch Airlines, Fokker, and Schiphol was of great importance for the development of commercial aviation in the Netherlands (El Makhloufi & Kaal, 2011).

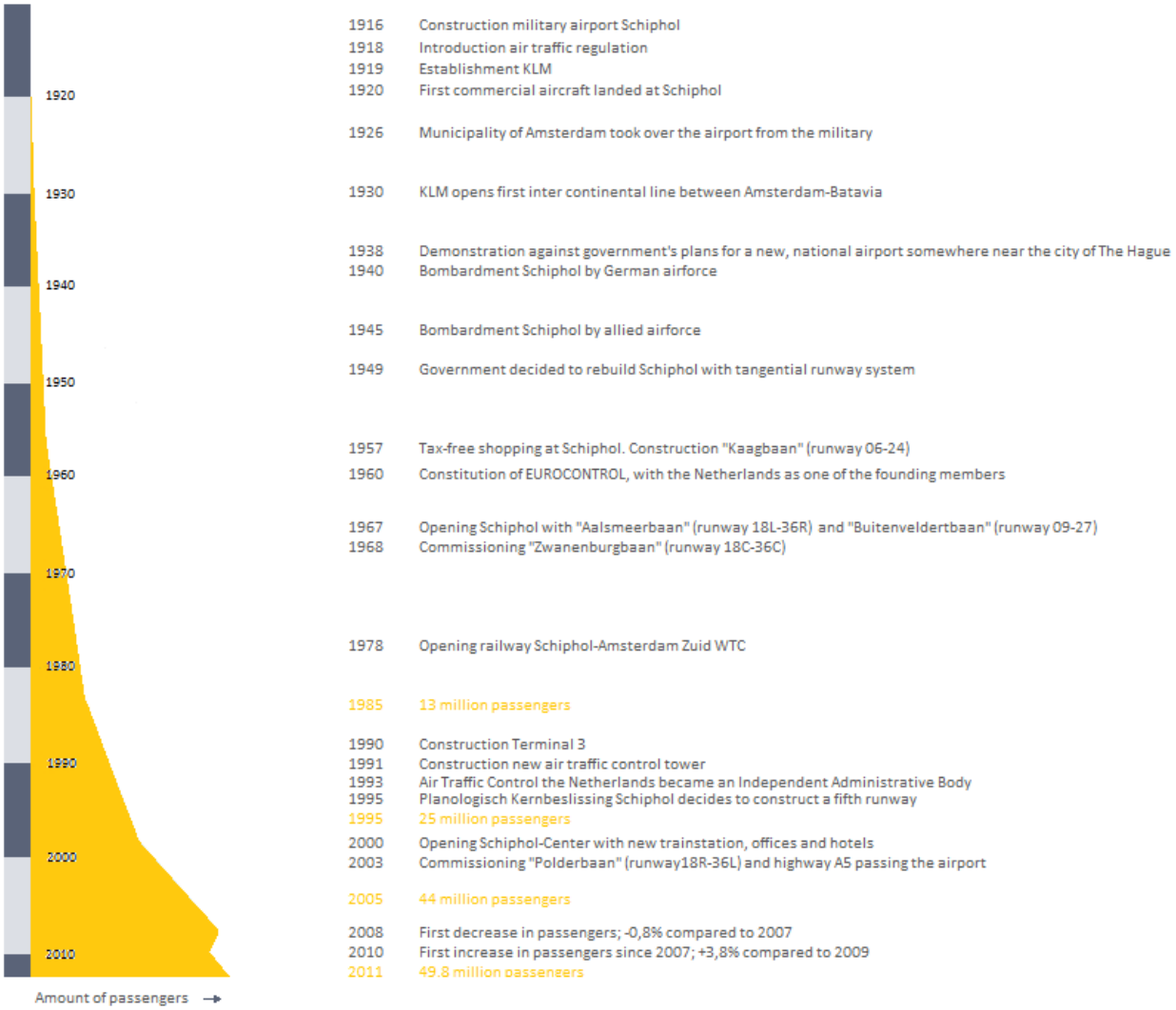

FIGURE 12 - EVOLUTION MAINPORT SCHIPHOL
SOURCE: (GORDIJN, ET AL., 2008)

destinations (WTC Schiphol Airport, 2012). Nowadays Schiphol is transporting approximately 48.9 million passengers a year (Schiphol Group, 2011).

Despite the international orientation of the Dutch aviation sector, airspace arrangements remained a national matter.

["Airspace is historically arranged, based on nations' territory."]
interview #6, LVNL

As these nations' territories differ, e.g. in size, differences in technological styles arose. The Netherlands is a small country and therefore has a small airspace. The increase in air traffic over the years resulted in significant changes in the organization, structure and use of Dutch airspace (Dutch government, 2011, p. 11). These were either incremental changes in the configuration and design of the airspace or by applying new technologies and operational concepts in air traffic control (Dutch government, 2011).

As the Dutch aviation sector evolved, the Dutch society evolved along with it. The evolution of the Dutch aviation sector brought benefits, such as prosperity and employment (Oxford Economics, 2011). But it also brought disadvantages, such as nuisance and environmental pollution to the Dutch society (Berglund, et al., 1999; Morrell & Lu, 2000). And as the Netherlands became a densely populated nation (Centraal Bureau voor Statistiek, 2012), and Schiphol grew into a major hub-airport[21], social conditions gained in importance.

Social conditions

The residents and environmentalists increasingly started to complain about these disadvantages. Action groups arose in an attempt to influence policy. This influenced the Dutch technological style, as these growth related issues put intense pressure on available capacity at mainport Schiphol

[21] Hub-airport is defined as any airport that contains transferring passengers and originating passengers (Virta, et al., 2002).

(van Eeten, 2000). Their voice gained in importance. Since the 1980s, the Dutch government not only had to take in account the economic benefits coming with the growth of Schiphol airport, but also the environmental impact of a growing Schiphol emphasized by those action groups. The action groups forced the government to recognize the nuisance and environmental drawbacks of a growing Schiphol (van Eeten, 2000). This made it more difficult for Schiphol airport to grow and develop, as additional interests were forced to be taken into account.

Geographical conditions

Then there are also geographical conditions shaping the Dutch technological style. Both the geographical conditions on the ground and in the air have an influence. Weather conditions, residential density and the location of mainport Schiphol are geographical ground conditions that influence the Dutch technological style.

Schiphol has to cope with adverse wind conditions due to its location near the sea (Knowledge for Climate, 2012). As a result of these adverse wind conditions Schiphol's runway system is arranged in a complex way (Figure 13).

FIGURE 13 - RUNWAY SYSTEM SCHIPHOL AIRPORT
SOURCE: (SCHIPHOL GROUP, 2012)

Wherever the wind is coming from, there is always a runway that enables air traffic to start and land.

Another issue the Dutch aviation sector has to cope with is, a high residential density around mainport Schiphol. This emphasizes the importance of safety in ATC procedures and processes, as aircraft are arriving and departing over residential areas (ANP, 2009).

["The Netherlands and the entire West of Europe is densely populated, this is the area where most air traffic takes place. So I assume that safety is of increased importance in that area."]
interview #17, TUD

Mainport Schiphol is a large hub-airport in a small country. This means only a small percentage of the passengers have the Netherlands as their start- or final destination. The majority of the passengers are transfer passengers, travelling via Schiphol to their next/final destination. The Dutch aviation sector got arranged in such a way that it supports Schiphol in their hub-business. The Dutch aviation sector aims to attract passengers from Europe towards Amsterdam Schiphol airport, to send them via Schiphol towards their destination. This caused the inbound and outbound waves at Schiphol airport, which is a characteristic of the Dutch technological style.

["…we have to find ways to get passengers from all over Europe to travel via Amsterdam towards their destination. We do that by means of in- and outbound waves."]
interview #9, LVNL

Schiphol airport is characterized by a particular pattern of arriving (inbound) and departing (outbound) air traffic, caused by the business strategy of KLM[22] (Boelens, 2009). Schiphol airport facilitates seven peaks, i.e. waves, a day which last 1,5-2 hours. These are synchronized with the arrival and departure schedules of the passengers travelling via Schiphol[23].

The fact that the Netherlands is a small country inherently means that they have little airspace available. Due to the important hub-function of mainport Schiphol, the densely populated areas and the little airspace available, the Netherlands grew into a particular technological style. With 6 runways available LVNL operates with three runways during the day and two at night. Depending on the inbound or outbound peaks, LVNL uses either two runways to arrive and one to depart, or two runways to depart and one to arrive (LVNL, sd). LVNL aims to provide a continuous throughput of air traffic from and to Schiphol airport. When demand for runway capacity exceeds the throughput capacity LVNL starts using stacks (Bubalo, 2011). However, this is not preferable as using stacks has a negative impact on noise concentration and the environment (Fairbanks, et al., 2008). This procedure

[22] The hub-and-spoke strategy whereby KLM connects cities via Schiphol, where a direct connection between these cities would not be profitable (KLM-Air France, 2012).
[23] First passengers from outside Europe will arrive early in the morning during an inbound wave. This wave is followed by an outbound wave transferring these passengers to their next/final destination within Europe. Then European flights arrive (in a following inbound wave), followed by an outbound wave transferring passenger outside Europe (KLM-Air France, 2012).

is a characteristic of the Dutch technological style. This procedure differs from the style executed at London Heathrow. London Heathrow air traffic controllers use stacks to create a maximum runway capacity. They do that because they only have two runways available and this allows them to achieve a maximum runway throughput. These geographical differences between nations cause differences in technological styles.

Cultural conditions

Cultural conditions can be described as the conditions that led to a collective programming of the human mind that distinguishes the members of one human group of another (Wagner, 2008). The Netherlands distinguishes itself from other nations by the Dutch traders mentality (Osinga, 2012; Peerlings & Gardebroek, 2009, p. 48). This mentality shaped KLM in taking a hub-and-spoke strategy, and Schiphol facilitating that strategy. Due to these strategies mainport Schiphol is nowadays used as one of the international gateways to international trade (Uw magazine, 2011). This is why mainport Schiphol became important for the Dutch, because it connects the Netherlands with the rest of the world (Nsecure Safety & Security, 2011; Roland Berger Strategy Consultants, 2007, pp. 8-9)

["… we do have huge interests, because we want to secure the position of mainport Schiphol in Europe."]
interview #14, Ministry of Infrastructure and Environment

However, the Dutch are also known as people who complain a lot (Hoetmer, 2006). This also shaped the technological style of the Dutch aviation sector. Residents and environmentalists influenced the creation of the departure and arrival routes (as explained earlier in this section concerning the social conditions).

Resources

Another aspect shaping the technological style is resources. Aviation related developments require large financial resources. Accordingly, the Dutch technological style is characterized by the mentality that if it's possible to continue the operation, in an economically viable- and safe way, with the existing technologies, they will do that.

["If you can continue to fly with the old systems into place, then one will do so, because certifying a new system really costs a lot of money."]
interview #2, LVNL

Economics

The second last property, economics appears to continuously influences the Dutch aviation sector. The slightest changes in the economy can have a big impact on the entire Dutch aviation sector (Qfinance, sd).

However, the Dutch aviation sector is also influencing the nations' economy. Mainport Schiphol is important for the Netherlands because it's a major driver of the Dutch economy. It provides jobs, links the Netherlands to the rest of the world, and it allows many companies to profit from the business activities at mainport Schiphol (Government of the Netherlands, sd).

On the other hand, the current economic situation makes it very difficult for the airlines to earn profits. As the Dutch aviation sector consists of many interdependencies, e.g. KLM and mainport Schiphol, the entire Dutch aviation sector is sensitive to economic changes (Southern Limits, 2012).

["The sale of an extra one or two seats can mean the difference between breaking even and a loss."]
Andrew McKay, Southern Limits

Small profits are gained in this industry, and with the current economic downturn in the Netherlands the demand for air traffic decreased accordingly (Kotoky & Leung, 2011; Dutch government, 2009; Travel Management Priorities for 2012, 2012). However, there are some differences between countries in how profitable the industry is, because the way they handle their business is highly dependent on the nation's economic situation.

["… the aviation sector fluctuates along with the economy."]
interview #4, LVNL

Despite the economic downturn, Schiphol airport's network portfolio was hardly affected by the economic crises in 2008 and 2009 (Airneth, 2009). However, Schiphol did had to cope with a decrease in passengers in 2008 and 2009 (Figure 12). In general it was found that hubs have broadly suffered less than point-to-point airports during that period (Allen & Overy, sd).

Legislation

The last property, legislation differs per nation, because each nation has its local circumstances to which it has to adapt in order to safely operate. These regulations are influenced by the nations' social conditions, - geography and - cultural conditions. The existing regulations make it more difficult to create the path towards the SES, because it protects the nations' interests[24] and therefore keeps the differences intact.

["I think a lot of changes have to be made in the current legislation. For example, in the USA they have one airspace and less ANSPs guiding air traffic. That is possible because they have one airspace and one law."]
interview #2, LVNL

[24] Maintaining the hub-position of Schiphol airport, enabling a better performance within the environmental and safety limits (Dutch government, 2012).

["Because the national interests are recorded in legislation it is not easy to change the airspace arrangement."]
interview #6, LVNL

According to the data obtained, the differences in technological styles will always continue to exist.

["The basic SES regulations will be the same, but per airport, nation, or area there will remain differences that emphasize the use of unique procedures or techniques."]
interview #10, NLR

Inherent to the different technological styles between nations is that different trade-offs were made based on their local circumstances.

["The differences between nations result in different priorities."]
interview #11, NLR

To conclude this section it is argued that all these properties caused the Dutch technological style to differ from e.g. the English, French or Italian aviation sector. These differences in technological styles can cause difficulties in reaching a consensus regarding the development strategies, between the participating organizations in the SES project. This consensus-seeking slows the process of realizing a SES down, as multiple organizations are looking after their own interests.

["…the fact that we'd like to optimize across the border of our nation with the Germans, made us notice that the Germans are still focused at achieving an optimal situation in their own operational area."]
interview #8, LVNL

Every nation stands behind their technological style. In SES context this hampers decision-making, because every nation starts to defend their technological style, despite the fact that they are aware that their way of doing things is not necessarily the most optimum way.

["… the British know that their technological style is not the best way to manage air traffic in the future […] but if they would say that out loud, you're suggesting that you're the party that needs to spend money and energy in adjusting your technological style, and that's not the message you would like to give."]
interview #14, Ministry of Infrastructure and Environment

5.1.2 Reverse salient

In order to identify a possible reverse salient we need to look at both the Dutch- as well as the European aviation sector. Reverse salients in the Dutch aviation sector do not trigger a project like SES to arise, as these only create a sense of urgency among the Dutch stakeholders. Reverse salients in the European sector, on the other hand, do trigger the start of a project like SES. While the Dutch reverse salients only concern the Dutch stakeholders, the European reverse salients concern the entire European aviation sector. Therefore only European reverse salients can trigger a project like SES to arise.

As explained in section 1.1 and shown in Figure 6, SES got triggered by a fragmented European ATM system, which performance couldn't keep up with the expected demand in air traffic (Mihetec, et al., 2011; EUROCONTROL, sd). In addition, the costs that come with the fragmentation of the European ATM system is estimated at €4 billion euro's per year (European Commission, 2012). This also triggered the constitution of the SES project.

The data showed that the current European aviation sector is still known to be *fragmented*. It often operates with *old technologies*, its operation is still dependent on *human factors*, and the Dutch airspace is divided between *military* airspace and civil airspace. These are perceived to be the critical problems, i.e. reverse salients (Figure 11), in achieving the sector goals (as presented in section 0) (SESAR Joint Undertaking, 2012).

This section explains how these reverse salients are hampering the LTS from reaching an optimal performance level. It also explains how these properties are driving the organizations to create a path towards the SES.

Fragmentation

A fragmented European ATM system is caused by the fact that arranging airspace is one of those aspects of the aviation system that has always been the state's responsibility (Dutch government, 2011).

["All nations sub-optimally developed their own airspace, that was considered as normal in Europe and the rest of the world."]
interview #14, Ministry of Infrastructure and Environment

It was considered as normal to locally develop the technologies, processes and procedures of the aviation sector (The Associated Press, 2010). These historical events led to a European system with 27 fragmented airspaces, 60 air traffic control centers and hundreds of approach control centers. While the United States is capable of handling twice the amount of flights for a similar cost using only about 20 air traffic centers (The Associated Press, 2010). Fragmentation makes flying across Europe less efficient than it could be, which has its effect on the capacity of the European ATM system (Dutch Government, sd).

["The system is not operating efficiently. It is too fragmented."]
interview #10, NLR

["Capacity is going to be a problem in Europe that needs to be solved. But especially the costs of flying through Europe are too high if you compare it with nations outside Europe."]
interview #12, KLM

Military

Another reverse salient is the fragmentation within the Dutch airspace arrangement. Parts of the Dutch airspace are assigned to the military for their operations.

["In many countries military airspace can hardly be used for civil aviation. And in some countries a significant part of the airspace is assigned to the military, so that's also a constraining factor for the European aviation industry to grow."]
interview #6, LVNL

["From an air navigation service providers' point of view, the division in national airspace between military and civil can be seen as the bottleneck."]
interview #8, LVNL

In the European core area, which includes the Netherlands, 32% of the airspace volume above flight level 195[25] is shared airspace between the civil and the military airspace users (EUROCONTROL, 2007). In low-level airspace in the Netherlands there is a current division of 4 civilian and 6 military airspace zones (Ministry of Defense, 2012).

An example of the consequences caused by a fragmented, European ATM system, and the lack of flexibility between military and civilian aviation for an airspace user flying from Rome to Amsterdam.

FIGURE 14 - EXAMPLE OF THE REVERSE SALIENTS
SOURCE: DFS

This division in airspace causes inefficiencies for the civil operations[26], as civil airspace users and air traffic controllers need to take these airspaces into account during their operations (Figure 14). Air traffic controllers have less room to handle air traffic, which creates capacity limitations. And these military airspaces, prevent the civil airlines to efficiently fly to their final destination, because they have to navigate around the military airspaces.

Old technology

As ATC has always been the states´ responsibility, the ANSPs also developed their own operational systems, as did all the other ANSPs. ANSPs slowly moved from in-house development to wider, international industry, based developments. However, this process is still going on, and progressing slowly. Part of the reason is the importance of safety. In order to ensure the safety level, ANSPs make sure that the new technology can still operate with the input of the old technology (SJU, 2012). This hampers revolutionary innovation. Another reason is the mentality that if one can operate with the old system, procedures and processes, there is no need to replace it. In order for the ANSPs to invest in new technologies a reverse salient is needed. Otherwise, they'll continue to choose reparation of the system over installing a new one, as this is financially more attractive.

["ANSPs tend to run their systems and computers until they are confronted with not being able to buy spare parts on the second hand market, nor finding anybody willing to invest time/money in making spare parts for outdated technologies."]
interview #3, LVNL

This is why the (Dutch) aviation industry is relying on old technologies, procedures and processes. These old technologies are hampering the LTS to achieve the required performance levels regarding the KPAs.

["Traffic growth cannot be sustained using 1940s technologies to deliver the services that we need."]
Executive Director, SJU[27]

As mentioned earlier safety plays a role in the fact that the aviation sector is still operating with old technologies. There are newer technologies on the market, but these can only be applied once they've been proven to be safe. That's why not only the ground systems are characterized by old technologies, but also the aircraft are equipped with old technologies.

["The computers in the cockpit are much older than the devices I have at home. These devices are more capable and

[25] Approximately 6 kilometers.

[26] Military need to give permission to the civil branch of the aviation sector to use their airspace. However, there are some exceptions, because some military areas are only being used between a certain time. Outside that range civil airspace users are automatically allowed to make use of those areas. In those cases permission of the military isn't necessary. Another exception is when a civil airspace user is planning to land on Eindhoven airport. The Eindhoven airspace, surrounding Eindhoven airport is assigned to the military. This means the military ANSP will provide the air navigation service in that area. No permission is needed here either, because that is given when the filed flight plan gets approved.

[27] Audio recording Knowledge Development Centre (KDC) Event November 16th 2010.

faster. The only thing is they are less reliable. And this reliability needs to be demonstrated in practice in order for the new devices to get installed."]
interview #14, Ministry of Infrastructure and Environment

In other words, new technologies enable a better performance of the aviation sector. Only, the fact that phasing out technologies is a long process in the aviation sector, makes that these old technologies are still in place. As said before, developments in the aviation sector require huge investments. For example, the operating system of LVNL required an enormous investment to get installed. Then there were also the additional investments to adjust the system to the user's needs throughout the years. Because of these huge investments, LVNL wants to keep working with this system as long as possible. But as soon as these old technologies prevent the system from reaching a better performance they become a reverse salient.

["What you hope for, is a situation in which the system is operating to its limits, and can't grow any further with the existing technology while new technology enables the system to grow."]
interview #3, LVNL

Human factors

As a consequence, a lot of ATC tasks aren't automated yet. Besides separating air traffic, an air traffic controller has several other tasks, e.g. providing the pilot with weather information, which runway is in use. These tasks can be automated. Automating some tasks of an air traffic controller will lay the foundation to increase the capacity, as the workload of the air traffic controller is reduced (Erzberger & Paeilli, 2002; Tobaruela, et al., 2012; Honeywell, 2012). The LTS is therefore still subject to human factors (Shorrock & Kirwan, 2002). The good thing about this is that in case of an emergency the air traffic controller can deviate from its standard procedures.

["ATC is a cognitively complex job to fulfill, because there is little support in the sense that air traffic controllers are free to develop their own strategy in their daily operations."]
interview #17, TUD

However, a negative aspect is that accidents have occurred in the past which were characterized by human errors[28] (Shorrock & Kirwan, 2002). Approximately 60% of the aviation accidents were directly related to human factors in the 2000s (PlaneCrashInfo.com, 2010). The aviation sector is a socio-technical network, which makes it impossible to completely rule out the human error (Cacciabue & Vella, 2010). However, automation might assist the humans in preventing them from making fatal decisions (Boeing, 2008).

Airport congestion

Finally, it needs to be mentioned here that it is still expected that airport congestion will start to become a reverse salient as well. By 2030 congestion at the European airports will result in delays for 50% of all flights (European Commission, 2011). At mainport Schiphol it is expected that demand exceeds supply by 67.5% in 2025 (de Wit & Burghouwt, 2007).

To sum up, there are a couple of critical problems in the current LTS, which are hampering the aviation sector in reaching an optimum performance. These are the fragmentation in airspace across Europe, the use of old technologies, the division between military and civil airspace in the Netherlands, human factor, and in the future airport congestion might also become a reverse salient in the near future. This results in a European aviation system that suffers from inefficiencies, different technological styles, too many ANSPs, old technologies and thus higher costs (danubefab, 2012; AINonline, 2012).

Accordingly, the aviation sector aims to solve these reverse salients by means of the SES project. The European aviation sector has set goals, i.e. the Key Performance Areas (KPAs). Furthermore, the European aviation sector expects defragmentation to create a more efficient system.

Reverse salients should trigger the aviation sector to resolve them. However, there are several aspects in this case that are preventing the reverse salients to have an effect on the aviation sector.

First, whether the reverse salients are perceived as such, depends on the perceived sense of urgency. In order to be perceived as urgent the reverse salient needs to jeopardize the organizations' business model. However, according to the interviewees there is still room to grow within the current LTS.

["At this very moment, I don't think the Dutch aviation sector would be able to handle more air traffic if our airspace would be arranged differently. Or if we were better connected to our neighbors. In the future the demand for capacity will exceed the supply, but for now it's only less efficient than it could be."]
interview #11, NLR

It appears that capacity is the crucial factor in creating a sense of urgency. The system still allows for an increase in capacity for the time being, a sense of urgency among the industry to collectively tackle this reverse salient is therefore missing (Paylor, 2012).

[28] A tragic example includes the 1977 Tenerife runway collision of the Pan AM Boeing 747 and the KLM Boeing 747, which killed 583 people (Shorrock & Kirwan, 2002).

["Not reaching the capacity limits has an effect on the ANSPs, airports and EUROCONTROL, which accordingly say that there's no rush in moving that border."]
interview #12, KLM

However, airlines and EUROCONTROL do expect that capacity growth will be hampered in the near future when the demand for air traffic exceeds their load factor (as explained in section 2.1).

["The load factor has never been as high as it is now, most airlines are over 80%."]
interview #18, EUROCONTROL

Second, the fact that available airspace became scarce makes it more difficult to implement changes in this system (Figure 15).

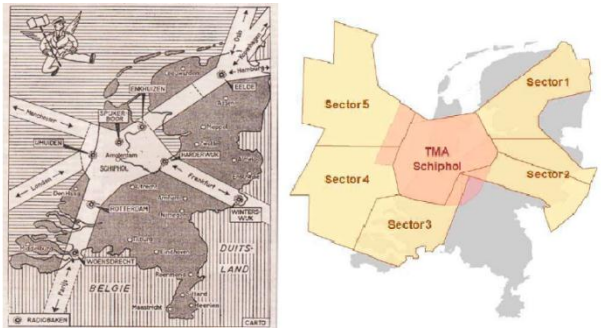

FIGURE 15- AIRSPACE ARRANGEMENT IN THE 1950S AND 2011 SOURCE: (DUTCH GOVERNMENT, 2011)

["Throughout the years airspace became more scarce, which made it even more difficult to change things."]
interview #6, LVNL

This figure shows that the sector areas became wider over the past 60 years. The grey areas on the right figure are assigned to the military for their practices (Dutch government, 2011). In other words, there is no free airspace left in the Netherlands.

And third, resolving these reverse salients requires a lot of financial investments. Just like many developments in the aviation sector. Solving these reverse salients require the entire European aviation sector to cooperate, and make investments at the same time. And if an organizations recently invested in a local technology, they first need to earn that investment back before they are able to invest again (Brooker, 2009). Otherwise, they run the risk of jeopardizing their business. And they are not willing to take that risk.

["There is absolutely no incentive to commit suicide for the Single European Sky."]
CEO, LVNL

So the difficulty lies in the fact that every industry organization continuously makes investments to ensure their operations. This makes it is very difficult to get a situation in which every industry organization is both able to cooperate and invest.

5.1.3 MOMENTUM

The last category under the LTS characteristics is momentum (Figure 10). To measure whether the European aviation sector, and therefore also the Dutch aviation sector, has acquired momentum, both quantitative and qualitative data are collected. An overview of the quantitative data gathered, by means of 18 interviews, and is presented in Table 3[29].

This section explains to what extent the LTS has acquired momentum, and how this influences the organizations in creating a path towards the realization of the SES.

It was stated that an indicator was perceived to be present if it would have an average score of 3.0 or higher (as explained in section 4.2.1). Table 3 indicates that, in terms of stability, the current aviation sector scores a 4.2 on a scale of 5. In terms of how difficult it is to implement changes in the aviation sector (i.e. inertia), a 4.1. With a 4.3 on a scale of 5 the aviation sector is perceived as complex, and depending on the situation, changes, once under way are difficult to stop or reverse, because it scores a 3.3 on a scale of 5.

This data was gathered to indicate whether the aviation sector has acquired momentum. If it would have a total average score of 3.5 or higher on the 5-point Likert Scale, and three out of the four indicators appeared to be present it is safe to conclude that the aviation sector has reached momentum (as explained in section 4.2.1).

The interviewees perceptions are used to indicate whether the LTS has acquired momentum. Table 3 provides an overview of these perceptions. It shows a total average of 4.0, which thus indicates that the aviation sector, as we are familiar with today, has acquired momentum.

Mature industry

The qualitative data also indicates that the Dutch aviation sector we are familiar with today is a stable, inert and complex system that is perceived as a mature industry.

["The aviation sector is a very mature industry, which means everything is connected, arranged and regulated."]
interview #3, LVNL

A mature industry may be defined as an industry that has passed both the emerging and the growth phases of industry growth. Earnings and sales grow slower in mature industries than in growth and emerging industries (Castagnera, 2010). In this mature industry developments, once under way, are difficult to reverse.

[29] Results are based on a 5-point Likert-Scale.

Stability

It is mentioned during the interviews that the stability of the LTS is dependent on human factors, weather and the economics.

["... if an ANSP goes on strike, the entire European air traffic will be influenced."]
interview #1, LVNL

["If you leave out the weather influences I think the aviation sector is a stable system."]
interview #10, NLR

["If you include economic influences the system becomes less balanced."]
interview #17, TUD

The stability of the system is part of the reason why revolutionary innovation is difficult to achieve, as changes in the aviation sector take time (Sinclair & McManners, 2012).

["The whole cycle of achieving a major change in what we do is extraordinary long in aviation. [..] The system is reliable and works well, but to believe that we can change something overnight is an illusion."]
interview #18, EUROCONTROL

Reasons for this long time horizon are the high investments required to implement changes, but also the acquired stability of the LTS. The aviation sector likes to maintain at least the same stable performance level, which makes that they set high demands for new developments. There is no discipline that sets higher demands regarding safety, sustainability and quality than the aviation sector (TU Delft, 2004).

Another important indicator of a stable system is the fact that the aviation sector managed to achieve and maintain an enviable stable safety record (Helmreich, 2000; Shorrock & Kirwan, 2002) (Figure 16).

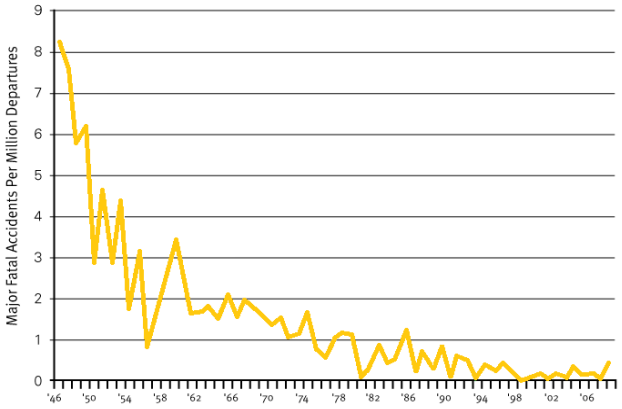

FIGURE 16 - MAJOR ACCIDENT RATES SINCE 1946
SOURCE: FAA, 1946-2008

This safety level is also an indicator of a stable system, as it appears to level of at close to zero major fatal accidents per million departures. Safety is a number one concern in the aviation sector (Wytkind, 1997).

Complexity

The complexity of the aviation sector negatively influences the ease with which changes are realized (Lambe, 2006).

["The system itself, the operation, is to a great extent dependent on how things are related. This characteristic is also linked to the complexity to change."]
interview #10, NLR

It is expected that the complexity of the system is going to increase over time. This is because the industry aims for harmonization, which will create even more dependencies. These dependencies make it more difficult to implement changes in the system, i.e. it makes the system inert to change (Oreizy, et al., 1998). Because an ANSP, airport, airline or aircraft manufacturers can't achieve changes on their own anymore, they need each other to work with them as they are interdependent on each other.

TABLE 3 - QUANTITATIVE DATA INDICATING WHETHER THE AVIATION SECTOR HAS REACHED MOMENTUM.

Interview:	1	2	3	4	5	6	7	8	9	10		11	12	13	14		15	16	17	18	Average:
Stability	3	4.5	4	2	5	4.5	4	5	4	5	5	4	4	4	4	4	5	4	5	*	4.5	4	4.2
Inertia	4	4.5	5	4	*	4	4	5	3	5	4	4	4	4	4	4	3	3	4	*	5	4	4.1
Complex	5	5	4	4	4	4	4	5	3	4	4	4	4	4	4	5	4	5	5	*	5	5	4.3
Difficult to reverse changes once under way	5	1	1	3	*	*	1	*	4.5	2	4	4	5	3	2	4	4	5	4	*	3	4	3.3**
																			Total average:				4.0

* Interviewee didn't have an answer, or couldn't give an answer because there were too many exceptions to the rule to generalize it with a number on a 5-point Likert Scale.
** Variance is 1.92.

["I think that to accomplish changes the industry needs a large integral European plan. *Because of the dependencies between the organizations?* Yes, because of the complexity, internationally."]
interview #17, TUD

And achieving that is difficult, as explained in the previous section.

["We'd like to take it one step further to deployment, but sometimes that is difficult, because others have a different deployment roadmap in mind than we do."]
interview #15, MUAC

Inertia

The importance of safety, combined with the aviation sector's complexity, is a reason that revolutionary innovation is difficult, i.e. that the aviation sector appears to be an inert LTS. Safety is a factor that will not be jeopardized when changing technologies, procedures and processes.

["New technologies, procedures and processes must be developed in such a way that at no point in time the safety of the sector is compromised."]
interview #3, LVNL

["The aviation sector is difficult to change, because safety has a high priority. So organizations rely on what works.]
interview #4, LVNL

However, it is perceived that the willingness to change is increasing in the aviation sector.

["I notice that there is a growing willingness to change and innovate within the aviation sector."]
interview #5, CANSO

Willingness to change is fundamental to overcome inertia, as this creates the tension to move through the change process rather quickly. However, individuals differ in their ability and willingness to change (Darling, 1993). The failure of many large-scale change programs results from unwillingness to change (Bovey & Hede, 2001).

To conclude this section, it can be said that it is perceived that the European aviation sector, has acquired momentum. This hampers the process to create a path towards the SES. The complexity of the aviation sector is a direct consequence of the existing interdependencies, which is a characteristic of a mature system. These dependencies require the involvement of all stakeholders to achieve SES. Involvement of all stakeholders slows the innovation process down, as innovation requires unanimous willingness to change, which is difficult to achieve since willingness to change differs per individual.

5.2 Path management

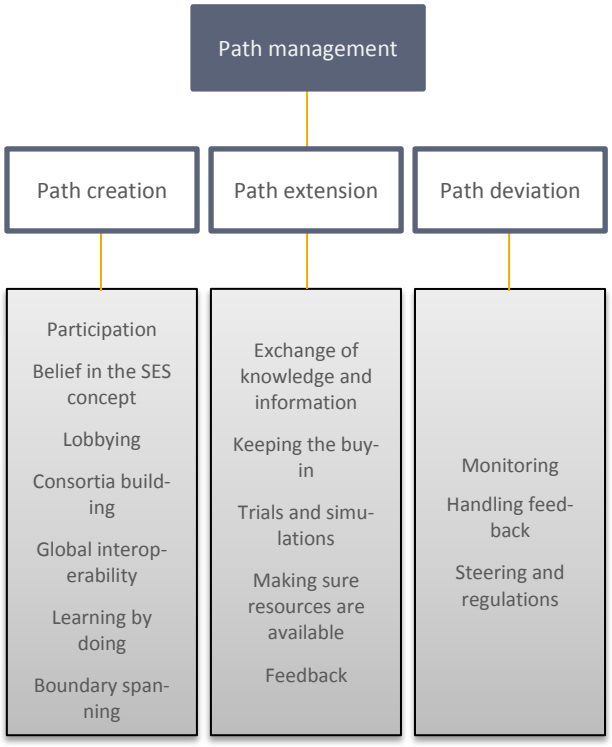

Figure 17 - Path management concepts and its properties

The path management activities and properties of importance are presented in Figure 17. This section focuses on these activities and has included the most recurrent path management activities (Appendix VI – Code system).

This section elaborates on these path management activities and explains for what reasons they are carried out. And how the industry and the institutions are being influenced by the LTS characteristics in carrying those activities out.

5.2.1 Path creation

The institutions started to create a path towards the realization of the SES, triggered by the reverse salients (European Communities, 2001). Path creation is all about getting the SES project off the ground. The data indicates that the concept of path creation is characterized by the following activities *participation*, *belief in the SES concept*, *lobbying*, *consortia building*, *ensuring global interoperability, learning by doing* and *boundary spanning* (Figure 17).

The first SES initiative came forth from EUROCONTROL. This SES initiative was transformed to a legal framework in 2004.

["A reason for transforming this initiative into a legal framework, was to be able to use the European Union (EU) mechanism, where you could actually force through laws and regulations and legislation states to comply, rather than the traditional EUROCONTROL model, which was to have them volun-

tarily commit."]
interview #18, EUROCONTROL

Accordingly, the European aviation sector took off in what they called the definition phase of the SESAR program. Within this definition phase the European industry organizations proposed a plan to work towards a new European ATM system which could cope with the forthcoming demands. This resulted in the SESAR program consisting of six main deliverables[30], which cover all aspects of the technological trajectory towards the future European ATM system. Deliverable 1 (D1) covers the market, D2 the market requirements, D3 the top product, D4 how to build it, D5 the action plan and D6 covers the execution of the action plan.

D5, the action plan, is called the ATM Master Plan. The ATM Master Plan was accepted by the EC as the agreed roadmap towards the realization of the SES. The ATM Master Plan became the foundation of the SESAR program. The ATM Master Plan outlines the essential operational and technological changes that need to be implemented to achieve the SES (SESAR, 2012). The ATM Master Plan is divided into 16 Work Packages (WPs). These WPs cover themes, such as airport operations (WP 6) or aircraft systems (WP 9) (SESAR Joint Undertaking, sd). WPs are divided into 325 projects, which focus on a particular subject within the theme of the WP (SESAR Joint Undertaking, sd; SESAR, 2012). Each WP has an assigned leader, which either is an ANSP, an institution, an aircraft manufacturer, or an ATM system supplier.

To manage these WPs and projects during the definition phase, the institutions constituted an organization called the SJU in 2007. The SJU attempts to keep the industry organizations focused at the ATM master plan by means of promotions and management. In other words, in order to get the SES project off the ground participation of the European aviation sector is required (CAPA Centre for Aviation, 2011).

Participation

To ensure participation, the European aviation sector had the opportunity to become a member of the SJU. A member has the privilege to influence the projects selected by them. They do that by contributing to the WPs by providing their expertise (SESAR Joint Undertaking, 2012). Fifteen European industry organizations signed a membership agreement with the SJU. AAS became a member as part of SESAR European Airports Consortium (SEAC)[31]. In 2010 another 13 European industry organizations joined the SJU as associate partner. An associate partner is an organization supporting a member with its SESAR related responsibilities. It is a prerequisite that the associate partner and the member are the same kind of organizations. So an ANSP can only have an ANSP as an associate partner, and an aircraft manufacturer can only have another aircraft manufacturer as an associate partner.

Finally there is also a possibility to participate as a subcontractor. A subcontractor is also an organization that supports a member or an associate partner with its SESAR related responsibilities. Only subcontractors do not necessarily have to be similar organizations as their members of associate partners. For example, the NLR, which is a research institute, is a subcontractor of AAS, which is an airport.

Initially the Dutch aviation sector remained hesitant in their participation, because of the financial contributions and in-kind contributions that were inherent to a membership of the SJU. In-kind contributions are non-cash inputs which can be given a cash value.

No Dutch industry organization became a prominent SJU member. However, sooner or later the Dutch industry organizations started to participate. MUAC started to provide their expertise to several of the SESAR projects.

["Several work packages have been defined, and there are a total of approximately 300 projects. And we've selected approximately 30 of those projects to which we contribute here in Maastricht."]
interview #16, MUAC

LVNL, combined with the NLR, joined as an associate partner of a member.

KLM has limited influence in the SESAR program. Institutions initially thought that it was more important to have the commitment of the ANSPs, airports and aircraft manufacturers. This is why the KLM and other airlines, only have the opportunity to contribute as a subcontractor.

["The institutions became aware that it isn't realistic that the airlines have such a limited influence in SESAR. However, research indicated that of the 30 billion euros, 20 billion needs to be invested by the airlines."]
interview #12, KLM

NLR also became an associate partner of the SJU, together with DLR. Another associate partner of the SJU is the ACSES consortium, where TUD is a part of (SESAR Joint Undertaking, 2012).

KNMI participates as a subcontractor of EUROCONTROL within EUMETNET Consortium. Their participation is required as weather has a critical impact on the performance of the future ATM system (SESAR Joined Undertaking, 2012).

[30] The names of the deliverables are; D1 – Air Transport Framework, D2 – The Performance Target, - D3 – The ATM Target Concept, D4 – The ATM Deployment Sequence, D5 – The SESAR Master Plan, and D6 – The Work Programme for 2008-2013 (Civil Aviation Authority, sd).

[31] SEAC includes Paris' airports, Schiphol airport, München airport, Frankfurt airport, Zurich airport, and Londons' airports.

The Dutch industry organizations participated for a variety of reasons. Organizations participate, because the developments coming from SESAR are in line with their own, because SESAR offers financial benefits[32] (SESAR Joint Undertaking, 2012), and because they want to have an influence on the future developments.

["There is a demand for fixed arrival routes in the Netherlands. This is in line with the SES ideas. So if we are contributing, we better pick something that contributes to our organizational vision."]
interview #1, LVNL

["If we participate in SESAR, we'll receive financial compensation for our activities."]
interview #1, LVNL

["You want to have an influence on those future developments."]
interview #2, LVNL

However, most of the participants participate because the SESAR developments affect their businesses and they want to ensure their own interests.

["SESAR developments can influence our operation. That's why it's so important for us to participate."]
interview #13, Ministry of Defense

Furthermore, some industry organizations only participated because of the pressure of other industry organizations. For example, when the Dutch aviation sector had the opportunity to become a member of the SJU, only Schiphol airport became a member as part of SEAC. This was perceived as an unwanted development by the Dutch aviation sector, as the European aviation sector started to focus its attention and subsidies on SESAR. By not participating the Dutch aviation sector was missing out on these subsidies and employment.

["If you would consider SESAR to be a financial construction, we didn't make a smart decision by not becoming a member of the SJU."]
interview #3, LVNL

["Not being involved in SESAR is not smart."]
interview #12, KLM

Accordingly, the NLR started to lobby for support to participate from the Dutch government. As a result the Dutch government strongly recommended LVNL to become an associate partner.

["There were times that we didn't want to have any part in SESAR, and that's where top-down pressure played a role."]
interview #1, LVNL

Accordingly, the Dutch aviation sector doesn't have a big influence onto the SESAR processes, as there is not prominent Dutch member of the SJU. The members of the SJU have a much bigger influence, than the associate partners and subcontractors.

["We are bothered by the fact that the Netherlands isn't a significant player. […] We see that the members have a lot of influence. […] There is no prominent Dutch member."]
interview #10, NLR

Belief in the SES concept

A property that indicates that a path is created is belief in the SES concept. Without a critical mass believing the SES concept, the SES project would not have gotten off the ground (SESAR Consortium, 2007; Sydow, et al., 2005).

["Alone, we cannot change the entire ATM paradigm. That means that we have to do something all together."]
Executive Director, SJU[33]

All the 23 interviewees more or less expressed their confidence in the SES concept. There appears to be a belief in the SES project for different reasons. Some say it's because there is nothing else, some say it's because there are other similar projects out there[34], but most of the interviewees indicated that the only way to overcome the existing reverse salients is to have an initiative such as the SES project.

["… we are not the only ones working on a rearrangement of ATM. On the other side of the ocean they are working on a similar program, as well as in Japan and Australia. So I think that there is a general perception that something has to change."]
interview #17, TUD

["If you really want to achieve improvements, you have to have a collective approach."]
interview #11, NLR

["Yes, there is belief. The necessity to rearrange airspace to increase the capacity is big. And SES is the only initiative to accomplish this."]
interview #12, KLM

Even though the majority believes in the SES concept, there is also a group of players in the Dutch aviation industry that are having a cautious attitude towards the SES strategy.

[32] For the definition phase of SESAR, allocated the SJU a third of the budget to the manufacturing industry, a third to the ANSPs and a third to EUROCONTROL. The definition phase is the first out of three phases towards the implementation of the SES. The second phase is the development phase, and the third phase is the deployment phase (audio recording KDC event, 2010) (SESAR Joint Undertaking, 2011).

[33] Audio recording KDC Event November 16th 2010.

[34] The USA is having a similar project called NextGen, Asia also has a similar program called Seamless Asian Sky (Rollo, 2011).

["I am not convinced that this is the way to succeed."]
interview #16, MUAC

["There is no world without SES. But I can't answer whether we truly believe in it. It is the way it is."]
interview #5, CANSO

Only one interviewee expressed confidence in the SES strategy as well.

["SES is already in our mindset, as our organization can be already operates across four states."]
interview #15, MUAC

Indicated reasons for this skepticism concerning the SES strategy are;

- lack of operational benefits (IATA, 2012),
- deadlines that aren't met,

["When an influential industry organization argues that they tried, but they just couldn't make it before the deadline, the EC simply changes the deadline for them."]
interview #16, MUAC

- the size and complexity of the SES project,

["We became aware that this is a very long, complex process to successfully bring to an end. As a result our confidence decreased."]
interview #4, LVNL

- technologies that aren't ready for implementation,

["The institutions want to start the deployment phase, but there aren't many technologies available which are ready for deployment."]
interview #7, LVNL

- and lack of political will of large influential nations (AINonline, 2012; CAPA centre for aviation, 2012).

This skepticism indicates a lack of support from the industry, which participation is required to succeed (Airlines international, 2012). The proper functioning of SES can only be assured if the stakeholders actively participate and honor the stated deadlines (Paylor, 2012).

["There is a lack of commitment from countries and ANSPs to drive real SES benefits."]
Director of Industry Charges, Fuels and Taxation, IATA

Lobbying

The path creation phase is also characterized by the concept lobbying. The Dutch aviation industry lobbies to influence the institutions to ensure their own organizational interests.

["We don't do much lobbying, except for our own interests."]
interview #9, LVNL

Industry organizations also lobby on behalf of the Dutch interests, when that's not contradicting with their own strategy, or when it will eventually bring advantages to their own organization. They would even lobby for organizations outside their own nation, or motivate other industry parties for the same reasons. They also lobby to get development ideas into the program. By lobbying the sector aims to find support for their wishes and aims in the SES project.

["We lobby for support in Brussels on behalf of the national military interests, but we also lobby with other military organizations to strengthen our vote within certain consultative bodies and committees."]
interview #13, Ministry of Defense

Lobbying is a necessary activity for the organizations within the aviation sector, because there are many different interests taken into account in this process. This means consensus has to be reached, whereby organizations have to make concessions. Accordingly, organizations try to align their interests, by lobbying for support among other organizations and institutions for their ideas.

["It is necessary to rearrange airspace to increase the capacity. Lobbying is part of the process in reaching this goal. Lobbying is necessary because the stakeholders have different perspectives regarding (the timing of) the realization of the SES."]
interview #12, KLM

Consortia building

The third property, consortia building also came forward in the interviews. Consortia are build both nationally and internationally. Nationally, LVNL formed a consortia with the NLR, called Consortium LVNL. Furthermore, LVNL is currently working on achieving a close collaboration with the military to become cheaper and more efficient.

["We are collaborating with the military towards one organization with the aim to create a cheaper and more efficient system in the Netherlands."]
interview #7, LVNL

As a result of the SESAR program, NLR initiated the SESAR NL consultation meeting. This is arranged twice a year by the NLR. Participating organizations are the NLR, KLM, AAS, LVNL, Ministry of Infrastructure and Environment, Ministry of Defense and TUD. During these SESAR NL consultation meetings these organizations exchange information regarding their SESAR related developments, achievements and activities.

["I arrange the SESAR NL consultation meeting approximately twice a year. This SESAR consultation meeting is held with NLR, KLM, AAS, LVNL, Ministry of Infrastructure and Environment, Ministry of Defense and TUD."]
interview #10, NLR

In an international context AAS joined with six other airports the SEAC (SESAR Joint Undertaking, 2012). TUD joined the ACSES consortium, and KNMI joined the EUMETNET consortium.

Consortium LVNL became an associate partner of the Italian-, German-, and French ANSP (SESAR Joint Undertaking, 2012). Furthermore, the NLR started collaborating with other international organizations in SESAR context.

["Internationally we collaborate with DLR, Honeywell, the German ANSP, the Italian ANSP, the French ANSP, Thales and EUROCONTROL."]
interview #10, NLR

And in a specific SESAR project, called i4D, MUAC started to collaborate with Airbus, which is an airline manufacturer.

SESAR also triggered better collaborations between similar organizations, NLR associated with DLR in a consortium called AT-One (AT-One , sd). LVNL and other ANSPs united in CANSO, and KLM and other airlines united in airlines associations, such as IATA and the Association of European Airlines (AEA).

["First of all, united we are strong. That's also the case for the SESAR program. Accordingly, the airlines united in airline associations."]
interview #12, KLM

The main reason for consortia building is the industries' awareness that collaborations create strength and helps them to achieve more than they are capable of on their own (Roland Berger Strategy Consultants, 2007, p. 4). This awareness comes forth from the realization that the industry organizations are all dependent on each other.

["If you go back 20/30 years ago […], so a lot of improvements could be achieved by those kind of entities working in splendid isolation. But then you get to a point […] where improvements in isolation will not actually pay off, and that means you need to start collaborating."]
interview #18, EUROCONTROL

Global interoperability

The fourth property concerns ensuring global interoperability. EUROCONTROL is an organization that is closely involved in ensuring global interoperability, since the aviation sector is not a European, but a world-wide sector. Interoperability in this sense can be defined as the ability for two or more [systems] to operate together (or in conjunction) (Camarinha-Matos, et al., 2009).

["So to the extent possible we try to globalize what we do in order to sort of not look too narrowly to the European issues only."]
interview #18, EUROCONTROL

Part of doing that is a task delegated to EASA which is trying to make sure that the SARPs are transferred to Europe in a harmonized way. This way they aim to limit the amount of differences between the technological styles of similar organizations. However, there is the awareness that a balance in harmonization is required. Too much harmonization can lead to constraints, as differences in social-, geographical-, cultural- and economic conditions will always continue to exist.

["There have to be exceptions […] if those are ruled out it will constrain us in our capacity performance."]
interview #5, CANSO

It should always be possible for a nation to adapt to these circumstance, regardless of the harmonization activities.

Learning by doing

Another characteristic of the path creation phase is learning by doing. Learning by doing refers to the improvement in [technology] that takes place in some industries […] as they learn by experience (Levitt, et al., 2012). Sometimes when developing a concept you can't always oversee what problems lie ahead of you until you run into them. So learning by doing is inherent to this process of creating a path towards the SES.

["Along the way troubles will appear. When they do you almost always think, I could have known this. That's what they call the hind sight bias."]
interview #17, TUD

This indicates that you can't think the whole process through. Learning by doing is, and will be part of the realization of the SES.

Boundary spanning

The last property mentioned in this section is boundary spanning. The establishment of the SJU is a boundary spanning activity, as the SJU involves the industry organizations by letting them develop the SES technologies. Another boundary spanning activity is carried out by EUROCONTROL. EUROCONTROL organizes workshops to create an understanding among the industry organizations regarding a particular SES technology.

["If any is sort of promoting SES/SESAR, it is EUROCONTROL."]
interview #18, EUROCONTROL

To conclude this section it can be said that the European aviation industry managed to get the SES project off the ground. The majority of the Dutch industry organizations started participating in a later stage. This is why the Dutch aviation sector has had little influence in the path creation process. However, the participation of the Dutch aviation

industry resulted in better collaborations on both a national-, and international level.

It is important, however, that the aviation industry maintains this level of interference and tries to extend this path. The institutions rely on the expertise and participation of the industry organizations. If the industry organizations would stop providing the institutions with their expertise and participation, the SES can't be achieved.

5.2.2 Path extension

Path extension is needed to pass a point of no return in the path management process. After reaching this critical point a certain form of irreversibility exists and the likelihood of returning to the old technological trajectory decreases (Bassani & Dosi, 2001; Sydow, et al., 2005).

This point of no return is what the European aviation sector is trying to achieve in the development phase (2008-2013) (SESAR Joint Undertaking, 2011). This is the phase following up the definition phase, which lasted until 2008 (SESAR Joint Undertaking, 2011). During the development phase, which is part of the path extension phase, the industry organizations produce the required technical systems, components and procedures to get SES into place (SESAR Joint Undertaking, 2011).

The path extension phase appears to be characterized by *exchange of knowledge and information*, *keeping the buy-in, trials and simulations*, *making sure resources are available*, and *feedback* (Figure 17).

Exchange of knowledge and information

Exchange of knowledge and information is required to make the right decisions along this process.

["We are open to share knowledge and information to secure the operability. It is also required to reach the right decisions."]

interview #13, Ministry of Defense

The interdependent character of the aviation sector makes it crucial to exchange knowledge and information in order to make progression. The Dutch aviation sector exchanges knowledge and information with the Dutch government to enable this institution to represent the Dutch aviation sector in a European context.

["We share knowledge and information with the Dutch government to create an understanding of the importance of our interests, so the Dutch government is able to argue for our interests on behalf of us."]

interview #12, KLM

However, the industry organizations also exchanges knowledge and information with each other in a national- and international context. For example, when the industry organizations are collaborating in a certain project as Cross-Border Area Land/Central West[35].

["If you want to establish Cross-Border Area Land/Central West, you have to share knowledge and information. If you want to know of your collaboration partner how the airspace is arranged, how you want to arrange it in the future, how often airspace is being used, and that sort of things, you need to share your knowledge and information."]

interview #4, LVNL

Keeping the buy-in

Sharing knowledge and information is also done to keep the buy-in, and to benchmark. Getting the buy-in can be defined as getting the stakeholders to get behind an initiative (Clemmer, 2009). It is important to keep the buy-in, because if the European aviation sector successfully wants to deviate from the existing technological trajectory, i.e. path, all stakeholders need to be involved.

["… no one can exclude themselves completely from deployment, because then SES will not be a success."]

interview #18, EUROCONTROL

Internationally, there are some big influential nations, and it is really important to stimulate them and to keep the buy-in.

["France and Germany are the biggest countries participating, they have the biggest economies and therefore have the biggest influence."]

interview #3, LVNL

The buy-in of these nations is important because they have a big influence on the entire European aviation sector, including the Netherlands.

["The institutions know that if France or Germany sais 'no', they have to start negotiating, because without the participation of France or Germany SES can't come into place."]

interview #16, MUAC

Keeping the buy-in is now more crucial than ever, also in the Netherlands. Especially since the majority of the industry organizations have expressed their skepticism regarding the strategy taken to realize SES. Plus, with the economic downturn every organization is forced to cut costs. And this makes the organizations to go on a survival mode. This means that they will not be willing to jeopardize their core business, if that's what is required to implement SESAR developments (AINonline, 2012). On top of that the path management process is progressing too slow, and is currently falling be-

[35] Cross-Border Area Land/Central West is a large-scale cross-border airspace re-arrangement, planned at the borders of Germany and the Netherlands. This is a project in which the Dutch and German military, the LVNL, the German ANSP and MUAC are all collaborating with each other (FABEC, 2012).

hind schedule (ANP, 2012; European Commission, 2012; European Parliament, 2012). This caused a trend among some airlines to take a background position in the realization towards the SES. This means that they aren't willing to make financial investments before the institutions make some progress.

["But the airlines say that they are taking a step back, because some progress needs to be made first."]
interview #12, KLM

In other words, it appears that the airlines are losing confidence in the path management process towards the realization of the SES. The airlines became influential organizations in this process, as the institutions realized the importance of their participation.

["The institutions became aware that it isn't realistic that the airlines have such a limited influence in SESAR. However, research indicated that of the 30 billion euros, 20 billion needs to be invested by the airlines."]
interview #12, KLM

Keeping the buy-in of those organizations is therefore considered crucial. Despite this trend among the airlines, the Ministry of Infrastructure and Environment does not put an effort in keeping the buy-in of the airlines or other Dutch industry organizations. Partly, because the Ministry of Infrastructure and Environment does not consider themselves as the ones responsible for that, and partly because they don't have the feeling that it is needed among the Dutch aviation sector.

["We don't have to sell the SES concept, […] we are not in the driver's seat. […] I don't have the feeling that we have to drag the Dutch aviation sector into participating."]
interview #14, Ministry of Infrastructure and Environment

EUROCONTROL does make an effort to keep the buy-in of the industry. They do that by executing 'lobbying activities'.

["We don't see ourselves as a lobby organization […] we are not putting a lot of effort into lobbying. *But you do "lobby" to keep the buy-in?* Yes, we do. A typical thing we use a lot is workshops."]
interview #18, EUROCONTROL

But also by using workshops to provide clarity regarding a certain theme, identify the issues of the industry and try to address these problems by coming with a solution.

Another activity carried out to keep the buy-in is the mandatory initial contribution to the SJU. If an organization decided to become a member of the SJU, it was obliged to pay a minimum initial contribution of 10 million €[36] within one year of their accession to the SJU (SESAR Joint Undertaking, 2012). This created a threshold for the members to drop out whenever that seems like an attractive possibility[37].

Trials and simulations

Another crucial activity along the path management process is to execute trials and simulations.

["We need the trials to test our ideas, because our ideas are often about human factors and automation. […] The new ideas have to be tested against the air traffic controllers who eventually will have to work with it. […] We perform these tests to receive feedback from the air traffic controllers."]
interview #17, TUD

LVNL held a trial in 2011 regarding a SESAR project called Atlantic Interoperability Initiative to Reduce Emissions (AIRE) (Airspace, 2011). LVNL finds it important that a trial is about a useful and mature development that is perceived to really pay off, once put into practice. If this appears not to be the case prior to a trial, organizations appear resistant in carrying out trials and simulations.

["We are no proponent of operational trials. […] The work floor of the air traffic controllers is no playground to us. We are willing to perform real time simulations, but we rather not have those trials and simulations disturb our operation from its daily routine."]
interview #7, LVNL

Furthermore, the results of the trials and simulations are used to improve the technology, and/or to sell the ideas among the relevant organizations in the sector. The end goal is to create a new standard out of that technology.

["Airlines visit us to see what kind of validations we do. For example, i4D is a technology which depends on the airlines. We'll make sure the airlines get the right feedback and the results of the validations. Accordingly, that will help Airbus[38] to sell their concept in their aircraft."]
interview #15, MUAC

This quote shows again that the industry organizations are dependent upon each other. If MUAC wants to implement i4D, it's dependent on both the airlines and the aircraft manufacturer. By pointing out the positive outcomes of the trials to the airlines, MUAC is making it easier for the aircraft manufacturer to sell the technology needed to the airlines. So trials help organizations to get SESAR ideas into the market.

[36] Members that got assigned within 12 months of the SJU's constitution were given a discount of 5 million € (SESAR Joint Undertaking, 2012).
[37] For example, when the economy goes down.
[38] Airbus is an European aircraft manufacturer.

Making sure resources are available

These trials and simulations require resources and time. It is difficult to gather these resources, because they are scarce. However, to get the SESAR ideas into the market organizations have to make sure resources are available. For an organization to put resources aside for a development it is important that the development is in line with the organizations' interests. Developments in the aviation sector often require huge financial investments (as explained in section 5.1.2). This makes that organizations sometimes have to make trade-offs between investing in SESAR technologies, or technologies offering a local solution to a local problem.

["… but we could have used those resources for other developments as well, so we have to make decisions."]
interview #10, NLR

Feedback

During the path extension phase feedback is provided and received between the institutions and the industry organizations, but also between the industry organizations. Feedback is important, because it helps to improve the path management process (Töpfer, 2011). However, even though feedback can be a powerful tool, it is not always used as such in the SES project.

EUROCONTROL is an institution that applies the process of providing and receiving feedback to the SES project. They provide feedback to both the institutions, as well as the industry organizations on a regular basis. EUROCONTROL does that by means of annual reports, meetings and publishing facts on their website for general exposure. EUROCONTROL monitors data[39] and identifies bottlenecks in the system and talks to the relevant industry organizations about it so they can do something about it. They also point out the laggards in an implementation process during meetings. This usually has the effect of the laggard aiming to catch up with the rest, as nobody likes to be the laggard.

["Through name, blame and shame, which is a sort of strategy whereby we use our monitoring data. […] And we use this data in order to sort of show progress. And there is some psychology in being painted as the least performing. People typically do not like that."]
interview #18, EUROCONTROL

The Ministry of Infrastructure and Environment also provides feedback, but that only appears to play a clear role in the concrete projects related to the SES. When it comes to the path management activities in general, carried out by the Dutch aviation sector, the Ministry of Infrastructure and Environment doesn't really provide concrete feedback to the industry organizations.

["We take part in the SESAR NL meeting, initiated by the NLR, where we discuss with AAS and LVNL what their SESAR related activities are. But I don't know whether you can refer to that as feedback."]
interview #14, Ministry of Infrastructure and Environment

In concrete projects, however, the Ministry of Infrastructure and Environment does provide feedback to prevent disappointment in a later stage of development.

["Remote tower is one of the 325 SESAR projects[40] where I was working on. We've assessed the way they were developing that, and gave them feedback regarding some regulatory issues."]
interview #14, Ministry of Infrastructure and Environment

This kind of feedback helped to improve the remote tower concept, as questions were raised by the Ministry of Infrastructure and Environment that led to the discussion whether this concept was feasible at all, considering the existing regulations.

["Because of those discussions SESAR contacted ICAO with the question whether the remote tower concept was feasible considering the obligations regarding visual observations."]
interview #14, Ministry of Infrastructure and Environment

Between the industry organizations, i.e. SJU members and their associate partners, or subcontractors the process of providing and receiving feedback is an informal one.

["Last year, during the ATC-conference, we've been talking to the Italian ANSP regarding our SESAR collaboration. We had a brief meeting where we said to each other; 'things are going pretty well aren't they?']
interview #8, LVNL

But when these industry organizations are collaborating within a SESAR project, feedback becomes more serious. Giving and receiving feedback regarding a SESAR project increases the confidence in that project and accordingly support for that technology. This confidence and support is needed to eventually get technology on the market.

["Airlines visit us to see what kind of validations we do. For example, i4D is a technology which depends on the airlines. We'll make sure the airlines get the right feedback and the results of the validations. Accordingly, that will help Airbus[41] to sell their concept in their aircraft."]
interview #15, MUAC

[39] EUROCONTROL monitors data regarding the performance of the European aviation sector (EUROCONTROL, 2012).

[40] Project 06.09.03 (SESAR, 2012).

[41] Airbus is an European aircraft manufacturer.

Furthermore, it is also said that providing feedback doesn't happen on a regular basis. Interviewees indicated that feedback is usually provided after trials, and if an organization is not following the law.

["Of course, if you do not comply with the law you'll get feedback."]
interview #6, LVNL

What happens with that feedback, will be discussed in the next section, as handling feedback is considered to be a path deviation activity (as described in section 4.2.2).

In this section, I've discussed that knowledge exchange is required to create a path towards the SES. Furthermore it appears that the institutions appear to lose support of the industry in their attempt to extend the path towards the realization of the SES. As a result only European institutions are making a great effort in keeping the buy-in of the industry. The Dutch aviation sector is contributing by conducting trials, such as the AIRE trial. Successful trials can help ensuring the buy-in, as those indicate that the technology could work in practice. Furthermore, feedback is often used in official matter. It isn't used as an incentive to stimulate the industry organizations.

Because the institutions are still trying to keep the buy-in, and the aviation sector is still in the development phase (2008-2013), it can be concluded that the European aviation sector is currently in the path extension phase.

5.2.3 Path deviation

Path deviation is the phase wherein the European aviation sector actually moves away from its current path (Heiskanen, et al., 2011). During the path deviation phase large scale production, and implementation of the required technologies, procedures and processes are achieved (SESAR Joint Undertaking, 2011). This is what the European aviation sector plans to do in the deployment phase of the SESAR program. The deployment phase is scheduled from 2014 till 2020 (SESAR Joint Undertaking, 2011).

Even though the European aviation sector is still in its path extension phase, path deviation activities have been noticed. In some technology areas initial deployment activities are already taking place (Honeywell, 2012). Based on the interviews four characteristics came forward, namely *monitoring*, *handling feedback*, *steering* and *regulations* (Figure 17).

Monitoring

There are two different types of monitoring observed. The first is carried out by the industry organizations. These keep an eye on the activities of the other industry organizations involved. They also monitor their collaboration partners to ensure harmonization.

["High-level, we look at the strategic moves the French are making."]
interview #7, LVNL

["We see the performance reports which say how the other organizations perform, and we look at that.]
interview #4, LVNL

["We are all working on the same project and are therefore "controlling" one another, but that's not how I would like to describe it in this context."]
interview #15, MUAC

The other type of monitoring is carried out by the institutions, which concerns monitoring the performance of the industry.

["We collect data and we monitor data and we use the data in order to sort of show progress."]
interview #18, EUROCONTROL

This data is gathered to be able to confront the industry with their progression, through the name, blame and shame mechanism.

In terms of auditing, only the institutions are actively monitoring the entire process towards the realization of the SES. The industry organizations are mostly being monitored.

Handling feedback

EUROCONTROL handles feedback in a very structured manner. They make feedback summaries, which they either mark as fully taken into account, partly taken into account, or disregarded with an explanation. They'll present this back to the relevant organization.

["We always try to sort of summarize feedback in a sort of structured way. […] So we are very structured in feedback."]
interview #18, EUROCONTROL

The Dutch aviation sector simply reflect the received feedback with their own interests and see how they can do better.

["We reflect our received feedback with our own interest and look whether we have to lobby for something else, or something better."]
interview #12, KLM

Handling the feedback appears important for several reasons. Sometimes, there is a financial incentive involved, or legislation, but also because an organization wants to come across as a reliable partner.

["We work for the Italian ANSP, and they pay us for that. If they are not satisfied with our input, and we don't do anything about it, the Italian ANSP can decide to not pay us."]
interview #3, LVNL

["Legislation is a stimuli, but you also want to come across as a reliable partner. If we decide to not do anything with the received feedback, we have to have a good argument for it."]
interview #1, LVNL

Steering and regulations

The third characteristic of this path deviation phase is steering. This characteristic is intertwined with regulations. The LTS is steered by the SES regulations provided by the EC and by EUROCONTROL through a mechanism called name, blame and shame. The regulations released by the EC concern the boundaries, requirements, and deadlines[42] with which the industry has to create the path towards the realization of the SES (Civil Aviation Authority, 2012).

An example of a regulation package released by the EC is the Data Link Services Implementing Rule. This implementation rule was released on 16 January 2009 (EUROCONTROL, 2012). Data Link Services (CPDLC) is a technology that can be compared with text messaging on cell phones. CPDLC allows pilots and ATC to send canned data messages between the ground and the aircraft. This reduces the workload of the air traffic controllers as it automates tasks that take up to 50% of their time (Honeywell, 2012). In order for CPDLC to get operationalized, both airlines and ANSPs have to implement a technology. This is where the Data Link Services Implementation Rule refers to as it sets deadlines for those technologies to be implemented[43].

Stakeholders have to make investments at the same time to gain the benefits. For example, a new technology can be installed at LVNL, but in order to gain benefits from that technology the airlines have to install a technology in their aircraft as well. The difficulty lies in the following. LVNL only installs the technology if the majority of the airlines install the technology in their aircraft. Because it is difficult to gain benefits from the new technology if only a minority of the aircraft are equipped for it. Plus air traffic controllers can't work with two concepts at the same time, due to a high workload (Shorrock & Kirwan, 2002). But as explained in section 5.1.2 an airline only has small profit margins. They therefore want to earn back their investment in a relatively short amount of time (Brooker, 2009). A reason for that is the insecure business these organizations are currently operating in. These organizations don't know whether they manage to stay in business on the longer term (Mallan, C., 2009). Besides, not every airline is ready to makes such an investment at the same time. And this is needed to create the majority required by LVNL to install their part of the technology. A reason why airlines aren't ready to invest at the same time is that airlines have different business profiles, i.e. low cost carriers and legacy carriers, and a different roadmap.

These problems play a major role in all the SESAR projects. This is why the industry needs top-down pressure in the form of regulations.

To conclude this section, it appears that the European aviation sector isn't ready to deviate yet. The institutions are still working to keep the buy-in of the stakeholders, and it is difficult to align the roadmaps of the different stakeholders involved which is required to implement SES technologies. Therefore top-down pressure in the form of regulations is needed.

5.3 Interplay

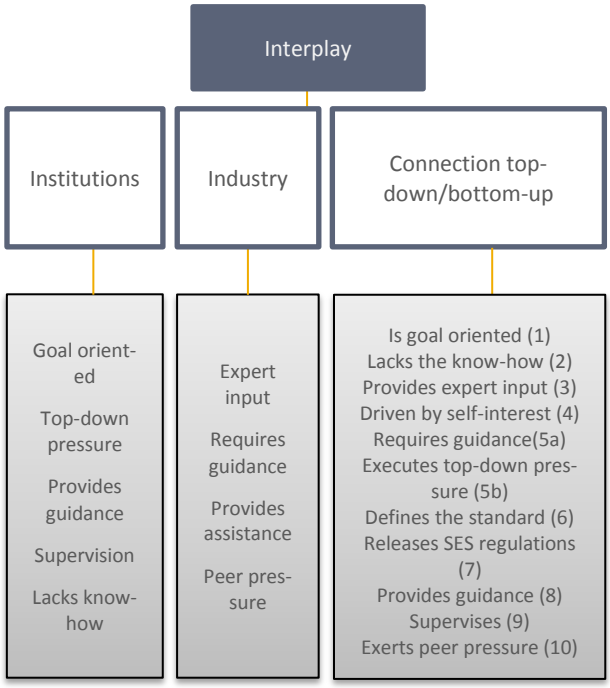

Figure 18 - Interplay concepts and its characteristics

This thesis also aims to investigate how the institutions and the Dutch aviation industry influence one another in their SESAR related path management activities. Figure 18 provides an overview of the concepts related to the interplay. This section elaborates on the characteristics of the institutions, the industry organizations, and the relation between the institutions and the industry organizations.

This section will also explain how this influences the path management process.

[42] These boundaries, requirements and deadlines concern: a framework for the creation of the SES, interoperability, common requirements concerning the provision of air navigation services, licenses, safety oversight, and others (Civil Aviation Authority, 2012).
[43] January 1st 2011 = all new aircraft operating above FL 285 shall be delivered with a compliant system.
February 7th 2013 = all LINK Region ANSPs shall have implemented an operational compliant system.
February 5th 2015 = all EU Region ANSPs shall have implemented an operational compliant system (EUROCONTROL, 2012).

5.3.1 INSTITUTIONS

The institutions are the EC, SJU, EUROCONTROL and the Ministry of Infrastructure and Environment. The institutions are characterized by being *goal oriented*, *top-down pressure*, *providing guidance*, and *lacks know-how* (Figure 18).

Goal oriented

The EC has set the high level goals of the SES project with the support from the Single Sky Committee (SSC) (Air Transport News, 2012). The SSC exists of the Member States' representatives and observers from third countries and EUROCONTROL (European Commission, 2012). These goals provide the industry with a sense of meaning and a purpose (McKnight & Kashdan, 2009).

Top-down pressure

Executing top-down pressure is seen as a prerequisite to enable the SES to become a success (Europees Parlement, 2012; Paylor, 2012). Due to the size of this SES project, a lot of bottlenecks must be overcome. Examples of bottlenecks are politics, complexity of the sector, fragmentation, national differences, the lack of resources, an immature strategy, and the fact that the SES is a revolutionary project in an evolutionary evolving aviation sector. In order to overcome these bottlenecks, airlines and members of the European Parliament argued for the institutions to execute top-down pressure (Breaking travel news, 2012; Turner, 2012).

The EC executes top-down pressure by means of releasing SES regulations. Within these SES regulations KPA values are slowly sharpened, and deadlines are provided regarding those SES regulations.

The SES regulations are presented as the SES I, II and II+ packages. These consist of implementation rules, that pass the states, and directly influence the industry organizations (and consists of regulations such as the Data Link Services Implementation Rule mentioned in section 5.2.3).

Commissioned by the EC, EASA is harmonizing safety regulations by means of a total systems approach. EASA keeps air transport safe and sustainable (EASA, 2012). The safety regulations are currently varying across the European nations. In harmonizing these safety regulations EASA aims to reduce risks coming from gaps, overlaps or confused responsibilities between different aviation domains (i.e. ANSP, airlines, airports, pilots, air traffic controllers) (Goudou, 2009).

The SJU also executed top-down pressure during the definition phase by means of the 'carrot and stick' approach. Their aim was to bring the industry organization together in their R&D activities towards the realization of the SES. Bringing together these organizations to form a partnership was a difficult task (KDC, 2010). Political support from the EC helped the SJU to create it, but also the fact that money was used as an incentive for the industry organizations to reach a consensus (KDC, 2010).

["What helped me a lot in achieving a common approach was the political support from the EC, basically supporting me in everything."]
Executive Director, SJU

["I have the money, and that means that I can decide. And that's what build the partnership. […] I told the different partners that if you cannot agree, I will decide."]
Executive Director, SJU[44]

If the parties would agree on a common approach, they would get the funding, and get to do it their way. Otherwise, the SJU would have made the decisions.

Provides guidance

EUROCONTROL helps the industry by drafting guidance material for the implementation of the released SES regulations, assisting the Member States in their activities and identifying needs for new regulations (EUROCONTROL, 2011).

["We make sure that the needed standards and provision and guidance material are put in place. Because the best way to get the industry to get it right is to support industry standards development."]
interview #18, EUROCONTROL

["We provide guidance material, we write specifications for people to help them understand what the regulations mean."]
interview #18, EUROCONTROL

Supervision

The Dutch government isn't responsible for the implementation regulations released by the EC. However, they do carry responsibility when the Dutch aviation sector doesn't comply.

["The Dutch government can be held responsible for complying with the implementation rules. Accordingly, the EC can impose an infraction procedure on the Dutch government."]
interview #14, Ministry of Infrastructure and Environment

The Dutch government, combined with the National Supervisory Authority (NSA)[45], and the 'Inspectie Leefomgeving en Transport' monitor the Dutch aviation sector regarding their compliance with the implementation rules. These two organizations, combined with the Ministry of Infrastructure and Environment can impose consequences, such as directives, fines, and in extreme cases even withdrawal of licenses organizations need to operate (Europese Unie, 2011).

[44] Audio recording KDC Event November 16th 2010.
[45] The NSA ensures the supervision of the ATM regulatory framework in all EU Member States (Skybrary, 2012).

Lacks know-how

However, what the institutions don't possess, is the knowledge that is required to develop the technologies, procedures and processes to create the SES.

5.3.2 Industry

The industry on the other hand does have the know-how and therefore provides *expert input* to the SESAR program. Furthermore, the industry *requires guidance*, *provides assistance,* and *peer pressure* (Figure 18).

Expert input

The Dutch industry provides expert input by either becoming a member, associate partner, or subcontractor related to the SESAR program. The industry is directly related to the operations, and therefore possess the know-how of what is required for the SES, and what technologies are needed to solve their problems.

Requires guidance

The majority of the industry organizations agrees that they need guidance to achieve the SES (Marinescu, 2011).

["We have to have a top-down plan to achieve this."]
interview #10, NLR

["Some things in SES can only be achieved with a top-down strategy."]
interview #17, TUD

["I think that without pressure from the EC SES will not come into place."]
interview #2, LVNL

["I think the EU needs to execute more top-down pressure, because the national interests prevail over the European interests."]
interview #2, LVNL

This seems contradictory with their actions, as each industry organization is trying to look after their own interests.

In other words, it appears as if the industry wants top-down pressure, provided that their own interests aren't jeopardized. This means that at a high level the industry knows that top-down pressure is required to get the SESAR projects implemented.

Top-down pressure requires the industry to make concessions. These concessions include aspects like outplacement of functions, joint ventures across borders, and ANSP center consolidation. As soon as the industry realizes that making these concessions negatively affect their business, a lack of political will arises (European Parliament, 2012; McNamara, 2012).

Provides assistance

Industry organizations also ask each other for assistance. For example, when they've signed up for more SESAR tasks than they can handle.

["The Italian ANSP signed up for too much work in SESAR. They asked the LVNL for help. And because the NLR wanted to participate, we've decided to help them out, provided that we could form a consortium with the NLR."]
interview #8, LVNL

They either call on an associate partner, or they hire the expertise of a subcontractor to help them fulfill their activities (Eijkman, 2011).

Assistance is also offered among the industry organizations when an organization notices that a SESAR project is being jeopardized, which has negative consequences for their own SESAR related activities. Accordingly, they try to help by finding a common solution to the problems jeopardizing that particular SESAR project.

["When SESAR developments do turn out to influence the realization of the SES in a negative way, we try to turn that into a positive effect again, even in cases when it's not our responsibility."]
interview #15, MUAC

Peer pressure

Peer pressure can be understood as pressure to think or behave along certain peer-prescribed guidelines (Clasen & Brown, 1985). A form of peer pressure is exerted by the airlines. The airlines' business is threatened by the status quo of the European ATM system. The lack of progress is currently perceived as frustrating and economically damaging by the airlines (CAPA centre for aviation, 2012). As the ATM system is fragmented, the airlines are forced to fly longer routes, deal with flight delays, burn extra fuel, and emit more CO_2 (CAPA centre for aviation, 2012). In addition the airlines also pay for the inefficient European ATM organization through the route-charges and landing fees. These costs are too high and need to be lowered urgently by means of the SES project. This is progressing too slow and accordingly, the airlines are trying to create a sense of urgency among the other industry organizations by taking a step back.

["The airlines are currently taking a step back in the SES project, because they want to see some progress first."]
interview #12, KLM

The airlines play an important role in the SESAR project, as technological developments have to be implemented in their aircraft in order for SES to become a success. By taking a step back, they are sending the message that it is up to the other parties to start contributing first before they are stepping in again.

EUROCONTROL also plays into this aspect of peer pressure by means of name, blame and shame. There is some psychology in being painted as the least performing. This triggers those least performing industry organizations to catch up with the rest of the industry.

5.3.3 Connection bottom-up/top-down

In the process of realizing the SES, it is important that the activities of the industry and the institutions are connected. This is important because both activities are needed to establish the SES.

Is goal oriented (1)

The European Commission started by setting high level goals for the European industry to comply with by 2020 and beyond.

Lacks the know-how (2)

However, the institutions don't have the knowledge to achieve that.

["We can't develop an Arrival Management (AMAN) system[46] here, that's something that the industry has to do."]
interview #14, Ministry of Infrastructure and Environment

Provides expert input (3)

They need the expert input from the industry. The Dutch aviation industry tries to influence the institutions at a European level by providing their input, advice and expertise to ensure their own interests. CANSO, for example, is an organization that represents the interests of the ANSPs[47] at a national-, and international level.

["I am working in both Brussels and The Hague to emphasize the interests of LVNL."]
interview #5, CANSO

The Dutch industry also advices and influences the Ministry of Infrastructure and Environment.

["We have an advisory function, regarding the developments of the ATM system, towards the Dutch government."]
interview #1, LVNL

["We share knowledge and information with the Dutch government to create an understanding of the importance of our interests, so the Dutch government is able to argue for our interests on behalf of us."]
interview #12, KLM

Driven by self-interest (4)

The industry is driven by their own interests

Requires guidance (5a)

As the interests do not always align, the industry is aware that they require guidance from the institutions.

Executes top-down pressure (5b)

Accordingly, the institutions execute top-down pressure. Top-down pressure helps to create a common approach taken by the industry. However, as no organization is willing to jeopardize its business it is important that these organiza-

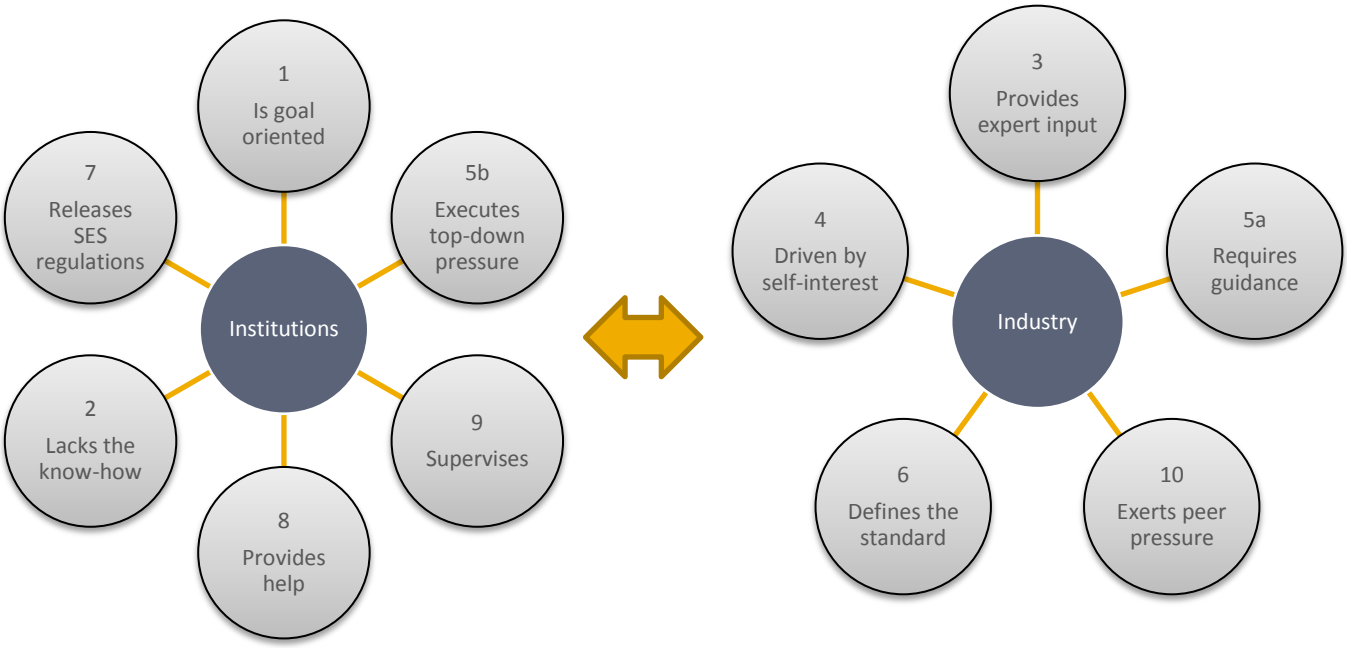

Figure 19 - Connection bottom-up/top-down activities

[46] AMAN is an application that supports the planning and implementation of an optimized arrival sequence by air traffic controllers (SIATM, 2012).

[47] The interests of the ANSPs can be described as aiming for a better performance than they already have within the environmental and safety limits (Dutch government, 2012).

tions are (to a certain extent) allowed to ensure their interests while they are creating a path towards the SES.

Another problem solved by top-down pressure is the fact that stakeholders have to invest at the same time to be able to gain the benefits from the technology. However, this appears not to happen in practice. For example, an implementation rule has been released for aircraft to be equipped with the ADS-B technology by 8 January 2015. However, at the same time there is no mandate for ANSPs to make use of this technology in their ground systems (Marinescu, 2012).

["You can still see that regulations are imposed that are not synchronized with the regulations imposed at other stakeholders."]
interview #12, KLM

Defines the standard (6)

Under the boundaries set by the institutions, the industry is working towards creating new standards regarding the technologies, processes and procedures beneficial for the SES project. They do that by developing concepts and having trials and simulations to test the value of those concepts in practice. After the concept is proven to be useful and mature, the concept is ready to become a standard (SESAR, 2012, p. 62). Before the institutions create the SES regulations concerning the mature concept, the concept is subjected to an early Regulatory Impact Assessment Process (eRIA). During this process the need for regulations is assessed, as well as an analysis of the interdependencies of the regulations required to get the standard implemented. This analysis helps the institutions to sequence and synchronize the deadlines regarding the SES regulations (SESAR, 2012). Before the EC releases the SES regulations, the Member States have to give their approval.

["The States need to approve the commission's policy."]
interview #14, Ministry of Infrastructure and Environment

In order for the Dutch government to properly do that, they needs to have the knowledge and information regarding the functioning and needs of the Dutch aviation sector. They do that by collaborating with the industry organizations, discussing their priorities, and defend these in European context (3).

["Together with the Ministry of Infrastructure and Environment we decide which issues are important to the Dutch aviation sector and how we can best pick up on SESAR regarding those issues."]
interview #11, NLR

Releases SES regulations (7)

When approved by the Member States, the institutions release the SES regulations. These regulations are perceived to be useful by the industry organizations. However, there are some mixed feelings about these regulations. Some say the regulations are generic, other say they are too specific. There is also a group which is concerned by these regulations, as there are many regulations released by the EC. These regulations are not easy to implement in the daily operations.

["If I look at the regulations coming from SES that affect us, I can only say that the regulations are still pretty generic."]
interview #6, LVNL

["We sometimes detest the specific regulations coming from the institutions, telling us what we have to do and how we have to do it."]
interview #9, LVNL

["The European regulations are becoming more important. […] There is an enormous wave of regulations coming from the EC that sometimes worries us in the sense that we have to figure out how we are going to implement those regulations into our daily operation."]
interview #9, LVNL

Furthermore, a large number of regulations coming from the EC are perceived as too much by the industry organizations. The industry can't keep up with complying with these regulations.

["There is a certain fatigue in the states' ability to comply with everything. Too many things have happened in a short amount of time, and the states are basically becoming overloaded."]
interview #18, EUROCONTROL

Provides help (8)

To help out, the Dutch government provides guidance by stimulating and steering the Dutch aviation sector in complying with the regulations released by the EC.

["We are the organization that stimulates and steers the making of implementing regulations at a European level."]
interview #14, Ministry of Infrastructure and Environment

Furthermore, the institutions also provide guidance to the industry. EUROCONTROL helps the industry by drafting guidance material for the implementation of the SES regulations. The industry needs this guidance as the regulations coming from the EC are both complex and large in number. These regulations are written in such a way that the industry organizations often don't know how to interpret those rules.

["Because regular people, all people, like you and me, we don't understand exactly how to interpret every single legal text."]
interview #18, EUROCONTROL

Supervises (9)

The institutions also supervise the industry in their SESAR related activities. EUROCONTROL monitors the European

aviation industry, and the Dutch government monitors the Dutch aviation industry. The Dutch government is responsible to ensure the industry organizations comply with the regulations as they come from the EC. After these regulations have been released by the EC, the Dutch state discusses with the Dutch industry organizations how these can best be implemented in the Dutch aviation sector.

["You have a bottom-up process towards decision making, which is done by the EC. […] When an implementing rule needs to be executed, we come together with all the industry organizations to discuss how we can best execute these implementing rules in the Dutch aviation sector."]
interview #14, Ministry of Infrastructure and Environment

However, the Dutch aviation industry perceives the SESAR program as opaque.

["… I hear too often 'is SESAR still operating?' 'Do they achieve anything?' 'Is there something on the way?' …"]
interview #14, Ministry of Infrastructure and Environment

There is so much information available, that the industry organizations can't keep up with that. Due to the opaqueness, industry organizations are hesitant with their investments. When a strategy or the big picture is unclear, there is a higher risk that the project fails (Great Leadership, 2011).

Exerts peer pressure

The industry organizations also carry out peer pressure. EUROCONTROL triggers peer pressure among the industry organizations by using their mechanism of name, blame and shame.

In addition, the airlines have taken a step back as a result of the low progression rate (Turner, 2012). This triggered the members of the European parliament to call for an increase in top-down pressure onto the industry conducted by the EC (5b) (European Parliament, 2012). They call for a more stringent 'carrot and stick' approach. Reward will be given in terms of EU funding, which consist of an indicative budget of €50 million. And they will punish by means of penalties (Europese Commissie, 2012).

["Not following implementation rules can lead to infraction procedures. Those are penalty procedures that can be up to €4 million."]
interview #5, CANSO

However, on the other hand more top-down pressure onto the industry organizations by using the power of money as an incentive doesn't always work out.

["I don't think that money is the incentive which will lead to a better performing system […] It doesn't matter if one really believes in the SES project, the industry will participate anyway because of the huge amount of money made available for it."]
interview #15, MUAC

Industry organizations tend to react to this incentive by joining the SES project, collect the financial means made available for it, and use it for their own interests instead of using it to make an effort to contribute to the SES.

["They like to get money out of this, for developing their own products."]
interview #18, EUROCONTROL

There are organizations who notice this and are disappointed in organizations like the SJU for not tackling this problem.

["I'm involved with some projects and during the first meeting I can tell that that particular project is a waste of time and money. […] It strikes me that the SJU doesn't do something about that."]
interview #7, LVNL

In other words, it is perceived that the SJU lacks a critical perspective. SJU uses money to intimidate, but as soon as the industry organizations reach a consensus and get the money, it appears as if the SJU doesn't supervise whether the industry organizations use the money for the right purposes.

In addition, even though top-down pressure has paid off in the definition phase and development phase of SESAR, that doesn't mean the same approach can be used during the deployment phase. A complication in the deployment phase is that the SES is bigger than the EU[48]. The EC can only execute top-down pressure onto the Member States of the EU. However, as there are nations involved that aren't a member state of the EU a different set-up is required to enable top-down pressure.

5.4 Progression

Progression is measured by means of four indicators. Interviewees' opinions are used to ask whether the current strategy is an improvement compared with the strategy taken by EUROCONTROL, before the EC and the SJU got involved.

The four indicators are the ease with which resources are accessible, collective approach, confidence in the project, and progression in terms of actual achievements.

This study indicates that progression has been made, however at a slow pace.

[48] Norway, Iceland, Croatia, Macedonia, Albania, Bosnia and Herzegovina, Serbia and Zwitserland aren't part of the EU, but are participating in the SES project (European Commission, 2009).

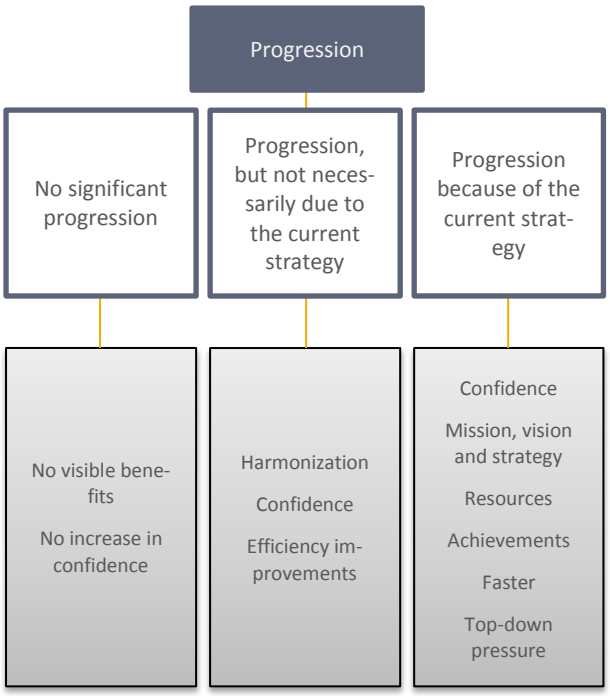

FIGURE 20 - PROGRESSION AND ITS PROPERTIES

The interview responses can be divided into three groups, one group saying that *no significant progression* has been made, one saying that *progression has been made but not necessarily due to the current strategy*, and one saying that *progression has been made because of the current strategy* (Figure 20).

5.4.1 NO SIGNIFICANT PROGRESSION

No visible benefits

The minority of the interviewees indicated that they believe no significant progression has been made. There are still no visible benefits coming from SESAR in their daily operations.

["Nothing has changed in our operations. If you look at the work floor, everything remained the same and the employees have no idea. The effects of the SES developments are not visible there."]
interview #12, KLM

["I don't think progression has been made."]
interview #7, LVNL

However, this group of interviewees did praise the involvement of the EC and the SJU, as this has been perceived to increase the enforceability. EC and SJU have the power to execute top-down pressure.

No increase in confidence

Because of the involvement of the EC and the SJU, expectations were raised among the industry organizations. However, due to a lack of tangible progression confidence of KLM and other industry organizations has weakened.

["*Does the KLM have more confidence in SES since the introduction of the SJU?* No, unfortunately not."]
interview #12, KLM

5.4.2 PROGRESSION, BUT NOT NECESSARILY DUE TO THE CURRENT STRATEGY

["Yes, I have noticed progression. However, it is important that you do not link this to the establishment of the SJU. Because progression is not necessarily related to the introduction of the SJU."]
interview #9, LVNL

Harmonization

Some interviewees noticed progression regarding the harmonization, because the industry organizations started to collaborate better.

["… when it comes to SES and the way we, as the military, interpret and implement SES, we think it's important to adjust with our neighbors."]
interview #13, Ministry of Defense

Confidence

And despite the difficulties the SES project has to cope with, this group of interviewees still has confidence in the strategy taken by the EC, EUROCONTROL, SJU and the industry. It is the only way to realize the SES.

["It is not easy to establish the SES with all those parties involved. Every party has to make concessions along that process in which consensus has to be reached. This is a slow process, but it is the only way to realize the SES, and with this strategy the participation of the EC is required."]
interview #13, Ministry of Defense

Efficiency improvements

This group of interviewees also have seen some efficiency improvements and they said these small progressions happened due to the actions taken by the industry organizations. However, because these industry organizations were already working on these projects before the SES came into being they couldn't tell whether the progression was made due to the new strategy or due to the fact that they were already working on those projects.

["You can see some efficiency successes, but I wonder whether those are actually caused by the SJU or whether those are caused by the local findings."]
interview #12, KLM

5.4.3 Progression because of the current strategy

Confidence

The majority of the interviewees did say the new strategy contributed to the progression that has been made so far. The confidence of the industry organizations has grown since the involvement of the EC and the SJU.

["… every party is more or less convinced that SES will come, and that's progression."]
interview #12, KLM

["*Does the LVNL have more confidence in a harmonized ATM system, than before the EC and the SJU got involved?* I would say yes, because you do see a positive development towards the realization of the SES."]
interview #9, LVNL

However, there appears to be a thin line between confidence and uncertainty, as the majority of the interviewees also indicated that they have their doubts concerning this strategy for the future of the SESAR program. For that reason KLM has taken a step back in the SES project.

Mission, vision and strategy

The current strategy towards the realization of the SES influences the industry organizations' mission, vision and strategy (Roland Berger Strategy Consultants, 2007, p. 8).

["We are more involved with the realization of the SES. We want to make sure our interests are not forgotten along the process."]
interview #13, Ministry of Defense

["Our organizations' mission, vision and strategy definitely changed because of the introduction of SES. We've put more emphasis on SES developments by establishing a department in which 11 employees are working on the SES developments.`]
interview #15, MUAC

Resources

SJU provides financial support and that's perceived more accessible than the resources available during the time EUROCONTROL was still guiding this project.

["It got a little bit easier for us to get resources because the SJU set up a separate WP for research. And the SJU also provides a financial contribution for the activities conducted within this WP."]
interview #17, TUD

Achievements

The industry organizations have also seen some successes in the establishment of the FABs, trials, harmonization through better collaborations and the defragmentation of research.

["Functional Airspace Block Europe Central (FABEC) is arranged, SESAR is arranged."]
interview #1, LVNL

["The AIRE trial is an example of progression towards the realization of the SES."]
interview #2, LVNL

["I think that the work we've been doing in SESAR has actually achieved defragmentation of research."]
interview #18, EUROCONTROL

Faster

However progression is found to be extremely slow (SESAR Joint Undertaking, 2011, p. 56), some say it goes faster than it did during the period when EUROCONTROL led the European ATM development.

["We noticed that the progression rate increased compared to EUROCONTROL times."]
interview #13, Ministry of Defense

Top-down pressure

These progression successes are, according to the interviewees, caused by the top-down pressure executed by the EC, SJU and EUROCONTROL.

["… we could not have achieved these goals if something like SES didn't come into this world, because you need to collaborate within Europe to accomplish this. As well as mandates and vigor from the EC."]
interview #11, NLR

There are some mixed perceptions when it comes to the progression made so far towards the realization of the SES. However, the majority believes that at least some progression has been made as organizations are increasingly crossing borders in finding solutions to their problems. The industry managed to create a common view of the direction they'll be moving in. The involvement of the EC and the SJU increased the confidence in the enforceability of the SESAR activities.

6. Conclusion

This thesis aimed to test the LTS theory combined with the path management notion. It also aimed to gain insights in how the industry can best anticipate to the developments coming from the SES program.

I started this thesis by asking **How does the existing Large Technical System, and the interplay between the institutions and the Dutch aviation industry, influence the progression towards the Single European Sky?**

Accordingly, I've stated three propositions to find an answer to this question.

PROPOSITION 1: THE CURRENT LTS CHARACTERISTICS OF THE AVIATION SECTOR HAVE A CONSTRAINING INFLUENCE ON THE ACTIVITIES THAT THE INSTITUTIONS AND THE DUTCH INDUSTRY CARRY OUT.

This proposition is validated. The differences in locally installed technologies, procedures and processes between European nations formed different technological styles across Europe. As a result nations have different priorities on which they want to focus their activities. The differences in technological style caused fragmentation in the European ATM system. Fragmentation, military, old technologies, human factors and airport congestion are holding the aviation industry back in its performance. However, there are differences in the sense of urgency across the industry organizations to solve these reverse salients. This creates difficulties, as the aviation industry organizations are interdependent. Furthermore, the current European aviation sector is a stable, mature, complex, and inert system, which explains why it's difficult to achieve changes by carrying out activities.

PROPOSITION 2: THE INSTITUTIONS AND THE DUTCH INDUSTRY INFLUENCE EACH OTHER IN THEIR PATH CREATION-, PATH EXTENSION- AND PATH DEVIATION ACTIVITIES.

This proposition is also validated. During path creation, i.e. SESAR definition phase, the institutions positively influenced the Dutch aviation sector. In the initial phase of SESAR, only Schiphol decided to become a member of the SJU via SEAC. The rest of the Dutch industry organization got involved in a later stage as associate partner or subcontractor due to different incentives coming from both the Dutch industry organizations as the institutions. These incentives were subsidies, workshops to create a better understanding, and pressure from other Dutch industry organizations.

During path extension, i.e. development phase, the institutions are attempting to push this process over a point of no return. However, due to the skepticism towards the strategy taken by the institutions, as well as the economic downturn, industry organizations tend to take a step back. As a result the European institutions are currently working to keep the buy-in as this is a prerequisite for SES to succeed.

The path deviation phase is scheduled to start in 2014, however some regulations are already released in the form of implementation rules. These influence the industry organizations to take actions to implement SES related technologies, processes or procedures. However, there is misalignment in

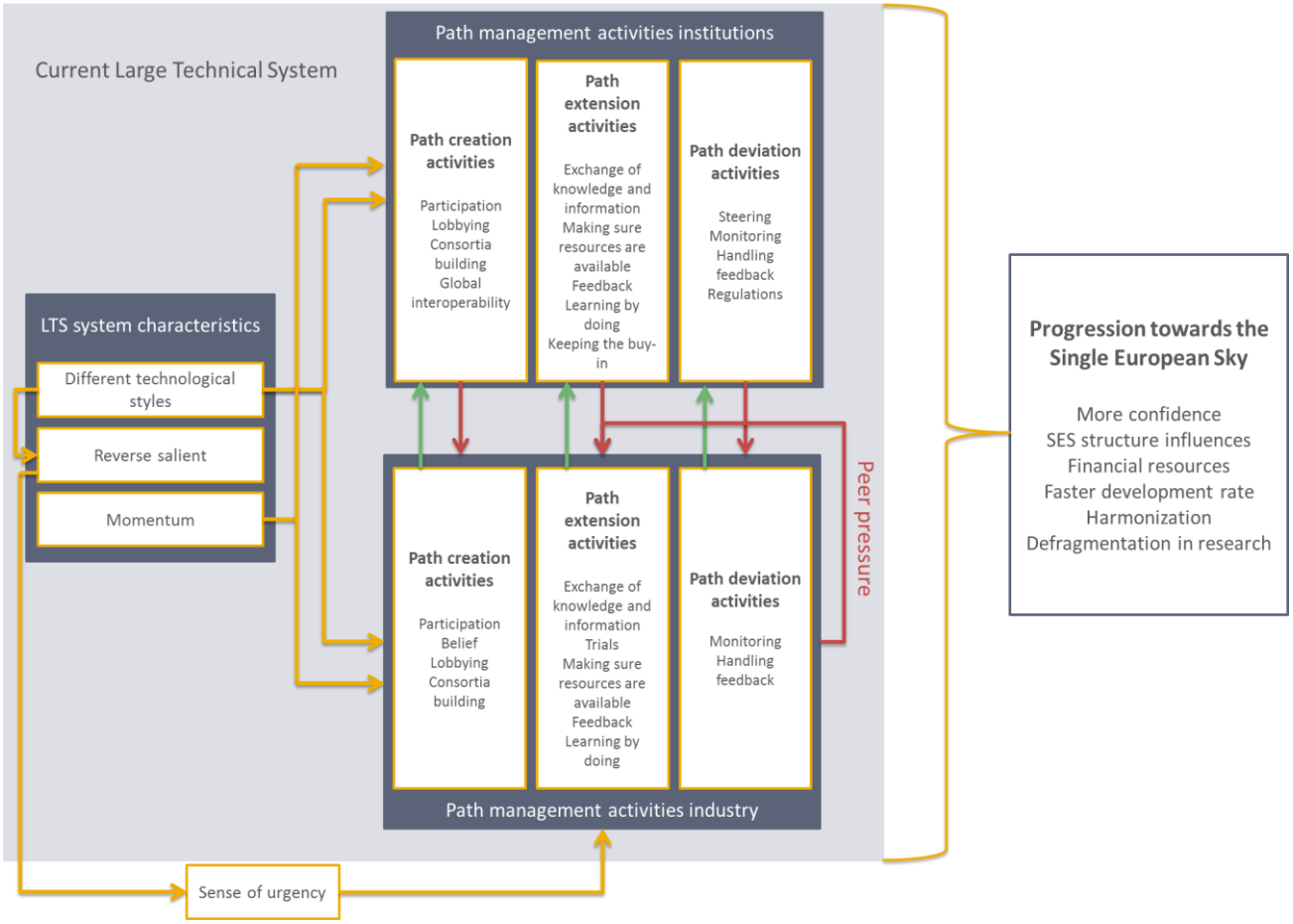

FIGURE 21 - REVISED CONCEPTUAL MODEL

this process as airlines do receive the implementation rule to implement their part of the technology, but the ANSPs don't receive an implementation rule saying they need to install theirs.

PROPOSITION 3: THE PATH MANAGEMENT ACTIVITIES CARRIED OUT BY BOTH THE INSTITUTIONS AND THE INDUSTRY FOSTER THE PROGRESSION TOWARDS THE SES.

Proposition 3 is validated because it is safe to conclude that some progression has been made due to the current strategy. So far, the European aviation sector has achieved defragmentation of research, there were some successful trials, and some implementation rules have been released by the EC. This indicated that the industry has been able to create standards. During the path creation phase confidence has increased, but this requires maintenance. There is a thin line between confidence and uncertainty, and airlines have taken a step back as a result of a decrease in confidence. These achievements are caused by the activities carried out by the industry, as well as the top-down pressure executed by the institutions. The current strategy has worked for the path creation phase , as not every organization had to participate. However, the path deviation phase requires a different strategy, as every industry organizations has to participate, and because the SES project is bigger than the EU. The latter makes it more difficult to execute top-down pressure.

Accordingly a revised conceptual model presents the LTS characteristics, the path management activities and the progression made since the involvement of the EC and the SJU. It also shows how some of these characteristics influence others or are being influenced by others (Figure 21).

7. DISCUSSION

Like every research, this research has some limitations. Starting with the theoretical framework. The path creation part of the theoretical framework is mostly based on the work of Strobel & Duschek (2007). There is, other than that paper, little research referring to the notion of path management. However, the fact that my research validated the propositions and was able to recognize the path management characteristics, adds to the credibility of this notion.

I've chosen a qualitative method to be able to provide explanations behind the certain activities taken by the sector organizations. Therefore, this research was subject to interpretation. Different formulated interview questions could have led to different answers. I took some pilot interviews first, to check whether the stated questions were interpreted like I intended to. Furthermore, I've used a qualitative data program to code the data according to its topic. Again this process is subject to interpretation. Due to the many relations it was difficult to create saturation in the coding process. I've reached that by deciding to stay close to the stated theoretical framework. As a result not all relations are discussed, only the ones that matter when it comes to this research.

Another limitation concerns the fact that I've chosen a single case study. A disadvantage of a single case study is that generalization of the results is difficult. I therefore chose a critical single case study. If the theoretical framework appears to be valid in a critical case it's most likely also valid in similar other cases as well (Eckstein, 2000). But that's still to be proven by means of further research.

The theoretical contribution of this research is that the extension of the LTS theory with the notion of path management is perceived to be validated in this case. These innovation theories were able to explain how the European aviation sector is attempting to innovate the ATM system, because the propositions were all validated. Furthermore, this combination of theories can be of great value for the intermediaries in a path management process. The intermediaries play an important role in these processes as they connect the strategies of the industry with the institutions. These theories can help the intermediaries fulfill this important role.

As for the practical contribution, it appears that there are a few points that need to be improved. Both the industry and the institutions believe in the common view of the SES, but a lack of confidence rules for the strategy taken within the set deadlines. I would recommend a feasibility study regarding the deadlines set by the institutions. There are many stakeholders involved, which business is at stake during the creation of a path towards the SES. This still causes resistance. The biggest bottlenecks are the time within SES has to be established, and the alignment of the strategies of the different participating organizations. A feasibility study could answer the questions; how these bottlenecks can best be solved, or whether there are ways to work around these bottlenecks by following a different strategy.

The EC appears to slowly take over the industry via the constitution of SES regulations. However, the industry is concerned about the amount of SES regulations. This disables the industry to provide the proper know-how for further developments, as their time is required to implement these. This is not a good development, as accordingly the EC can constitute regulations which have negative consequences for the industry organizations. I would recommend to the industry to stay involved and lobby for a more realistic approach towards the realization of the SES. This means that the time originally set by the institutions needs to be reviewed, based on the findings of this thesis.

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APPENDIX I – SEMI-STRUCTURED INTERVIEW QUESTIONS

TABLE 4 - OPERATIONALIZATION TABLE

	Concepts	Interview questions
System characteristics	Reverse salient	Do you agree with the following statement? The way Air Traffic Management is arranged constrains the European aviation industry to grow. Explain why? Does that influence this organization to execute activities for the purpose of the SES? If so, how?
	Technological style	Even though the way in which aircraft are handled per nation is captured by European regulations, differences between nations exist. Think of the differences in airport arrangements, airspace arrangements and ATC procedures (e.g. London is working with holding patterns, while the Netherlands is lining aircraft up). Do you think that sort of differences between nations is influencing the process towards the SES? If so, how?
	Momentum	On a scale from 1 to 5 could you indicate how you would assess the following statements? DEFINITION STABILITY: A SITUATION WHICH TENDS TO REMAIN THE SAME WITHOUT AN INTERVENTION. Not at all 1 2 3 4 5 Very How would you rate the degree of stability in the European aviation sector? How would you rate the ease with which changes are accomplished in the European aviation sector? DEFINITION COMPLEXITY: DIFFERENT FUNCTIONS AND ORGANIZATIONS WITHIN A SECTOR THAT ARE LARGE IN AMOUNT AND INTERDEPENDENT UPON EACH OTHER. How would you rate the degree of complexity in the European aviation sector? To what extent is a technological development in the European aviation sector, once under way, difficult to stop/reverse? **For the institutions only:** **How would you rate the ease with which your organization**

		can control/steer the industry in its activities towards improvements?
	Path creation activities	Could you also indicate per question whether your organization executed the activity based on the organization's own initiative or whether the activity was executed based on pressure from the institutions? Does/Did your organization lobby for support for the purpose of the SES? Does/Did your organization form a consortia with others for the purpose of the SES? **For the institutions only:** **Does/Did your organization present SES in a way that makes sense to the industry and includes their interests?**
	Path extension activities	Could you also indicate per question whether your organization executed the activity based on the organization's own initiative or whether the activity was executed based on pressure from the institutions? Are the developments towards the SES important for your organization? Does your organization share knowledge and information with other organizations for the purpose of the SES? How would you rate the credibility and legitimacy of the SES project? (how come?) Not at all 1 2 3 4 5 Very Does your organization test SES technologies? (why?) **For the institutions only:** **What does your organization do to prioritize the SES among the industry?** **Does your organization make resources available for the industry to execute activities for the purpose of the SES?** **What does your organization do to enhance the credibility and the legitimacy of the SES project?**
	Path deviation activities	Could you also indicate per question whether your organization executed the activity based on the organization's own initiative or whether the activity was executed based on pressure from the institutions? Does your organization monitor other organizations' activities which they conduct for the purpose of the SES? Does your organization receive feedback regarding the activities it executes for the purpose of the SES? Does your organization receive feedback regarding the tests of the SES technologies? If applicable: What does your organization do with the received feedback regarding SES technologies/activities? Does your organization invest in the SES with money, manpower, and other resources?
Progression towards the SES	Progression	Does your organization notice any progression concerning the

		SES since the introduction of the SJU? What are the main reasons to thank for that progression? Does your organization have better access to resources since the introduction of the SJU? Do you believe there is a more collective approach towards the SES since the introduction of the SJU? Did your organization's thrust/believe in the SES project increased since the introduction of the SJU?

APPENDIX II – PILOT INTERVIEW FOR THE INDUSTRY

	Questions related to the interviewee's background
1	What is your function within this organization, and what are your main tasks?
2	How long have you been working for this organization?
3	How long have you been fulfilling this function?
	General questions related to the European aviation system and the SES
4	Do you believe implementing the SES is necessary? (why)
5	Do you believe the industry needs the institutions to manage the SES project? (why and what's your opinion regarding their current stragey)
6	What motivates your organization to participate in the SES project? (how)
7	Are there any circumstantial factors influencing your organization's ability to achieve a transition towards the SES? (which factors and how)
8	Do any of these aspects hinder your organization in taking actions towards the SES? (how)
9	Are there any system components that have a low performance level that hampers the rest of the European aviation system in its overhaul performance? (which components and how)
10	Are the current industry norms, -values, -standards influencing your organization's ability to achieve a transition towards the SES? (how)
11	How would you rate the existing aviation system's degree of stability? **Not at all 1 2 3 4 5 Very** How would you rate the existing aviation system's degree of inertia? **Not at all 1 2 3 4 5 Very** How would you rate the existing aviation system's degree of complexity? **Not at all 1 2 3 4 5 Very** Is it difficult to control the existing aviation system's activities? **Not at all 1 2 3 4 5 Very** Is progression of technological developments, once underway, inevitable, unavoidable and irreversible in the current aviation system? **Not at all 1 2 3 4 5 Very** (how) How important is the SES in your organization's daily operation? **Not at all 1 2 3 4 5 Very** (why)
	Questions related to the activities your organization is carrying out for the purpose of the SES
12	What sort of activities does your organization carry out to contribute to a transformation towards the SES? (why and how do these contribute towards the SES)

13	Does your organization collaborate with other organizations in relation to the SES project? (which organizations and why)
14	How does your organization exchange knowledge/information with other organizations?
15	Does your organization give other organizations/institutions feedback regarding their intentions?
16	Does your organization receive feedback regarding the activities/intentions of your organization?
17	What does your company do with the received feedback? (why)
18	What investments did your organization make regarding the SES project?
19	What are the consequences for your organization when the SES project doesn't work out?
20	Does your organization lobby for certain policies, rules and activities among other organizations/institutions to get implemented?
21	Does your organization conduct tests regarding the SES project? (how and why)
22	What activities does your organization/company carry out to prevent a fragmented approach towards the SES?
	Questions related to the relation with the institutions
23	Do the institutions take in account your organization's interests? (how)
24	How do the institutions influence your organization's ability to achieve a transition towards the SES?
25	Does your organization gets stimulated by the institutions to carry out activities for the purpose of the SES?
26	Does your organization have a clear view regarding the activities it needs to carry out regarding the SES? (how come?)
27	How would you rate the credibility and legitimacy of the SES project? **Not at all 1 2 3 4 5 Very** (why)
	Questions related to the progression towards the SES
28	To what extend does your organization's mission, vision and strategy support the aims of the SES project? **Not at all 1 2 3 4 5 Very** (why)
29	(in case previous question answered with Very (4 or 5)) Did your organization had to adjust its mission, vision and strategy in order to align them with the SES aims? (why) (in case previous questions answered with not at all (1, 2 or 3)) Is your organization experiencing any problems because of the disarranged mission, vision and strategy? (how is your organization coping with that)
30	Does your organization have better access to resources since 2004? (how)
31	Do you believe there is less fragmentation in the approach towards the SES since 2004? (how)
32	Did your organization's confidence in this SES project grew over the years? (why and how)
33	Did your organization notice any progression regarding the SES since 2004? (how)
34	What are the main reasons to thank for that progression? (why)
35	Do you have any additional documented information available (that is not publicly available) that you would be able to give to me for the purpose of this research?

APPENDIX III – OFFICIAL INTERVIEW DESIGN INDUSTRY

- **INTRODUCTION THESIS**
  My master thesis is about the SES and how organizations solely, and together, are creating a path towards the SES.
- **GOAL OF THE INTERVIEW**
  By means of this interview I would like to find out to what extent the existing aviation sector is influencing the activities conducted by the organizations, what particular activities these organizations are executing, to what extent pressure from the institutions play a part in this and how all of this is influencing the realization of the SES.
- **INTERVIEW THEMES**
  During this interview I will ask questions regarding the following themes;
  - Your function
  - Your opinion about the influences of the existing aviation sector onto the realization of the SES
  - The activities your organization is executing to create a path towards the SES
  - And finally some questions regarding the progression
- **REQUEST**
  If you don't have a problem with it, I would like to record this interview. The recording will not be shared with others and will only be used for the purpose of this thesis. Your name will also not be mentioned in my thesis report. Instead I will use the title of your function.
- **INTERVIEW RESULTS**
  I will use this to write down the entire interview, which I will send it to you afterwards, so you'll have the opportunity to read it again and possibly adjust your answers. I will use this data solely for the purpose of this thesis and it will remain anonymous to third organizations.
- **DO YOU HAVE ANY QUESTIONS OR REMARKS BEFORE WE START THIS INTERVIEW?**

	Interview questions	
1	What is your function within this organization and what are your most important tasks?	
2	How long have you been working for this organization?	
3	How long have you been fulfilling this function?	
4	Do you agree with the following statement? The way Air Traffic Management is arranged constrains the European aviation industry to grow.	Explain why.
5	Does that influence this organization to execute activities for the purpose of the SES?	If so, how?
6	Even though the way in which aircraft are handled per nation is captured by European regulations, differences between nations exist. Think of the differences in airport arrangements, airspace arrangements and ATC procedures (e.g. London is working with holding patterns, while the Netherlands is lining aircraft up). Do you think that sort of differences between nations is influencing the process towards the SES? If so, how?	
7	Could you indicate, on a scale from 1 to 5, where 1 = Not at all and 5 = Very, what your experiences are regarding the following	

	questions?							
	Not at all 1 2 3 4 5 Very							
8	DEFINITION STABILITY: A SITUATION WHICH TENDS TO REMAIN THE SAME WITHOUT AN INTERVENTION.	Not at all				Very		
	How would you rate the degree of stability in the European aviation sector?	1	2	3	4	5		
9	How would you rate the ease with which changes are accomplished in the European aviation sector?	1	2	3	4	5		
10	How difficult is it to control/steer activities taken within the European aviation sector?	1	2	3	4	5		
11	DEFINITION COMPLEXITY: DIFFERENT FUNCTIONS AND ORGANIZATIONS WITHIN A SECTOR THAT ARE LARGE IN AMOUNT AND INTERDEPENDENT UPON EACH OTHER.							
	How would you rate the degree of complexity in the European aviation sector?	1	2	3	4	5		
12	To what extent is a technological development in the European aviation sector, once under way, difficult to stop/reverse?	1	2	3	4	5		
13	The following questions concern the activities your organization is executing for the purpose of the SES. Can you also indicate per question whether institutional pressure played a part?	Own initiative			Institutional pressure			
	Does your organization collaborate with other organizations for the purpose of the SES?	☐			☐			Why?
14	Does your organization share knowledge and information regarding the SES with other organizations?	☐			☐			Why?
15	Does your organization lobby for support for the purpose of the SES?	☐			☐			Why?
	DEFINITION LOBBY: AN ATTEMPT TO INFLUENCE PARTIES / ORGANIZATIONS / AUTHORITIES / INDIVIDUALS OR GUIDE THEM IN A PREFERRED DIRECTION.							
16	Does your organization test SES related technologies/ideas?	☐			☐			Why?
17	Does your organization put aside resources for the execution of SES related procedures/technologies/ideas?	☐			☐			Why?

18	Does your organization monitor other organizations' activities which they conduct for the purpose of the SES?	☐	☐	Why?
19	Does your organization provide feedback regarding SES related activities?	☐	☐	Why?
20	Does your organization invest in the SES with money, manpower, and other resources?	☐	☐	Why?
21	What does your organization do with the received feedback?	☐	☐	Why?
22	How important are SES related developments for your organization?	☐	☐	Why?
23	Does your organization believe in the SES?		How come?	
24	What other activities are your organization executing to contribute to a transformation towards the SES?	☐	☐	Why?
	Does your organization have better access to resources since the introduction of the SJU?			
25	Do you believe there is a more collective approach towards the SES since the introduction of the SJU?			
26	Did your organization's confidence in the SES project increased since the introduction of the SJU?			
27	Does your organization notice any progression concerning the SES since the introduction of the SJU?			
28	What are the main reasons to thank for that progression?			
29	What, according to you, needs to happen to improve the progression towards the SES?			

Do you have any reports, documents or emails regarding these topics that you can share with me?

Can I approach you again, when I need some more clarity regarding one of these topics?

- **Introductie scriptieonderwerp**
  Mijn scriptie gaat over de SES en hoe bedrijven alleen, en met elkaar, een pad creëren naar die SES.
- **Doel interview**
  Het doel van dit interview is om erachter te komen in hoeverre de bestaande luchtvaartsector van invloed is op de acties die de bedrijven uitvoeren, welke acties de bedrijven uitvoeren, in hoeverre druk van bovenaf hierbij een rol speelt en hoe dit alles van invloed is op de realisatie van de SES.
- **Onderwerp interview**
  Tijdens dit interview zullen de volgende onderwerpen aan bod komen;
  - Uw functie,
  - Uw mening over invloeden van de bestaande luchtvaartsector op de realisatie van de SES
  - De acties die uw organisatie uitvoert om een pad te creëren naar de SES
  - En tot slot een paar vragen over de vooruitgang die geboekt is.
- **Verzoek**
  Voordat we beginnen wil ik u vragen of ik dit interview op mag nemen. De opname zal niet aan anderen beschikbaar worden gesteld en zal uitsluitend gebruikt worden voor mijn scriptie. Ook zal uw naam niet genoemd worden in mijn scriptie.
- **Resultaten interview**
  Na afloop zal ik dit interview uitschrijven en naar u toesturen, zodat u het nog een keer kan lezen en eventueel op uw antwoorden terug kunt komen. De data zal uitsluitend gebruikt worden voor mijn scriptie.
- **Heeft u verder nog vragen of opmerkingen?**

	Interview vragen	
1	Wat is uw functie binnen deze organisatie en wat zijn uw belangrijkste taken?	
2	Hoe lang bent u al werkzaam binnen deze organisatie?	
3	Sinds vervult u deze functie al?	
4	Bent u het eens met de volgende stelling? Air Traffic Management belemmert de Europese luchtvaartindustrie om te groeien.	Leg uit waarom.
5	Beïnvloed dat deze organisatie om acties te ondernemen ten behoeve van de SES?	Zo ja, hoe?
6	Ondanks het meeste is vastgelegd in de Europese regelgeving, er blijven verschillen zitten in de manier waarop een land met het vliegverkeer om gaat. Denk hierbij aan de verschillende manieren waarop een vliegveld of een nationaal luchtruim is ingedeeld, wat procedures met zich mee brengt die per land verschillen. Een voorbeeld is de manier waarop de luchtverkeersleiding het vliegverkeer rondom Londen afhandelt, zij werken met holding patterns waar zijn continue vliegverkeer uit trekken om te laten landen, waar de Nederlandse verkeersleiding dit verkeer al van tevoren achter elkaar op lijnt om een continue toevoer te kunnen bewerkstelligen. Beïnvloed dit soort verschillen de aanpak naar de SES? Zo ja, hoe?	
	Kunt u aangeven op een schaal van 1 tot 5, waarbij 1 = helemaal niet en 5 = heel erg, wat uw ervaringen zijn met betrekking tot de volgende vragen? Helemaal niet 1 2 3 4 5 Heel erg	

7	DEFINITIE STABILITEIT: STABILITEIT IS EEN SITUATIE WAARIN, ZONDER VERSTORINGEN, GEEN VERANDERING PLAATS ZAL VINDEN.	Helemaal niet				Heel erg
	Hoe zou u de mate van stabiliteit van de huidige Europese luchtvaartsector beoordelen?	1	2	3	4	5
8	Is het makkelijk om veranderingen in de huidige Europese luchtvaartsector te bewerkstelligen?	1	2	3	4	5
9	DEFINITIES COMPLEXITEIT: DE MATE WAARIN DE VERSCHILLENDE FUNCTIES, BINNEN EEN SECTOR, GROOT IN AANTAL EN AFHANKELIJK VAN ELKAAR ZIJN.					
	Hoe zou u de mate van complexiteit van de huidige Europese luchtvaartsector beoordelen?	1	2	3	4	5
10	Hoe moeilijk is het om de verschillende activiteiten die uitgevoerd worden in de Europese luchtvaartsector te sturen/controleren?	1	2	3	4	5
11	Is het makkelijk om een technologische ontwikkeling, wanneer deze eenmaal in gang gezet is, terug te draaien/af te breken?	1	2	3	4	5
12	De volgende vragen gaan over de acties die uw organisatie onderneemt ten behoeve van de SES. Kunt u naast het antwoord op de vraag ook aangeven waardoor deze actie wordt uitgevoerd? Komt dat door eigen initiatief vanuit de organisatie of door druk van bovenaf?		Eigen initiatief		Druk van bovenaf	
	Werkt uw organisatie samen met andere organisaties ten behoeve van de SES?		☐		☐	Waarom?
13	Deelt uw organisatie kennis en informatie over de SES met andere organisaties?		☐		☐	Waarom?
14	Lobbyt uw organisatie voor ondersteuning ten behoeve van de SES?		☐		☐	Waarom?
15	Test uw organisatie SES gerelateerde technologieën/ideeën in de praktijk?		☐		☐	Waarom?
16	Zorgt uw organisatie dat er middelen beschikbaar zijn voor het invoeren van SES gerelateerde procedures/technologieën/ideeën?		☐		☐	Waarom?
17	Monitort/Controleert uw organisatie de acties die andere organisaties uitvoeren ten behoeve van de SES?		☐		☐	Waarom?
18	Ontvangt uw organisatie feedback met betrekking tot de acties die uw organisatie uitvoert voor de SES?		☐		☐	Waarom?
19	Investeert uw organisatie in het SES project met geld, mankracht en andere middelen?		☐		☐	Waarom?
20	Wat doet uw organisatie met de ontvangen feedback?		☐		☐	Waarom?
21	Zijn de ontwikkelingen naar de SES belangrijk voor uw organisatie?		☐		☐	Waarom?
22	Gelooft uw organisatie in de SES? Hoe komt dat?					

23	Wat voor andere acties onderneemt uw organisatie ten behoeve van de SES?	□	□	Waarom?
24	Is het makkelijker voor uw organisatie om aan de middelen te komen om de acties voor de SES uit te kunnen voeren, sinds de introductie van de SJU?			
25	Is er nu sprake van een betere gezamenlijke aanpak naar de SES, sinds de introductie van de SJU?			
26	Heeft uw organisatie nu meer vertrouwen in het SES project, sinds de introductie van de SJU?			
27	Heeft uw organisatie gemerkt dat er vooruitgang geboekt is naar de bewerkstelliging van de SES, sinds de introductie van de SJU?			
28	Waar is die vooruitgang volgens u aan te danken?			
29	Wat moet er volgens u gebeuren om de progressie naar de SES te verbeteren?			

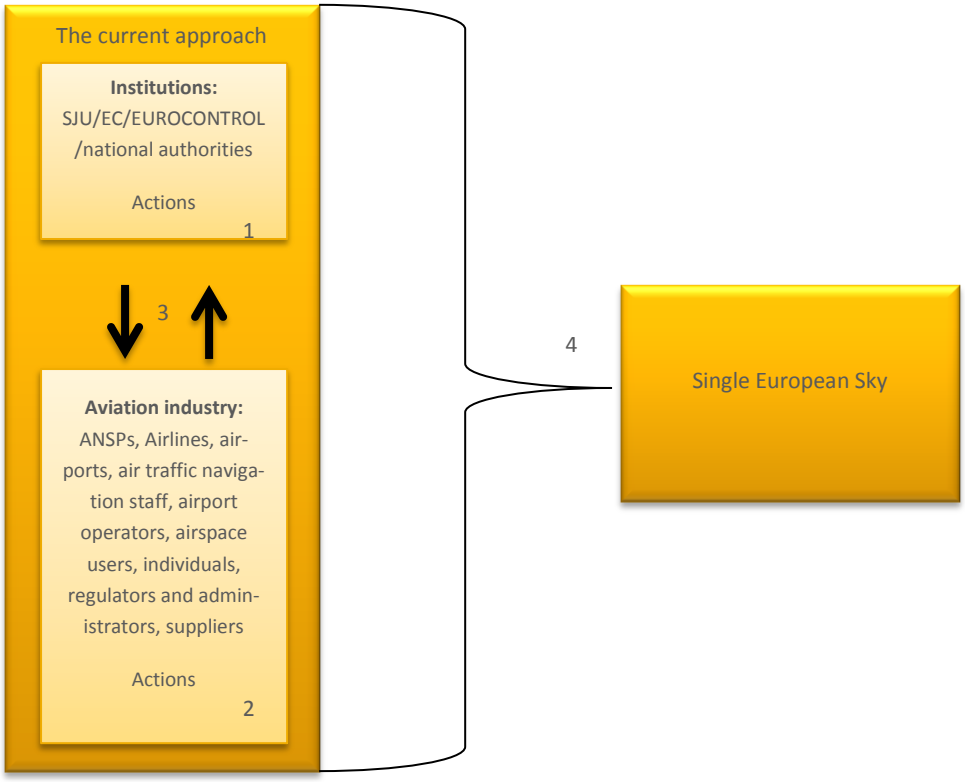
Heeft u nog documenten, rapporten of e-mails over deze onderwerpen die u mij kunt toesturen/meegeven?

Vindt u het goed als ik u nog een keer benader, wanneer mij over bepaalde onderwerpen van deze vragenlijst nog wat extra vragen te binnen schieten?

APPENDIX IV – OFFICIAL INTERVIEW DESIGN INSTITUTIONS

INTRODUCTION THESIS SUBJECT

By means of this thesis I'm investigating how organizations along, but also in collaboration with each other, contribute to the creation of a path towards the Single European Sky.



1) What actions are taken by the institutions to contribute to the realization of the SES?
2) What actions are taken by the (Dutch)industry to contribute to the realization of the SES?
3) How are the institutions and the industry influencing each other? (top-down versus bottom-up approach)
4) How is this current approach influencing the progression towards the realization of the SES?

GOAL INTERVIEW

By means of this interview I hope to find out to what extent the existing aviation sector and infrastructure is influencing the actions taken by the institutions and the aviation industry, which actions are taken by the industry organizations, to what extent top-down pressure plays a role in this, and how this current approach is influencing the progression to the realization of the SES.

THEMES WITHIN THIS INTERVIEW

- Some function related questions;
- Your opinion about the influences of the existing aviation sector + infrastructure;
- The actions your organization is taking to contribute to the realization of the SES;
- To conclude with some questions regarding the progression.

REQUEST

Before we start I would like to ask you if it's okay if I record this interview? This recording will not be used for any other purposes than my thesis. It will not be shared with other parties, and your name will be excluded from my thesis report.

- RESULTS

After this interview I will literally write down what we have said. I will send this to you so you'll have the opportunity to get back at your answers or give me feedback of any other kind you find relevant. I will use the revised version of that interview for my thesis.

- DO YOU HAVE ANY QUESTIONS BEFORE WE START THIS INTERVIEW?

	Interview questions	
1	How is your function, Director ATM Strategies, related to SES and then specifically SESAR?	
2	Do you have any previous experience with SES, and then specifically SESAR?	
3	Do you agree with the following statement? The way the airspace is arranged constrains the European aviation industry to grow. DEFINITION AVIATION INDUSTRY: EVERY COMPANY AND ORGANIZATION THAT DIRECTLY CONTRIBUTES TO THE AVIATION SECTOR. DEFINITION AVIATION SECTOR: THE AVIATION INDUSTRY + THE EXISTING INFRASTRUCTURE (RUNWAYS, TAXIWAYS, NAVIGATION AIDS, AIR ROUTES, ATC TOWER, ETC.).	Please explain why you do or don't agree with this.
4	Influences this your organization to take actions to contribute to the realization of the SES?	If so, how?
5	Despite the fact that most is recorded in ICAO and European legislation, there are still differences between countries in the way they handle the airspace users. Think about different environments (Austria, Norway and Switzerland have to deal with mountains, where the Netherlands is flat), weather conditions, but also differences in procedures. For example, if your compare ATC in the Netherlands with ATC in England, there is a significant difference in the way they deal with arriving airspace users. London Heathrow uses stacks where they store their arriving air traffic, while Schiphol Airport lines them up in advance. The question belonging to this is; do you think these differences in countries influence the approach towards the realization of the SES? If so, how?	
	Could you indicate on a scale from 1 to 5, where 1 equals completely not and 5 equals very much, what your experience is	

	concerning the following questions?					
6	DEFINITION STABILITY: BALANCE.	Completely not				Very much
	Is there a certain degree of stability in the daily operation of the aviation sector (in general)?	1	2	3	4	5
7	Is it difficult to accomplish changes in the current aviation sector (in general)?	1	2	3	4	5
8	DEFINITION COMPLEXITY: THE DEGREE IN WHICH DIFFERENT FUNCTIONS, WITHIN A SECTOR, ARE LARGE IN AMOUNT, AND DEPENDENT UPON EACH OTHER.					
	How would you rate the degree of complexity of the current aviation sector (in general)?	1	2	3	4	5
9	Is it difficult to reverse/discontinue technological developments, once they are under way?	1	2	3	4	5
10	How do the stages of these factors (stability, complexity, accomplish changes, reverse/discontinue technological developments) influence your organization to contribute to the realization of the SES?					
	The following group of questions are about the actions your organization is taking to contribute to the realization of the SES.					
11	What are the main reasons for your organization to collaborate with others?					
12	Does your organization share knowledge and information with others regarding SESAR related aspects?					Please explain why and what kind of information?
13	Does your organization lobby for support among the aviation industry, or other organizations when it comes to the SES?					Please explain why and among which organizations?
14	Does your organization stimulate other stakeholders/participants to support the SES(AR) mission, vision and strategy?					If so, how?
15	Does your organization make sure there are resources (money, manpower, technology, etc.) available for SESAR related actions?					Why? Are there any conditions involved?
16	Does your organization monitor/steer other organizations in their actions towards the realization of the SES?					Why and how?
	When doing so, does your organization take into account the interests (mission, vision and strategy) of the industrial parties or the nations?					Why and how?

17	Does your organization provide feedback to others concerning their actions towards the realization of the SES?	Why and how?
18	Does your organization receive feedback from others concerning your actions or ideas towards the realization of the SES?	From which organizations?
19	How does your organization handle the received feedback?	Please explain why?
20	What actions does your organization take to realize a common industrial approach towards the realization of the SES? In other words; What does your organization do to keep the industry focused at SES developments?	Why? And how?
21	What does your organization do to enhance the credibility and legitimacy of the SES project?	Why and how?
22	Does your organization execute top-down pressure on the stakeholders? If so, what are the usual responses to that?	Please explain how and why?
23	Does your organization give penalties?	
24	How are the industrial parties influencing your organization to take actions that contribute to the realization of the SES?	
25	Does your organization help to overcome resistance and indifference of the stakeholders?	How?
26	What does your organization do to prepare the sector for SES(AR)?	
27	Are there any other actions your organization is taking to contribute to the realization of the SES?	
28	Do you believe there is a common mission, vision and strategy among the industrial parties towards the SES, since the EC and SJU got involved?	
29	Do you think there is a better common approach towards the realization of the SES, since the EC and the SJU got involved?	
30	Does your organization has more confidence in the SES project, since the EC and the SJU got involved?	
31	Did your organization notice any improvements towards the realizations of the SES, since the EC and the SJU got involved?	
32	What caused that progression?	
33	Are there any aspects, within the current strategy, that you think can be approved?	

APPENDIX V – CASE STUDY PROTOCOL

A case study protocol helps to guide the researcher in carrying out the data collection from a single case study (Yin, 2003). The research questions, propositions, theoretical framework and method are discussed in sections 0, 2 and 4, so this protocol only emphasizes the topics under investigation, the sources used to collect the data from, time schedule, the interview questions, and the nominated interviewees.

TOPICS

To be able to answer the research questions and achieve the research aims, relevant data has to be collected regarding the following topics;

- The characteristics of the current aviation sector as LTS.
- How these characteristics are influencing the activities carried out for the purpose of the SES.
- The activities the institutions are carrying out for the purpose of the SES.
- The activities the industry is carrying out for the purpose of the SES.
- How both organizations are influencing one another in their activities for the purpose of the SES.
- How all this together is influencing the progression towards the SES.
- And whether progression has happened since 2004 regarding the SES.

SOURCES

Data regarding these topics are collected via semi-structured interviews with members from the organizations mentioned in Table 6. These interviewees will be asked whether they have documented material available for this research, like archival documentation or emails. Furthermore, additional publicly available data is collected from websites and journals. This data is used to support the data collected via the semi-structured interviews.

TABLE 5 - PUBLICLY AVAILABLE DATA

Websites	Journals	Books
http://www.lvnl.nl/nl/nieuws-pers	SESAR magazine	Achieving the Single European Sky Goals and Challenges
http://www.klm.com/corporate/en/publications/index.html	Airspace journal	Beyond open skies: a new regime for international aviation
http://www.nlr.nl/reports/	Air traffic management magazine	European aviation law
http://www.eurocontrol.int/content/maastricht-uac	Journal of air transport management	An introduction to air law
http://www.schiphol.nl/index_shg.html	http://www.pdfmagazines.org/tags/SPs+Aviation/	
http://www.lr.tudelft.nl/actueel/laatste-nieuws/archief/year/2011//browse/2/select_category/15/		
http://www.knmi.nl/cms/content/12286/knmi_luchtvaartdienstverlening_gecertificeerd		
http://www.iata.org/pressroom/Pages/index.aspx		
http://ec.europa.eu/transport/air/single_european_sky/single_european_sky_en.htm		
http://www.eurocontrol.int/content/sesar-and-research		
http://www.eurocontrol.int/content/single-sky-europe		
http://www.sesarju.eu/		
http://www.a6alliance.net/		

INTERVIEWEES

From each organization, part of the case study under investigation (section 3), ideally one member related to the SES project will be interviewed. These members are identified based on the LVNL's business network, or on contact information found on SES related websites. A prerequisite used to select the interviewees is that their functions have to be directly related to the SES project. It is

assumed that the interviewees who's function is directly related to the SES project have the knowledge, information and insights available to answer the interview questions related to the stated research questions. The interviewees selected for the purpose of this research are incorporated in Table 6. To be able to provide the interviewees anonymity in this research, the names and (in case preferred by the interviewee) companies are presented as a black box.

The interviewees are approached the following email;

Dear Sir/Madam,

On behalf of Utrecht University and Air Traffic Control the Netherlands I'm conducting my master thesis regarding the Single European Sky.

I'm investigating this topic from an innovation perspective. I'd like to identify which actions are deliberately taken by the public and private organizations to achieve a Single European Sky. Based on the underlying motivations to conduct those actions I'd like to explore to what extend private organizations are conducting actions which are coordinated by the public organizations, and to what extend private organizations are conducting autonomous actions to achieve a Single European Sky.

In order to identify these actions I'd like to ask if you, on behalf of your company, would be willing to participate in this investigation. I'd like to have an interview with you regarding;

- **the actions your company is conducting towards the Single European Sky,**
- **the companies' perspective on the approach taken to achieve the Single European Sky, and**
- **its opinion regarding the constraining factors.**

As I continue to investigate this topic I might have some additional questions coming to the surface which I would like to ask you via e-mail or over the phone.

I'm looking forward to hear from you regarding my request.

Best Regards,

Beste Meneer/Mevrouw,

Als studente aan de Universiteit Utrecht studeer ik af binnen Luchtverkeersleiding Nederland op het onderwerp 'Single European Sky'.

Ik onderzoek hoe de huidige aanpak de overgang naar een 'Single European Sky' beïnvloed. Dit doe ik door vanuit een innovatieperspectief te gaan kijken naar de acties die organisaties uitvoeren voor de 'Single European Sky'. Vervolgens wil ik gaan identificeren in hoeverre deze organisaties gestuurd worden in hun acties door organisaties als de Europese Commissie, SESAR Joint Undertaking en EUROCONTROL en in hoeverre zij de acties zelfstandig uitvoeren.

Om dit te kunnen onderzoeken heb ik uw hulp nodig. Ik zou u bij deze willen vragen of u, namens uw bedrijf, mee zou willen werken aan dit onderzoek. Ik zou hiervoor graag een interview met u willen hebben waarin ik u wil vragen naar de volgende onderwerpen;

- **de acties die uw bedrijf uitvoert ten behoeve van de Single European Sky,**
- **het standpunt van uw bedrijf met betrekking tot de huidige aanpak, en**
- **uw mening betreffende de belemmerende factoren.**

Ik zie uw reactie graag tegemoet,

Hartelijke groeten,

Hellen Caspers
Master student Science & Innovation Management
Utrecht University

Interview questions

The semi-structured interviews are presented in appendix III and IV. Since the SES project is a large and complex project, it is expected that not every questions can be answered by every interviewee. Namely, some interviewees are specialized in a specific part of the SES project and is therefore not able to answer certain specific questions regarding relations he/she doesn't have anything to do with. It is attempted to adjust the interview questions to the interviewee's expertise based on insights provided by the LVNL. In case of doubt, the questions will be asked anyway. The interviewee is always able to say he/she doesn't have de knowledge, information or insights to answer that question.

Furthermore, some additional questions might come up during the interview, because topics might be raised which aren't foreseen in advance. These questions are recorded in the case study database and used during the data analysis.

At the beginning of each interview, the interviewee is asked whether he/she has a problem if I record the interview for the purpose of this research. But also whether he/she would like to remain anonymous in this research. At the end of each interview the interviewee is asked whether I can contact them in the future in case I need to ask them some more questions.

Time schedule

First, two planned pilot interviews will be conducted to pick out the interview design's flaws, limitations, or other weaknesses. Accordingly, the interview will be improved where necessary. Hence, this interview design will be used for the official interviews. An overview of the interviews I would ideally like to conduct is provided in Table 6 below. When the interviewees wish to stay anonymous in this research, the names and possibly the company names as well will be black boxed.

Table 6 - Important information regarding the interviews

Interview number	Interview type	Date	Organization	Function interviewee
1	Pilot	August	LVNL	ATM Expert
2	Pilot	August	LVNL	ATM Expert
3	Official	September	LVNL	SESAR Expert
4	Official	September	LVNL	FABEC Expert
5	Official	September	CANSO	ATM Expert
6	Official	September	LVNL	SESAR Expert
7	Official	September	LVNL	SESAR Expert
8	Official	September	LVNL	SESAR Expert
9	Official	September	LVNL	SESAR Expert
10	Official	September	NLR*	SESAR Experts
11	Official	September	NLR	SESAR Expert
12	Official	September	KLM	SESAR Expert
13	Official	September	MLA	SESAR Expert
14	Official	September	Ministry of Infrastructure & Environment*	SESAR Experts
15	Official	September	MUAC	SESAR Expert
16	Official	September	MUAC*	SESAR Experts
17	Official	September	TUD	SESAR Expert
18	Official	October	EUROCONTROL	SESAR Expert

- These interviews were group interviews with either two or three interviewees.

APPENDIX VI – CODE SYSTEM

Code system – the path towards a single European sky [923]

Large Technical System characteristics

- Different technological styles [43]
  - Historical events → different starting position [16]
  - Social conditions [3]
  - Geography [1]
  - Cultural conditions [2]
    - Safety [12]
    - Standards & Procedures [2]
    - Sovereignty [1]
    - Pivot = Schiphol [17]
    - Distinction civil/military [1]
  - Resources [3]
  - Regulatory legislation [3]
  - Economics [6]
    - Marginal business [3]
  - Influences [9]
    - Future developments [3]
      - Most demanding will be the norm [2]
    - Slows process down [5]
    - Creates different interests [10]
    - Economics influence [8]
    - Creates difficulties [3]
    - Current legislation constraints [4]
    - Complexity Schiphol creates central position in SES [3]

- Reverse salient [54]
  - Architecture of the system [37]
    - Fragmentation [35]
      - High costs [5]
      - Fragmented airspace arrangement [26]
        - ATM uses it in the most optimal way [1]
      - Different technological styles [3]
      - Too many ANSPs [4]
      - Part of the industry benefits from fragmentation [1]
    - Available airspace is scarce [2]
  - Competition [2]
  - Old technology [1]
  - Airport congestion [1]
  - Variable reverse salient [1]
  - Sector goals [9]
    - Improvement in KPAs [12]
    - Better efficiency [2]
    - Defragmentation [2]
  - Influences [3]
    - Causes sovereignty [8]
    - Constraints efficiency [9]
    - Will/Could become bottleneck in the future [6]
    - Constraints performance [7]

- Airspace congestion constraints growth [1]

Momentum [28]

- Mature industry [3]
  - Safety [7]
  - Legislation [1]
  - Procedures [1]
- Stability [4]
  - Dependent on human factor [2]
  - Dependent on weather [1]
  - Dependent on economics [1]
- Inertia [6]
  - Getting better [1]
- Complexity [6]
  - Dependencies [5]
  - Will grow [1]
- Developments, once on their way, are difficult to reverse [1]
- High load factor for airlines [2]
- Influence [6]
  - Difficult to create changes [6]
    - Due to low ambitions [1]
    - Due to dependencies [3]
      - Requires collaborations [1]
      - Different responsibilities and interests [2]
  - Complexity slows down process [1]
  - Control issues [1]
  - Needs top-down pressure [1]
  - Indicates the necessity of EUROCONTROL [1]
  - Stimulates research laboratory to take actions [1]
  - Not constraining organizations to take actions [1]

Path management

Path creation [112]

- Lobbying [26]
  - Own initiative when it concerns own interests [8]
  - Aware that Dutch ANSP does not have a big say [1]
  - To influence [13]
    - Own interests [13]
      - For others, because of dependencies [1]
      - To motivate industry [3]
      - For the Dutch interests [4]
      - To get developments in SESAR [4]
        - No lobbying on behalf of the SESAR program [2]
        - Lobbying for support among industry parties [2]
- Consortia building [26]
  - International collaborations [18]
  - National collaborations [11]
  - Creating a shared space [2]
  - Reduce costs [2]
  - Flexible workload [1]
  - Associate membership [8]
  - Help is required [5]
  - To reach a common approach [5]
  - Because of dependencies [9]

- To have an influence [12]
  - The Netherlands is small [9]
    - Little resources [3]
    - Small surface [1]
    - Little influence [3]
  - Collaborations create strength [16]
- Political reasons [11]
- To look after own interests [7]
- To know what's going on the in the industry [1]
- To prevent overlap [1]
- Required to reach harmonization [7]
- Money [1]
- Better quality [1]
- Own initiative [6]
- Due to top-down pressure [5]

Participation [44]

- Defragmenting research [1]
- Providing expertise [4]
- Performing research [4]
- Developing technologies [3]
- Own interests [19]
- Money [9]
- Belief [3]
- Alignment [3]
- There is no alternative [1]
- Join work group [4]
- Join standing committee [2]
- Join steering group [1]
- SESAR NL [1]
- Research [9]
- Own initiative [1]
- Due to top-down pressure [2]

Global interoperability [1]

- Harmonizing legislation in Europe [2]
  - Requires finding a balance [1]
    - Too much harmonization leads to constraints [4]
      - Due to lack of knowledge [1]

Belief [17]

- Because there is no alternative [1]
- Because you need a common approach to tackle this [4]
- Because SES is the only initiative that can rearrange the ATM system [1]
- Credible steps [1]
- Offers some advantages [1]
- In FAB [1]
- In line with own business profile [1]
- Because there are similar projects in other parts of the world [1]

Boundary spanning [5]

- Preparing the industry for SES [2]
- Arranging workshops [1]
- Establishing the SJU [2]

Path extension [87]

- Exchange of knowledge and information [26]

- Part of collaborating [10]
  - Required for decision making [1]
  - To guarantee operability [1]
  - To help Dutch aviation sector [1]
  - Consult with other ANSPs [1]
  - Dependencies [2]
  - To come across as reliable [1]
  - To achieve goals [3]
- To keep the buy-in [3]
- To benchmark [1]
- Politics play a role [3]
- Part of the process [6]
- Advise the ministry [1]
- Communication means [30]
  - ESSIP/LSSIP [1]
  - Consultations [8]
    - Stakeholder consultation meetings [4]
  - Knowledge Development Centre [1]
  - CANSO [2]
  - Program Management Board [3]
  - SESAR NL [4]
  - Steering group/steering board [2]
  - OR [1]
  - Single Sky Committee [1]
  - Workshops [1]
  - Documents produced by the SJU and EUROCONTROL [3]
  - Negotiations [4]
- Own initiative [3]
- Due to top-down pressure [1]

Trials and simulations [20]
- No proponent [1]
- Simulations [2]
- Part of the process [5]
  - To prove that it works [2]
  - To get feedback [1]

Making sure resources are available [17]
- Part of the process [1]
- Investing resources [12]
- When in line with own interests [3]
- For the purpose of the Dutch aviation sector [1]
- In consultation with the Dutch government [1]
- Own initiative [2]
- Due to top-down pressure [2]

Feedback [18]
- Providing feedback [7]
  - To prevent disappointment in the future [1]
  - On behalf of own interests [1]
  - For the benefit of the system [1]
- Receiving feedback [11]
  - Via monthly progression reports FABEC [2]
  - If not following the law [2]
  - Regarding trials [1]
  - To assess work that has been done [1]

- Informal [1]
- From collaboration partners and institutions [3]
- Industry appreciates help EUROCONTROL [1]
- Learning by doing [4]
- Keeping the buy-in [2]

Path deviation [55]

- Monitoring [25]
  - For own interests [11]
    - To seek for collaboration opportunities [1]
    - Following other's actions [2]
    - Out of professional curiosity [1]
    - To be prepared for what's coming [1]
    - Projects that concern own interests [6]
  - Institutions monitor industry [3]
    - EUROCONTROL monitors [4]
    - Are being monitored [3]
  - Within ministry [2]
  - ANSP does not monitor [3]
  - CANSO does not monitor [1]
  - Within consortium [2]
- Handling feedback [16]
  - To get publicity [1]
  - Reflect with own interests [2]
  - To satisfy the customers [1]
  - Structured approach [1]
  - Own initiative [3]
  - Due to top-down pressure [2]
- Steering [4]
  - Using incentives [4]
  - Providing deadlines [1]
  - Executing top-down pressure [6]
  - Providing penalties [2]
- Regulations [10]
  - Implementation rules [4]
  - Common requirements [6]

Interplay

Institutions [19]

- Top-down pressure [16]
  - By using… [49]
    - Deadlines [1]
    - Theoretical penalties [9]
    - Resources as incentives [5]
    - Contracts [2]
    - SES I, II, II+ packages [9]
    - EASA [2]
    - Common institutional agreement [2]
    - Political influence [1]
    - Slowly sharpens values KPAs [2]
  - Caused by… [8]
    - The airlines [4]
    - The NLR [3]
    - The fact that a lot of money is invested in this program [1]

- EC [3]
  - Decides tempo [1]
  - Absorbs input and makes decisions accordingly [1]
  - Directly influences industry [1]

Industry [52]

- Needs top-down pressure [20]
  - LVNL didn't sign up at first [7]
    - Unclear what SESAR is going to do [1]
    - High entrance fee [1]
    - No stimuli from the national government [1]
    - They wouldn't be of influence [1]
    - Rather spend resources on own developments [1]
    - Because it was too big, therefore difficult to manage [1]
    - 2nd opportunity as associate partner [5]
  - Appreciate guidance material [1]
  - Trusts EUROCONTROL with data [1]
  - Peer pressure [6]
    - Ask for help between industry partners [1]
    - To collaborate [3]
    - To create a sense of urgency [1]
    - To participate [3]
    - Guidance in the right direction [1]
    - Small ANSP creates trust [1]
    - ANSP wants to come across as a useful partner [1]
    - In FABEC [1]
  - Schiphol became founding member (SEAC) [1]
  - Airline companies drop out due to lack of significant progression [1]
  - Limited influence [1]
  - By means of lobbying [7]
    - With the EC [1]
    - Influence via project meetings [2]
    - NLR tried to become a member [3]
    - Lobby for exceptions, delay or postponement on legislation [1]
  - Input [14]
    - Provide expertise [10]
    - Happens once convinced of idea [1]
    - Invested money [1]
    - To look after own interests [2]
    - Advice/Consult ministry [2]

Connection bottom-up/top-down [64]

- Mediator EUROCONTROL [9]
  - EUROCONTROL focuses on ATM development [2]
  - Initiator SESAR [1]
  - Offers help [15]
    - To realize a common approach [1]
    - To prepare sector [2]
    - Aims to identify shortcomings of the system [3]
    - Advices EC [1]
    - Through name, blame and shame [1]
    - Approach industry with their shortcomings [2]
  - Network Manager [1]
  - Market SESAR [1]
  - Does not try to keep the industry focused at SES, that's their own responsibility [1]

- Does not give penalties [1]
- Is open for bottom-up influence [1]
- Administrative board [1]
- Mediator Dutch government [25]
  - Dutch ministry seeks consensus [2]
  - The government needs to certify the changes [1]
  - Facilitates [1]
  - NSA [2]
  - MLA [1]
  - Top-down pressure [16]
    - Steering by means of task forces which aren't binding [2]
    - Guides and stimulates implementing rules [2]
    - No stimuli necessary to keep the buy-in [1]
    - Capable of executing top-down approach [1]
    - Doesn't execute top-down pressure at the moment [2]
    - The state is responsible for the nations' interests [8]
      - Via coordination committee and SSC [2]
      - Via multiple ways [1]
      - Via international consults [1]
  - Expectations [1]
  - Government could stimulate industry, because of its complexity [1]
- SJU [13]
  - Authorities expertise group [4]
    - Involved with life trials [1]
    - Make sure that the proposed changes can be certified [1]
    - Representatives from different states and EASA [1]
    - Plans to expand group to prevent overload [1]
  - Opportunity to sign up for SESAR [7]
    - NLR is no founding member [3]
  - SJU monitors information sharing [1]
  - Launched by EUROCONTROL & EC [1]
- Single Sky Committee [2]
- Standing Committee [1]
- CANSO [14]

Progression

- No [28]
  - Confidence [6]
    - Less influence due to the many players [1]
    - More difficult to control [1]
    - Remained the same [3]
    - Confronted with the complexity [1]
  - SES didn't influence the mission, vision and strategy [4]
    - Organizational changes have occurred but not necessarily due to SES [1]
    - Institutions do not have a direct influence on laboratories [1]
  - Resources [8]
    - Moved from EUROCONTROL to SES [1]
    - Scarce [1]
    - Difficult to get resources [5]
      - Economic situation [1]
      - Pressure to lower the costs [1]
      - CANSO lobbies for financial means [1]
      - Because the Netherlands is so small [1]

- Because there is not a Dutch prominent member [1]
- Common approach [6]
  - Structure is not necessarily an improvement [1]
  - Still can't deliver implementation package [1]
  - You used to have the 'kaderprogramma's' [1]
- Because nothing has been implemented because of SESAR [4]

Yes, but not necessarily thanks to the current strategy [9]

- Harmonization [1]
- Confidence [3]
  - Growing [1]
  - More hope [1]
  - Trials [1]
- Better collaboration [2]
- Little results [1]
- Efficiency improvements [1]
- Due to projects [1]

Yes, thanks to the current strategy [113]

- Confidence [9]
  - Positive impression of the happenings [1]
  - Enforceability [3]
  - Industry drive [3]
  - Belief [2]
- SES influences mission, vision and strategy [19]
  - Harmonization [12]
    - Not always perceived as relevant [2]
    - Aware that things have to change [2]
  - Alignment [5]
    - There is control that activities fit within SESAR [2]
      - Except for local developments [1]
    - Make sure actions are aligned with SES vision [1]
  - Own development agenda [1]
  - Better emphasis [2]
- Resources [7]
  - Financial support [4]
  - For SESAR related developments [1]
  - More accessible [1]
- Because it's all there is [1]
- Better motivation [1]
- More top-down control [17]
  - More guidance [4]
  - More pressure [2]
  - More power [2]
  - Better structure [2]
- It goes faster [3]
- Achievements [20]
  - First part of SES got delivered [1]
  - Established, equipped FABs [6]
  - Positive outcome trials [2]
  - Established NSA for supervision ANSPs [1]
  - Better collaborations [2]
  - Common requirements [3]
  - New safety governance structure [3]
    - Keeps ANSPs alert [1]

- Defragmented research [2]
- SES structure was proven to be useful, but not necessarily efficient in terms of forcing things to actually come in place [1]
- Common approach [20]
  - Common vision [2]
  - In ATM research [3]
  - More cross boarder collaboration [10]
  - Enables [3]
  - A6 [1]
  - Common mindset [4]
  - Due to common actions [2]
- Effects of top-down pressure [15]
  - Helps [4]
    - Causes SES to be important [1]
    - To collaborate [3]
  - Is not directly affecting the military [2]
  - Is not affecting NLS [3]
    - To share knowledge and information [1]
    - To collaborate [1]
  - Not always appreciated [5]
    - EASA narrowing down ICAO regulation [1]
    - Financial structure SES [1]
    - Regarding software safety assurance [1]
    - Implementation rule regarding system information exchange [1]
    - Because it determines organizations development agenda [1]
  - No pressure to share information and knowledge [1]

SES regulation is still generic [1]

Single European Sky

Only a mean to its goal [7]

- Governance structure [5]
  - Guided by EC [1]
  - SESAR, SJU, EC, FAB are all means [7]
    - FAB is tackling juridical issues [2]
    - SESAR is the technological pillar [5]
  - SES II+ [3]
  - ATM master plan [3]
  - Documents produced by the SJU [1]
  - ICAO [1]
  - SES I [1]
  - SES II [1]

Goals SES [13]

- Interoperability is important [2]
- Aims to break through growth constraining barriers [3]
- Completely unrealistic [3]
  - Will meet target according to demand [1]

Negative aspects [120]

- Criticism [30]
  - More progression outside core area [1]
  - SJU lacks critical perspective [1]
  - Lack of room in the implementation rules [1]
  - Lack of knowledge [3]
  - With ‘first come, first serve’ quality is less, than ‘may the best win’ [1]

- Different prestige's [3]
- Opaque [4]
  - Little information available regarding the happening in SESAR [3]
  - Due to the size of the project [1]
- Europe is only part of the world-wide industry [1]
- Difficult to jump in in a later stage [1]
- More faith in FAB [5]
- SESAR is supposed to be all encompassing, therefore organizations are hesitant with investing in necessary developments [1]
- Only in it for the money which they invest in own interests [1]
- EC should allow for some consolidation [1]
- Little faith in EC [1]
- More pressure is needed [3]
- Over-harmonization [2]

Bottlenecks SES process [90]

- Politics [3]
- Dependencies [7]
  - Confidence SES depends on FAB results [2]
- Fragmentation [2]
  - Get rid of national boundaries [1]
  - Distinction between civil/military [5]
  - Own interests [11]
    - And therefore different motivations to participate [2]
    - When not in line with common SES vision [1]
    - Current charging mechanism [1]
    - Afraid to come forward, that means investments [1]
    - Change in time [1]
- Differences [6]
  - Cause friction [3]
- Little resources [16]
  - Depends on available resources [2]
  - Focus on ROI [2]
  - Prioritizing [1]
- Revolutionary concept [29]
  - Conflicting interests [4]
  - Timeframe [7]
    - Therefore no urge to be leader [2]
    - Resources are rather spend on short term goals [1]
    - Difficult to plan due to conflicting interests [1]
    - Safety is important [1]
  - Risks [2]
  - Complexity [4]
  - Learning by doing [1]
  - Resource availability [2]
  - Safety demands prevent revolutionary growth [2]
  - Requires cooperation of all partners [1]
  - Focus on realistic developments [1]
  - Organizations are not ready for radical changes [2]
- Difficult to execute top-down pressure [3]
  - Top-down pressure isn't synchronized [1]
  - Execute penalties [2]
- Negative attitude [6]
  - Lack of strategy [5]

- No convincing driver [6]
- Still far away [8]
- Afraid for their own interests [1]
- Disappointment [1]
- Unwillingness [8]
  - Big influential countries appear unwilling [5]
    - Passive attitude [1]
    - Strikes [1]
    - Not prepared to make changes [1]
    - Own interests first [1]
    - Influences others to stay motivated [1]
  - To collaborate [2]
  - To invest, without being sure about the benefits [1]
  - To change [1]
  - To give up national ANSP [2]
    - Fear to lose jobs [1]
  - To forge ahead, because of ROI [1]
  - No enthusiasm [6]
- Reticent participation [15]
  - Reputation is at stake [1]
- Wait-and-see [10]
  - Because it has little influence due to the size [1]
  - Doesn't know what role to take [1]
  - Doesn't know what's going to happen with SESAR [2]
- Skepticism [20]
  - Previous SES experiences make stakeholders skeptical [2]
  - Because of insecurities [1]

- Immature [18]
  - Too little focus on take-off and approach [2]
  - Little synchronization between the different SES pillars [1]
  - Some aspects are missing [1]
  - Empty boxes [1]
  - Vague aspects [12]
  - Some problems aren't tackled by the EC [1]
- Slow and small progression steps [21]
  - Because goals are too far away [1]
  - Bureaucracy [3]
    - Because of overhead [2]
  - Lack of guidance on short term developments [1]
  - Because of little resources available [1]
  - Because of lack of knowledge [1]
  - Own interests [5]
  - Goes hand in hand with such a project [1]
  - Unclear strategy [1]
  - To reach a consensus [1]
  - Because of difference in starting position [1]
  - No significant progression [2]
- Financial arrangement hampers communication [1]
- Have to cope with phases of discouragement [1]
- Tension SES regulation because industry asks for exceptions on implementation rules [1]
- Own interests [1]

Positive aspects [122]

- Alignment with own interests [15]

- SES structure helps [7]
  - Common vision [4]
  - The relation with the industry [1]
  - Big players participate [1]
  - Smart move to start SJU [1]
    - SJU is a brilliant marketing tool [2]
- MUAC is seen as an example [1]
- Positive attitude [84]
  - Necessity [4]
  - SES will come [3]
  - Support [11]
  - Innovation requires development [2]
  - Stakeholders spend resources [1]
  - Aware that sacrifices have to be made [9]
  - Awareness that there are bumps in the road [6]
  - Belief [17]
    - Because there is no alternative [1]
    - Because you need a common approach to tackle this [4]
    - Because SES is the only initiative that can rearrange the ATM system [1]
    - Credible steps [1]
    - Offers some advantages [1]
    - In FAB [1]
    - In line with own business profile [1]
    - Because there are similar projects in other parts of the world [1]
  - Important [20]
    - Part of the solution for growth constraints [4]
    - Fuel usage is important for airlines [1]
    - SES influences [6]
      - Because it's enforced [1]
    - Because it helps to achieve the goals [2]
    - Own initiative [1]
    - Made it possible to continue taking actions that were already scheduled [2]
    - Importance SES caused by influence SES [1]
    - Because it's part of the organizations' core business [1]
    - Bottlenecks stimulate research laboratories to take actions [1]
  - Willing to contribute [11]
    - To look after own interests [1]
- Room to make it fit with own specific circumstances [8]
- Possibility to forge ahead [2]
- Looking for alignment civil/military [2]
- Institutions take interests into account [1]
- Fragmented Europe drives developments [1]
- Innovation is not always caused by external stimuli [1]

Triggered by… [7]

- The amount of money that went into this project [1]
- High level group leaded to SES I [1]
- Reverse salient [2]
- Current system is not hampering growth aviation sector [3]
  - Driver has moved from capacity to efficiency, cheaper, environmental friendlier [4]