KDC Completed Research Attachment 2021

KDC/2020/0056

Version 1

Version date: December 10, 2020

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Content overview

The research and development activities in KDC are managed on the basis of the KDC research agenda. This document is the attachment of the research agenda. It contains the descriptions of studies that are completed.

Table of Content

Completed Research

In this report the studies which have been completed are listed for reference purposes.

C1: Reduction ILS Calibration Flights

Ref. Programme	NVT	**Status**	Completed (June 2007)			
Project Number	PRJ-1522					
Customer	WG Air	**Performance Targets**	S	Ec	Es	Env
Assignment	WG Air report #42 KDC/2007/0115		0	+	0	+
Project Plan	Version 2.2	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	29-05-2006		0	0	+	
Project Lead	Jacco Bosch (LVNL)					
Sponsor	Roel Hellemons (AAS)	**Ref. ATM System Strategy**	Not Applicable			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Introduction:
Noise annoyance caused by ILS calibration flights can be reduced by decreasing the amount flights. Calibration flights can only be executed during a 1+1 runway configuration late in the evening.
The calibration programme, which takes approximately 2 hours, is executed twice a year for each ILS in order to assure that the ILS-signal meets the ICAO requirements. The execution of a calibration flights produces a certain noise load. This load is caused by the calibration plane itself as well as by the regular traffic which is forced to land on a different runway.
During the current programme, a calibration of the nominal landing signal as well as the functioning of the airborne monitor systems is performed. The range of the ILS is also measured. Objective of this project is to introduce alternative calibration methods which are able to test whether the landing signal meets the ICAO requirements. These methods should decrease the size of the calibration programme and by that minimize noise annoyance. A monitor concept which determines, besides the current features, also the *far field condition* of the ILS-signal is something which could be considered.

Assignment:
Research and implement a new calibration flight programme so that the noise load can be decreased by reducing the amount of calibration flights.

Short term objective:
Show that ground based calibration programmes are a possible substitute for the current calibration flights related to monitor systems. An implementation schedule of the ground based programme is considered also to be a deliverable in this phase.
Establishing the alternative programme on Schiphol airport by means of a transition period in order to demonstrate that the programme performs equally compared to the current flight calibration programme.

Midterm objective:
Further development of alternative calibration methods i.e. trial, certification and finally the implementation of the selected concept.
Research alternative calibration methods, including the utilization of regular traffic for air measurements and far field monitoring. Alternatives are judged based on feasibility, quality of the measurement, noise load, operational noise annoyance and costs.

Result Report:
Reduction of flight measurements for ILS calibration at Amsterdam Schiphol Airport, Phase 1 (NLR-CR-2007-038)

C2: CROS Pilot 1 (Switching runway preference Northbound vs. Southbound)

Ref. Programme	NVT	**Status**	Completed (Oct 2007)			
Project Number	PRJ-1519					
Customer	CROS	**Performance Targets**	S	Ec	Es	Env
Assignment	KDC/2006/0036 (letter)		0	0	0	++
Project Plan	Version 1.11	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	25-09-2006		0	0	+	
Project Lead	Hans van Grootel (AAS)					
Sponsor	Michel Bezuijen (CROS)	**Ref. ATM System Strategy**	Not Applicable			
Financial Partner	-	**Priority**	Normal			
TRL	9					

Introduction:
Several parties, like residents' representatives and sector parties, have indicated that there is need for measures of which is expected that they minimize Noise annoyance. CROS Pilot 1 is such a measure which is related to the periodic switching of runway preference North/South. Daily operations reveal that switching the runway preference, without pre-announcing, is directly observed by the surrounding residences and is experienced as noise annoyance. During this pilot, the preferred runway preference is switched periodically from north to south for a prescribed period.

Assignment:
Execution of CROS Pilot 1 by providing information regarding switching runway preference. Research the minimum switching frequency and the minimum implementation time for the change of runway preference and the corresponding limiting factors.

Short term objective:
Successful completion of Pilot 1. Research whether the noise annoyance decreases when the runway preference is determined by the environment (CROS), within the given boundary conditions.

Midterm objective:
Decrease the noise annoyance as experienced by the environment.

Long term objective:
-

Result Report:
Bijlage II – uitkomsten KDC Alders bewonersvariant CROS Pilot 1.pdf (KDC2007_0089)
Presentatie_Pilot-1_IVW.ppt

C3: Optimal Hub Concept: punctuality in simulated traffic scenarios

Ref. Programme	NVT	**Status**	Completed (Dec 2007)			
Project Number	PRJ-1558					
Customer	Roosevelt Overleg (RVO)	**Performance Targets**	S	Ec	Es	Env
Assignment	-		0	++	++	0
Project Plan	AMS/LN versie 1.4 (31-05-07)	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	30-10-2006		+	+	+	
Project Lead	Frank Dijkgraaf (LVNL)					
Sponsorship	Roel Hellemons (AAS)	**Ref. ATM System Strategy**	Identified Study, “Aanbod 60/60”			
Financial Partner	DGB	**Priority**	Normal			
TRL	1					

Introduction:
The Optimal Hub Concept (OHC) project is initiated as part of the Mainport Inc. programme. AAS, KLM and LVNL are participating equally in this project.
The objective of the OHC project is to determine the exact relationship between changing the peak pattern and connectivity as well as punctuality. A traffic scenario must be determined which provides the optimal balance between connectivity and punctuality. The year 2020, with 600.000 movements, is set as target year.

The following traffic scenarios are considered (for 2010 and 2020):
- 80/40 (2+1 runway usage)
- 70/50 (2+2 runway usage)
- 60/60 (2+2 runway usage) with reduced noise approach
- 60/60 (2+2 runway usage) without reduced noise approach

The activities within the OHC are distributed through ‘’Work packages’’ which are executed by Teams. The objective of the ‘’Punctuality Team’’ is to analyse what the punctuality effects are for each traffic scenario based on the accompanying ATM capacity figures as delivered by the ‘’Air Team’’. The ‘’Market Team’’ delivers the traffic scenarios. Punctuality is expressed in delay minutes and can be determined by means of simulations.

Assignment:
Determine the delays induced by the various ATM-system designs for a given traffic scenarios by means of a simulation. During the optimization phase, adapted traffic scenarios are analysed (e.g. different traffic mixture, different types of delays, etc.).

Short term objective:
Gain insight of the effect of traffic scenarios on punctuality.

Long term objective:
Iterative development and testing of traffic scenarios. A reliable justification for investments in capacity

Result Report:
To70 071204 Punctualities Optimal Hub Concept 06.282.01.pdf

C4: CDM Process Navigator

Ref. Programme	NVT	**Status**	Completed (Dec 2007)			
Project Number	PRJ-1611					
Customer	Roosevelt Overleg (RVO), CDM Programme	**Performance Targets**	S	Ec	Es	Env
Assignment	KDC/2007/0107		0	+	++	0
Project Plan	In preparation	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	Initiative phase: 02-07-2007		0	+	0	
Project Lead	Ron Slootbeek (LVNL)					
Sponsor	Jasper Daams (LVNL)	**Ref. ATM System Strategy**	Not Applicable			
Financial Partner	-	**Priority**	Normal			
TRL	2					

Introduction:
Collaborative Decision Making (CDM) has been recognised as an important enabler of increasing airport operational performance in terms of efficiency and capacity. Improved predictability and planning will also yield environmental benefits. The implementation of CDM requires technical and organisational solutions; moreover it relies on the correct attitude of all parties involved. Important here is that people are able to project oneself into the role of others, hence understand the processes of other parties. Only then, willingness to invest (in time, money, and in attitude) in CDM will get support. Currently, responsible managers for the implementation of CDM do not have sufficient insight in the consequences of their decisions. The Process Navigator will enable the CDM project managers of LVNL, KLM, and AAS to visualise the sector processes related to CDM and to find out what effect certain decisions may have on the processes of other actors involved. Other users foreseen are the operational employees of LVNL, KLM, and AAS, to provide them insight in the relations their work has with others.

Assignment:
The Process Navigator will be developed. This Process Navigator will provide an interactive means to allow the end user through animations to see the effect of their decisions in the CDM process. The system will be a desktop tool. The aim is threefold:
1. To provide an understanding in the functioning of the sector processes.
2. To support in decision making for Schiphol CDM procedures.
3. To support in verification of procedures and system design.

Two use cases are proposed to demonstrate the system in the first version:
- Inbound – turn around – outbound. This part of the system will model details of the arriving aircraft once it enters the TMA until it is airborne. It will implement the Timeline Protocol to find out details of the processes and their interrelationships.
- Hub function inside the airport. This part of the system will focus on the processes to model transfer passengers and interface relations between flights. It will also be concerned with the passenger processes inside the terminal.

Scope of the system is the tactical and operational processes at the airport with a time scale of up to 48 hours.

Short term objective:
The short term objective of the Process Navigator is to provide an early modelling of the different processes and give a demonstration of the capabilities of the proposed system. This phase will include modelling some contents of the processes and their interrelationships.

Details of the interfaces will be provided such as information flow, systems used, the relevant organisations and their personnel, responsibilities, decisions taken, timing of decisions, requirements to other processes, and effects on other process

Version 1.0 is available as of July 2007.

Midterm objective
The midterm objective of the Process Navigator is to completely model the aforementioned processes to enable the end user full insight in the CDM processes of his own organisation but moreover that of the other CDM partners. Additional functionality will be implemented to enable the end user to find out consequences of decisions and the impact of disturbances in the processes

It is proposed to follow an evolutionary development of the system over the next years, driven by the particular needs of the end users at certain moments. This then will depend on CDM projects that will be commenced at the airport.

Long term objective:
-

Result Report:
Resultaten Process Navigator v0.9.ppt
Navigator.exe (Programma CDM Process Navigator)

C5: NOC-rate vs. Sustainability

Ref. Programme	NVT	**Status**	Completed (Jan 2008)				
Project Number	PRJ-1530						
Customer	WG Air	**Performance Targets**	S	Ec	Es	Env	
Assignment	KDC/2006/107		0	0	++	0	
Project Plan	Version 1.1 (23-10-2006)	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	29-11-2005		+	+	+		
Project Lead	Dragana Mijatovic Jovanovic (LVNL)						
Sponsor	Ype de Haan (KLM)	**Ref. ATM System Strategy**	Not Applicable				
Financial Partner	-	**Priority**	Normal				
TRL	1						

Introduction:
KLM, AAS and LVNL have created their own assessment framework for decision making. This framework defines for each party the relevant quality aspects regarding operation. An assessment framework is used to support decisions regarding alterations of the operation. The assessment frameworks are interrelated. However, there is no consistent and coherent framework for the entire sector. Due to the lack of such a framework it is not clear whether the criteria which e.g. KLM sets to an operation, and whereby KLM depends on the performance of LVNL, are similar to the criteria which LVNL sets to the ATM-system.

Assignment:
-
Short term objective (2006-2007):
The objective of the KDC-project is to create an assessment framework for the hub-operation at Schiphol. This framework supports the sector's decision making and increases the understanding concerning the performance of the sector system. In order to attain such an assessment framework for the operations at Schiphol, the following activities need to be done:

- Research the relations between performance indicators of the sector parties based upon NOC (No Connection) rate. The NOC rate is an important performance indicator for the hub operator;
- Find and understand a relation between the sustainability of hourly capacity of the ATM-system and the NOC-rate of KLM from 2003 until now;
- If it is possible to establish this relation, the next objective is to use this relation to predict the NOC-rate for a given sustainability and/or to develop a model for it.

Involved parties:
AAS, KLM, LVNL, TU Delft. WG Air forms the steering committee for the KDC project team.

Source:
The WG Air has decided to request the KDC to research the relationship between a set of performance indicators of the sector partners. The understanding of this relationship may lead to the development of a joined sector assessment framework.

Planning:
In order to keep the project manageable, increments are defined. For each increment, a specific sub assignment is formulated. This is done in collaboration between the project team and the steering committee.

Result Report:
Final thesis PDF - Javier Wanga.pdf
Final_Thesis_Version1.0_Khalid.pdf

C6: Micro climate Rijsenhout: Noise Annoyance Reduction

Ref. Programme	NVT	**Status**	Completed (June 2008)			
Project Number	PRJ-1518 (PA/06/183)					
Customer	Roosevelt Overleg (RVO), Noise Management Programme	**Performance Targets**	S	Ec	Es	Env
Assignment	KDC/2006/0052 (letter)		0	0	0	++
Project Plan	Version 2.1	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	25-09-2006		+	0	0	
Project Lead	Suzanne Noordam-Bolding (LVNL)					
Sponsor	Jasper Daams (LVNL)	**Ref. ATM System Strategy**	ACE 39.1			
Financial Partner	DGB	**Priority**	Normal			
TRL	9					

Introduction:
Departing traffic from the “Kaagbaan” (RWY 24) or “Zwanenburgbaan” (RWY 18C) cause noise annoyance when overflying Rijsenhout. From available FANOMOS information, it appears that there is indeed a significant deviation of traffic during take-off at departure routes towards the south and east of the two runways. Even though statistics indicate that there is no significant growth of the formal deviations, the sector still considers this problem relevant. Further research is required in order to determine the cause and possible solutions for this problem. There shall be an explanation given for the difference between planned and actual tracks. LVNL has a long term co-operation with Boeing for the development of Advanced Arrival and Departure Techniques (AADT). The results of phase one of the joined study are primarily focused on adapting the departure routes with as objective to control noise. These results might be relevant for this research and may lead to improvement of the situation at Rijsenhout.

Assignment:
Study how the noise annoyance can be reduced at Rijsenhout.

Short term (qualitative) objective:
Find the cause for the difference between the planned and actual flown tracks. The focus is on the spread in the northern region of the departure route.

Midterm (quantitative) objective:
Reduce noise annoyance as experienced by the residents of Rijsenhout. Even though this is a difficult task to accomplish.

Method:
The so-called ‘’trial and proof’’ method shall be used during the research. The most promising option shall be implemented first, the results shall be analysed afterwards. The implementation of the next solution depends on the effect of the trial.

Involved parties:
LVNL, KLM, project members AADT

Result Report:
Eindrapportage en evaluatie Rijsenhout versie 1 0b - getekend.pdf (PRA-06/183)

C7: Forecasting LVP Conditions at Schiphol Airport (Phase 1)

Ref. Programme	NVT	**Status**	Completed (June 2007)			
Project Number	PRJ-1555					
Customer	Roosevelt Overleg (RVO)	**Performance Targets**	S	Ec	Es	Env
Assignment	KDC/2007/0114		0	+	++	0
Project Plan	Version 1.0 (05-06-07)	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	30-10-2006		+	0	0	
Project Lead	Rob ten Hove (AAS)					
Sponsor	Ype de Haan (KLM)	**Ref. ATM System Strategy**	-			
Financial Partner	Klimaatbestendig Nederland	**Priority**	Normal			
TRL	3					

Introduction:
Diminishing visibility conditions have a direct consequence on the available operational capacity. Prompt, unambiguous and reliable information concerning weather forecasts are crucial for decision making during bad visibility conditions. In order to minimize operational losses, it is of great importance to improve the prediction of upcoming mist and low visibility conditions. Flights can be delayed or cancelled if it is by forehand known that there will be capacity limitations at Schiphol airport. For this purpose the ''Capaciteit Prognose Schiphol'' (CPS) was developed some years ago. The effectiveness of this tool may be improved by providing more specific statements concerning probability and capacity. Therefore, the air transport sector needs a reliable visibility forecast.

Assignment:
The assignment is split into a short- and long term objective:
- Short term: Develop a more reliable and accurate low visibility forecast methodology.
- Long term: Gain a better insight in microclimate at SPL with regard to LVP conditions. The focus is on fundamental research on the causes as well as the possible prevention of low visibility conditions.

A determinant factor for this research is the moment at which mist sets in and dissolves coupled to the air transport visibility rates. Improving the sustainability implies that forecasts should be made by means of new methods. Currently, forecasts are made based on historical and actual information.
- 0-6 hr forecast: European flights can be arranged more efficiently by means of a reliable weather forecast. As a result, a faster and better implementation of tactical measures which increase capacity can be realized so that the declared airport capacity is fully exploited.
- 6-12 hr forecast: delivers optimal flow management in combination with extra fuel planning for the intercontinental flights.

Short term objective:
Validate method/system based on test results.

Midterm objective
- Gained insight in visibility problem and restriction problem with regard to weather phenomena, the cost/benefit ratio of restriction and diversion to airlines.
- Increase the utilization of the available capacity.

Result Report:
KDC/2008/0089, KNMI publication 222, Improved Low visibility and Ceiling Forecast at Schiphol Airport, Final report, part 1 (Final report fase 1 version 1.0 - definitief met handtekeningen.pdf).

C8: CROS Pilot 5A (Night arrivals for runway 18R

Ref. Programme	NVT	**Status**	Completed (Nov 2008)			
Project Number	PRJ-1470					
Customer	CROS	**Performance Targets**	S	Ec	Es	Env
Assignment	KDC/2006/0036 (letter)		0	0	0	++
Project Plan	Version 1.2	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	25-09-2006		0	0	+	
Project Lead	Geert Rozeboom (LVNL)					
Sponsor	Jasper Daams (LVNL)	**Ref. ATM System Strategy**	ACE 41.1			
Financial Partner	DGB	**Priority**	Normal			
TRL	9					

Introduction:
Traffic approaching the Polderbaan from the north at night, must execute the final approach within the so-called ''luchtverkeersweg'' and according to established air traffic paths and procedures. These procedures seem to produce significant noise annoyance. Pilot 5A investigates if modifications to the Continuous Descent Approach (CDA's) procedure can decrease noise annoyance experienced north of Schiphol at night.

Assignment:
Execution of CROS Pilot 5A by investigating whether the experienced noise annoyance, north of Schiphol, decreases by adaptations of the vertical profiles and modifications in the night transitions conditions. The aim is to have all aircraft fly continuous descending profiles (without power increase which cause noise annoyance). Route changes are excluded from pilot 5A. This project is part of the measures that are described in the "Convenant hinderbeperkende maatregelen" and is endorsed by the parties of the "Alders Tafel".

Short term / Midterm objective:
Optimization of the vertical flight profile definition and the flight profiles adherence by aircraft of all night approaches which fly over waypoint NIRSI (near Castricum). Research of the effects of the improvement in terms of reduced noise annoyance are outside the scope of CROS pilot 5A.

Long term objective:
The long term objective is to optimize the night approaches both in the vertical and horizontal plane. The "horizontal optimization", i.e. adjusting the night routes, is outside the scope of this pilot. Therefore CROS pilot 5A does not have a long term goal. Route optimization will be part of the mid-term MER studies.

Result Report:
Decision document Night arrivals for runway 18R_v10.pdf (D/R&D 06/073 version 1.0)
R-205 POD Aanpassingen nachttransities baan 18R_V10.pdf (ATM/PRO)

C9: Increased Landing Capacity Schiphol

Ref. Programme	NVT	**Status**	Completed (Jan 2009)					
Project Number	PRJ-1468							
Customer	LVNL Stratcor	**Performance Targets**	S		Ec	Es		Env
Assignment	KDC/2006/0043 (letter)		0		++	+		0
Project Plan	KDC/2006/0064, version 1.2 (2-4-2007)	**ATM concept**	ATS		ATFCM		ASM	
KDC Board Approval	29-11-2005		+		0		0	
Project Lead	Geert Rozeboom (LVNL)							
Sponsor	Kees van Dooren (KLM)	**Ref. ATM System Strategy**	ACE 35.1 and 35.2					
Financial Partner	DGB	**Priority**	**High**					
TRL	3							

Introduction:
Studies (see e.g. ''Capaciteitsstudie Schiphol 2020, CSS2020'') revealed that it is impossible with the 7PK system to realise 90% sustainability with a capacity of 150 movements per hour. A similar conclusion was drawn for the 5P system i.e. the capacity decreases significantly during poor visibility conditions. The landing capacity during marginal visibility must be increased in order to achieve the above stated sustainability.

The following aspects are of importance considering the desired improvement of the landing capacity during marginal and poor visibility conditions:

- Adapting the ILS Protection Areas size to the current ILS system requirements according to the state of the art technology, or narrowing the ILS radiation pattern;
- Possible modifications in the required approach guidance system.

At Schiphol airport a separation criterion of 9NM is used under LVP, while other airports use a 6NM separation requirement. Is it possible to apply the same criterion at Schiphol? Which modifications are required to accomplish this?

Assignment:
Identification and evaluation of measures which improve the landing capacity during marginal and poor visibility conditions.

Short term objective:
Increase the runway capacity during marginal and low visibility conditions. In order to reach this objective, an overview shall be generated which specifies the options and effects on capacity when a certain measure is applied. Additionally, a road map shall be generated for the further development of the identified measures which have a positive effect on capacity.

During the analysis phase, a benchmark of competitive airports is made in order to compare these airports with Schiphol, based on landing capacity of the individual runways.

Result Report:
Rapport Verhoging landingscapaciteit bij marginaal en slecht zicht v 1 0 _3_getekend.pdf (KDC/2008/032, versie 1.0)

C10: Increased Ground handling Capacity Schiphol

Ref. Programme	NVT	**Status**	Completed (Jan. 2009)				
Project Number	PRJ-1469						
Customer	LVNL Stratcor	**Performance Targets**	S	Ec	Es	Env	
Assignment	KDC/2006/0044 (letter)		0	++	+	0	
Project Plan	KDC/2006/0088, version 1.0 (20-02-2007)	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	29-11-2005		+	0	+		
Project Lead	Ronald Dubbeldam (LVNL)						
Sponsor	Koos Noordeloos (AAS)	**Ref. ATM System Strategy**	ACE 47.1				
Financial Partner	DGB	**Priority**	**High**				
TRL	3						

Introduction:
Several vision and strategy studies have focused on bottlenecks in the ground sector system. It is anticipated that the amount of bottlenecks will rise due to an increase of air traffic on one hand and significant alterations of the ATM system on the other hand. The identification of current and future bottlenecks raises the issue of a strategy to solve the stated problem. Potential solutions incorporated in the strategy can be:

- Creations of additional buffers at the runway.
- Expansion of the aprons and gates.
- Creation of a dual taxi-way system.
- Extension of A-SMGCS applications.

Furthermore, it is required that a solution strategy is accepted by all sector parties.

Short term objective:
The short term objective is to agree on the selection and planning of the available solutions for the ground related bottlenecks. To achieve this, an overview of the most important bottlenecks is made. Furthermore, an overview is created of the possible solution strategies and boundary conditions related to implementation. The overview should be incorporated in the sector strategy.

Assignment:
Identification and evaluation of measures which improve the ground handling capacity of the current runway system (5P).

Midterm objective:
The midterm objective is the realisation of an increase in the ground handling capacity based on solutions derived from the short term objective. Again, this in accordance with the strategy.

Long term objective:
The long term objective is the reduction of capacity losses during marginal and bad visibility conditions.

Result Report:
Verhoging grondafhandelingscapaciteit Oplossingen versie 1 0Met handtek.pdf (KDC/2007/0121 versie 1.00)

C11: Airborne Separation Assistance Systems (ASAS)

Ref. Programme	NVT	**Status**	Completed (Jan. 2009)			
Project Number	PRJ-1615					
Customer	Stratcor	**Performance Targets**	S	Ec	Es	Env
Assignment	KDC/2007/0111		0	+	+	+
Project Plan	V0.02 dd 28-09-2007	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	18-12-2007		+	+	0	
Project Lead	Nico de Gelder (LVNL)					
Sponsor	Jasper Daams (LVNL)	**Ref. ATM System Strategy**	-			
Financial Partner	DGB, KvB	**Priority**	Normal			
TRL	2					

Introduction:
This project is aimed at the opportunities of Airborne Separation Assistance Systems (ASAS) in all flight phases. In a first stage ASAS functionality can be used to increase situational awareness in the cockpit. This can be reached through the display of surrounding traffic on a so-called Cockpit Display of Traffic Information (CDTI). In a second stage it may be possible to delegate certain tasks or responsibilities from the controller to the pilot. Possibilities are “station keeping” (maintaining a separation instructed by the controller during an approach) or crossing or merging with other traffic.

Assignment:
Identify the opportunities of ASAS and analyse legal aspects. Results of research by Eurocontrol and NLR will serve as a starting point for this project.

Short term objective:
An overview of the possibilities of ASAS for increasing capacity and sustainability of the ATM system Schiphol. Evaluation of possible applications in a CONOPS. Formulating a strategy for gradual implementation of promising applications.

Midterm objective
Validation of applications that is promising for the Schiphol ATM system, in connection with EU activities.

Long term objective:
Execution of the ASAS strategy.

Result Report:
ASAS eindrapport handtekening.pdf (KDC/2009/0067)

C12: Trajectory Based Operations (BridgeT Phase 1, Definition Phase)

Ref. Programme	NVT	**Status**	Completed (June 309)				
Project Number	PRJ-1556						
Customer	Stratcor	**Performance Targets**	S	Ec	Es	Env	
Assignment	KDC/2007/0103		+	+	+	+	
Project Plan	KDC 2007/PRJ-1556 version 1.0	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	28-01-2008		+	0	0		
Project Lead	Lennard Verhoeff (NLR)						
Sponsor	Kees van Dooren (KLM)	**Ref. ATM System Strategy**	-				
Financial Partner	DGB	**Priority**	High				
TRL	3						

Introduction:
Today, air traffic control is primarily based on ICAO flight plans and ‘current state’ surveillance data. ATC estimates aircraft intent assuming aircraft performance and given actual and forecast weather. Differences between the estimated intent and actual realization disrupt the stability and predictability of traffic flows. This, in turn, reduces the efficiency, increasing the load on the environment and limiting the potential to perform complex operations in high-density traffic. Therefore, more accurate aircraft trajectory data including aircraft ‘intent’ is needed to establish an efficient and stable traffic planning,

The aircraft FMS generates intended trajectory data which is closed-loop executed by the aircraft flight control system. It is expected that using FMS trajectory data and functions will contribute to more stable, predictable and efficient operations. In SESAR D2, the “business trajectory” is proposed as the basis for such trajectory operations. The business trajectory is a 4D Trajectory which expresses the business or mission intentions of the airspace user, including any prevailing constraints. It is built from, and updated with, the most timely and accurate data available. The 4D Trajectory will be part of the future Flight Plan. Therefore, the BRIDGET work should enable embedding of the Dutch ATM system in the SESAR concept of operations and allow realization of SESAR goals.

Trajectory operations are expected to contribute significantly to efficient and stable traffic flows, a pre-requisite for the realization of daytime CDA’s at Schiphol. The NUP2+ project (Sweden) is an example project of such trajectory operations. The consortium has gained valuable operational experience using FMS trajectory data to enable daytime “Green Approaches” (CDA’s) in a medium density, single sector environment.

Assignment:
BRIDGET is a multi-year effort to enable trajectory operations in a multi-sector setting between Sweden and The Netherlands. The project team will extend the NUP2+ achievements to Europe’s core area (Schiphol specifically) using an implementation-oriented approach.

The objective is to develop, evaluate and demonstrate a prototype multi-sector communication network and ATM applications using that network and 4D Trajectory data, such as:
- Green Approach inbound Stockholm Airport Arlanda
- Time-based (EAT/RTA) operations inbound Arlanda
- Departure Management outbound Arlanda
- Trajectory based operation inbound Schiphol (e.g. time-based flights towards the Dutch FIR entry)
- Trajectory based operation outbound Schiphol (e.g. time-based flights towards Arlanda).

The work interfaces with the SARA project through integrated air-ground Trajectory Prediction, by way of a common mid-term research goal. The time frame for realisation of these objectives is 3 years.

Short term objective:
- Identify multi-sector trajectory application requirements, air-ground process aspects, and safety aspects.

Result Report:
BridgeTv1.0 Operational Concept 090409 incl handtekening.pdf (KDC/2008/0146)

C13: CROS Pilot 3B: Fixed Radius Turn

Ref. Programme	NVT	**Status**	Completed (June 2009)			
Project Number	PRJ-1537					
Customer	CROS	**Performance Targets**	S	Ec	Es	Env
Assignment	KDC/2007/0112		0	0	0	++
Project Plan	Version 1.0 (18-12-06)	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	18-12-2006		0	0	+	
Project Lead	Theo van de Ven (KLM)					
Sponsor	Kees van Dooren (KLM)	**Ref. ATM System Strategy**	ACE 48.1			
Financial Partner	DGB	**Priority**	Normal			
TRL	7					

Introduction:
There are discussions within CROS concerning the issue whether it is desirable, from a noise annoyance point of view, to spread or concentrate air traffic. The hypothesis is that it is not possible to point out the most desirable option. Pilot 3b examines the concentration of traffic through application of a fixed radius turn. The area of application is the initial right turn in the runway 24 Spijkerboor SID, between Hoofddorp and New Vennep. This project is part of the measures that are described in the "Convenant hinderbeperkende maatregelen" and is endorsed by the parties of the "Alders Tafel".

Assignment:
Research the effect of traffic concentration on noise annoyance through application of a fixed radius turn for KLM's 737 NG fleet, on the runway 24 SPY SID.

Short term / Medium term objective:
Successful execution of the pilot and to investigate the effect of concentrating the traffic between Hoofddorp and Nieuw-Vennep regarding noise annoyance.

Long term objective:
Reducing noise annoyance in the neighbouring communities.

Result Report:
- Rapport To70 Milieueffecten CP 3b 07.282.01 dec 2005.pdf
- Rapport 08.282.01 To70 Ex-post evaluation CROS pilot 3b juli 2008.pdf

C14: Speed & Route Advisor (SARA Phase 1)

Ref. Programme	NVT	**Status**	Completed (Nov. 2009)			
Project Number	PRJ-1557					
Customer	LVNL Stratcor	**Performance Targets**	S	Ec	Es	Env
Assignment	SCT/2007/018 KDC/2007/0113		+	+	+	+
Project Plan	KDC/2007/0040, version 1.0 (11-05-07)	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	30-10-2006		+	0	0	
Project Lead	Fredrik Eriksson (LVNL)					
Sponsor	Jasper Daams (LVNL)	**Ref. ATM System Strategy**	ACE 85.0			
Financial Partner	DGB	**Priority**	Normal			
TRL	3					

Introduction:
The realization of stable and predictable traffic streams is considered one of the building blocks of an ATM System Strategy that would enable Schiphol to meet up to its ambition to be one of Europe`s leading mainports.

The Speed And Route Advisor (SARA) function contributes to the stability and prediction of inbound traffic streams. The objective of the SARA function is to deliver advisories on speed and/or routing to (Upper) Area Controllers in order to achieve the planned arrival time(s) of the aircraft over fixes (and implicitly via the inbound planning function over the runway threshold). In addition to meet the planned arrival time, suggested trajectories are probed for conflicts and resolved where necessary.

In support of the envisaged ATM System Strategy the SARA function will contribute to a more accurate delivery of traffic at the metering fixes (IAFs) and cause less workload for the controllers involved. It is expected that the SARA function will overall reduce the number of tactical clearances (and thus the radio-telephony load), because of its ability to generate a single, comprehensive, conflict-free, meet time solution 20 to 40 minutes upstream of the IAF. This expectation is supported by the findings on similar functionality like the En-route Descent Advisor (EDA) developed by NASA. In order to meet the evaluation and demonstration objectives, a simulation (and later an operational trial) in the northern and eastern sectors is foreseen with Maastricht Upper Area Control (MUAC).

The development of SARA is a pre-requisite to the further development and implementation of fixed arrival routes in the Schiphol TMA.

Assignment:
Develop, evaluate and demonstrate in-service a SARA prototype for the purpose of assisting area controllers in providing effective speed and/or route clearances to improve the ''just-in-time'' delivery of traffic at the boundaries of the terminal airspace.

Short term objective:
In the short term period the development of the SARA function is the primary objective. This includes operational concept development, prototype development and evaluation of the effectiveness of the SARA function and production of a detailed production-level specification and implementation plan.

Midterm objective:
For the medium term the objective is to implement the SARA function in the operational ATM system. As a prerequisite in parallel development of the Trajectory Prediction, Inbound Planning and Conflict Management functions needs to be ensured. Increase of the planning horizon is built on the achievements of the Traffic Management activities with adjacent centres (in particular ground system changes for delay sharing).

Long term objective:
Long term goals for the SARA development will be aimed at expansion of the functionality and shall be part of the implementation of the SESAR concept. This includes TP improvements by use of down linked trajectories from suitably equipped aircraft, improved system support for inter-centre co-ordination, Conflict Management functions, etc.

Result Report:
- Decision_Document_SARA_versie_1.0 incl handtekening 18-11-09.pdf (KDC/2009/0125 version 1.0)
- CONOPS SARA v 1.0.pdf (KDC-2007-0092 version 1.0)
- HFI SARA v1 0.pdf (MS/Human Factor/2008/0060)
- JURIDISCHE EFFECTEN SARA v1.0.pdf (LA 47514)
- MRD SARA v1.0.pdf (D/R&D 09/027)
- Ops Trial Conclusion SARA v1.0.pdf (MS/Human Factor/2009/079 version 1.0)
- POD Operational Trial R-367 SARA v2.0.pdf (ATM/PRO)
- RTS Conclusion SARA v1.0.pdf (MS/Human Factor/2009/007 version 1.0)
- Trial URD SARA v2.0.pdf (2009-05-29 version 2.0 LVNL,S&I/SDI)
- VEMER SARA Trials v2.0.pdf (D/R&D 09/007 version 2.0)

C15: TP Meteoserver

Ref. Programme	NVT	**Status**	Completed (Dec 2009)			
Project Number	PRJ-1613					
Customer	Stratcor	**Performance Targets**	S	Ec	Es	Env
Assignment	KDC/2007/0109		0	+	+	+
Project Plan	V0.98, 15-01-2008	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	28-01-2008		+	+	0	
Project Lead	Paul de Kraker (LVNL)					
Sponsor	Jasper Daams (LVNL)	**Ref. ATM System Strategy**	ACE 89.0			
Financial Partner	DGB	**Priority**	**High**			
TRL	3					

Introduction:
One of the key elements in the ATM strategy is the so-called Trajectory Prediction (TP) functionality. This functionality is aimed at calculation of the 4D flight path of an individual flight. 4D information can be used for planning functions, conflict detection and resolution, and for general purposes for ATC personnel and external users.

In future operational concepts demands are increasing regarding the reliability and accuracy of the predicted 4D flight path. It is known that the accuracy of a TP functionality is strongly influenced by the quality of meteorological data. This regards especially the wind at various altitudes along the flight path.

Recently a feasibility study of LVNL pointed out that is very well possible to derive meteo data (wind and temperature) from Mode-S Enhanced Surveillance data. From approximately 70% of the aircraft in the Amsterdam FIR this information is already available. This percentage will increase in the next few years. This means that an important new source of actual meteo data is available. The feasibility pointed out that one of the best options is to co-operate with KNMI for integration of this data with data available at KNMI. By integration of this data a meteo forecast can be produced that meets the requirements for TP and other ATC functions.

Assignment:
Development of an optimal meteorological service for ATC, based on integration of KNMI data and data from aircraft that are Mode-S equipped.

Short term objective:
Research regarding the integration/assimilation of aircraft derived meteo data with other source data. Definition of an optimal data interface between LVNL and KNMI. A working system should be available at the end of 2008.

Midterm objective

Long term objective:
The possibility of uplinking meteo data to the aircraft and gradual deployment at a European scale.

Result Report:
TP Meteoserver-final report v1.0 incl handtekeningen.pdf (KDC/2010/0007)

C16: Holding Protection Areas

Ref. Ext. Programme	-	**Status**	Completed (March 2010)			
Project Number	PRJ-1683					
Customer	LVNL, dept. ATM/PRO/ASMD	**Key Performance Areas**	~~EFF~~	~~ENV~~	**CAP**	~~CST~~
Assignment	KDC/2008_0105		~~PRD~~	~~INT~~	**SAF**	
Project Plan	KDC2008/0131 version 1.0	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	30-01-2009		0	0	+	
Project Lead	Jurriaan Hoekstra (LVNL)					
Sponsor	Leo Mooijman (LVNL)	**Ref. ATM System Strategy**	Not Applicable			
Financial Partner	DGB	**Priority**	Normal			
TRL	2					

Introduction:
What should be the holding protection area in case the holding aircraft needs to be protected against other air traffic? This air traffic may fly in the same airspace (e.g. TMA) or in adjacent airspace with a different classification. Currently, the answer is provided by determining the protection area as specified in PANS-OPS, which is meant for obstacle clearance. The project is aimed at developing new criteria for the case there is not an obstacle but other air traffic in the vicinity.

Assignment:
The assignment is split into three phases:

- Firstly, the issue is explored. This implies an in-dept understanding of the relatively old PANS-OPS design methodology for the protection area of holdings, including the assumptions and some history. From this understanding, several ways to develop comparable criteria in case of nearby air traffic are considered and judged. Three important factors in this judgement are: Transparency (“Can the adaption of the criteria be explained easily, in the light of today’s practice?”), Feasibility (“Can the adapted criteria be applied with limited modeling of how aircraft behave in a holding?”) and Gain (“Do the new criteria indeed imply a smaller protection area without loss of safety?”).
- Secondly, the most appropriate way to develop new criteria is worked out further. This implies:

a) the provisioning of grounds of adapting some design criteria –for example as an obstacle is always there, while aircraft in the adjacent airspace are not,
b) the outline of the approach –for example, not adding all safety margins in an absolute way but applying a probabilistic approach,

Short Term Objective:
Firstly the exploration study will be performed. This study should not only reveal the technical and procedural feasibility of new design criteria, but will also provide a rough estimate of the volume of airspace that can be gained.

Mid Term / Long Term Objectives:
The second phase of the study will provide new design criteria. An approved airspace design methodology in The Netherlands, providing an untouched level of safety but with less airspace demand is a long term objective..

Involved parties:
Proposed are: LVNL and NLR.
Potentially, KLM and IVW could take part, for technical support on some specific issues and for review.

Result Report:
Holding Protection Areas in case of nearby air traffic, NLR-CR-2010-148, March 2010

C17: Optimising Schiphol sector performance - Part 1: Historic development of KLM flight schedule and ATM system

Ref. Programme	NVT	**Status**	Completed (June 2009)			
Project Number	PRJ-1674					
Customer	WG Air	**Performance Targets**	S	Ec	Es	Env
Assignment	KDC/2008_0102		0	0	++	0
Project Plan	KDC/2008/0100 version 1.0	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	30-01-2009		+	+	+	
Project Lead	Leo Hoogerbrugge					
Sponsor	Kees van Dooren (KLM)	**Ref. ATM System Strategy**	Not Applicable			
Financial Partner	-	**Priority**	Normal			
TRL	1-5					

Introduction:
The long-term objective for the aviation sector at Schiphol is to optimise flight schedules of Air France-KLM such that scheduled flight times ('block times') and connection times are reduced, and deviations from planning are reduced, while still achieving an acceptable arrival punctuality. This optimisation of Schiphol sector performance should take place in a dynamic environment in which - amongst others - Amsterdam Airport Schiphol provides a ground infrastructure and LVNL provides Air Traffic Management.

To support this optimisation it should be possible to estimate effects of changes in this dynamic environment. This information could be used as decision-making information, in particular in strategic phases, such as the development of future flight schedules and the ATM System Strategy. Before spending a lot of effort on defining changes to flight schedules, ATM system, etc. or the development of models, a 'business case' for that effort is needed. Analysis the historic development of KLM flight schedule and ATM system is expected to provide insight into the (realistic) potential benefits.

Assignment:
Research the development of the KLM flight schedule over the past five years, in relationship to the development of the ATM system and capacity.

Short term objective:
The objectives of the project are:

- to obtain more insight into the major factors that influence the arrival and departure performance of flights to and from Schiphol;
- to obtain more insight into the viable potential benefits of the optimisation of sector performance for AAS, KLM and LVNL;
- to recommend further steps to transform potential benefits into real benefits.

Midterm / Long Term objective
Support decision making regarding the further steps in optimisation of the Schiphol sector performance, both in proposed changes to flight schedule, ATM system, airport infrastructure and operational control.

Result Report:
Optimising Schiphol sector performance, Potential for optimisation from a historic perspective, KDC/2009/0069 version 1.0, version date: 24-2-2010

C18: Market survey and architectural road map for AMAN system component

Ref. Ext. Programme	-	**Status**	Completed (March 2011)			
Project Number	PRJ-1828					
Customer	LVNL Stratcor	**Key Performance Areas**	EFF	ENV	~~CAP~~	CST
Assignment	RPP/2010/112		PRD	INT	~~SAF~~	
Project Plan	NLR: ATAP/1333/6079	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval			+	0	0	
Project Lead	J. Westland					
Sponsor		**Ref. ATM System Strategy**	ACE ?			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Introduction:

The realization of stable and predictable traffic streams is considered one of the building blocks of an ATM System Strategy that would enable Schiphol to meet up to its ambition to be one of Europe`s leading mainports.

The Arrival Manager (AMAN) functionality within the ATS infrastructure produces a planning of inbound traffic throughout the FIR based on a series of constraints (airspace, routes, available runways, aircraft performance, etc.).

To reach the goal of stable and predictable traffic streams, additional AMAN functionality and better performance with respect to the current LVNL AMAN system component is one of the key enablers.

The following requirements have been identified:

- Increase of planning horizon
- Increase of planning resolution
- Multiple constraint support
- Both fixed approach route as dynamic route support
- Runway Configuration and Capacity Management support
- Disturbances support
- What-if probing
- Inter centre sharing and updating of plans

Assignment:

- Survey the market for commercially available, potentially suitable Arrival Managers
- Determine the Arrival Manager suitability with respect to the requirements
- Determine how suitable Arrival Managers could be integrated within the LVNL ATS architecture (current as well as foreseen LVNL iCAS architecture)

The results must be related to the SESAR programme and the SESAR Masterplan.

Short term objective: -
Selecting a new AMAN system component based on the requirements, determining the architectural road map for implementation.

Midterm / Longterm objective:
AMAN functionality within the LVNL ATS architecture that supports the realization of stable and predictable traffic streams. AMAN functionality within the LVNL iCAS architecture that supports the SESAR 4D trajectory based operations.

Involved parties: NLR

Result Report:
Marktonderzoek naar kandidaat Arrival Management systemen voor Schiphol, NLR-CR-2011-056, R.J.D. Verbeek
Applicability of arrival management systems for Schiphol airport, NLR-CR-2010-648; E.G. Knapen

C19: SANDOR, Safe Airport Navigation DemonstratOR

Ref. Ext. Programme	-	**Status**	Completed (October 2010)			
Project Number	PRJ-1726					
Customer	RST / Stratcor	**Key Performance Areas**	~~EFF~~	~~ENV~~	~~CAP~~	~~CST~~
Assignment	KDC/2009_0047		**<u>PRD</u>**	~~INT~~	**<u>SAF</u>**	
Project Plan	KDC/2009/0056	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	19-06-2009		0	0	+	
Project Lead	Lonneke Smit (LVNL)					
Sponsor	Koos Noordeloos	**Ref. ATM System Strategy**	NA			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Introduction:
Sustainability and safety are key performance indicators for the Schiphol operation. During low visibility procedures the number of taxiing aircraft at any given time is restricted to maintain safe airport operations. Maintaining safety at an acceptable level thus comes at the expense of reduced sustainability of the airport capacity. Research focused on increased safety and sustainability of airport surface movement operations is of key importance for the future of Schiphol airport.

Several initiatives have been developed in Europe and the USA which relate to runway safety. In 2008 the KDC ASAS study for effective applications at and around Schiphol Airport was completed. The study showed that two applications have the ability to support the ATM system and can be developed and implemented within a reasonable time frame. One of them is the application Air Traffic Situational Awareness on the Surface (ATSA-SURF). ASAS is one of the technical pillars of the SESAR concept. It is expected that the simplest of ASAS surface applications will be implemented Europe wide in a matter of years.
For reasons of safety and sustainability increase it is desirable to continue the development of Advanced Surface Movement Guidance and Control Systems (A-SMGCS). Currently at TU Delft solutions for A-SMGCS (levels 3 and 4) guidance and routing are being developed.

KLM has equipped their Boeing 777 with Electronic Flight Bag (EFB) systems on which a moving map of the airport with own-ship is displayed. This display helps pilots find their way around the airport and offers an opportunity to research and develop more advanced surface applications at Schiphol. Also AAS and the fire-brigade are searching for a solution for airport vehicles drivers to find their way quickly and efficiently around the airport.

This project aims to make use of the opportunity for the Dutch aviation sector to combine these initiatives and develop an application according to Schiphol surface requirements.

Assignment:
This project aims to develop an application on the aircraft EFB and/or vehicle display to demonstrate at Schiphol Airport. The demonstration must focus on reduction of runway incursions and related incidents as registered and analysed by the Runway Safety Team.
The results of the demonstration will be used to validate the application for operational feasibility and further develop and prepare the application for implementation.
The application must be evaluated together with the Schiphol Runway Safety Team, which has experience with the topic of safety on the airport surface.

Short term objective:
Demonstration of an cockpit application for safe airport navigation and situational awareness on the surface.

Midterm objective:
Development of a concept of operation for the ASAS application ATSA–SURF with guidance and routing. Development of a strategy for implementation.

Long term objective:
Implementation of the surface application. Increase of sustainability during Low Visibility Conditions. Increase of safety on airport surface.

Involved parties:
LVNL (project lead), AAS, KLM, NLR, TU Delft.
This group of organizations will be expanded with partners like LFV, HITT, Rockwell Collins, and SAS if possible. Subcontracting to the SESAR Joint Undertaking will be sought for reason of project financing.

Source:
Study of Airborne & Ground Surveillance Applications: How to support the ATM system of the Netherlands.

Result Report:
SANDOR (Safe Airport Navigation DemonstratOR), KDC/2010/0065, 20 October 2010

C20: Increased Schiphol Sustainability

Ref. Ext. Programme	-	**Status**	Completed (December 2010)				
Project Number	PRJ-1755						
Customer	WG-Air	**Key Performance Areas**	**EFF**	~~ENV~~	**CAP**	~~CST~~	
Assignment	KDC/2010/0010		**PRD**	~~INT~~	~~SAF~~		
Project Plan	KDC/2009/0114	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	22-12-2009		+	0	+		
Project Lead	Jurgen Teutsch (NLR)						
Sponsor	Koos Noordeloos (AAS)	**Ref. ATM System Strategy**	NA				
Financial Partner	DGB	**Priority**	**High**				
TRL	3						

Introduction:
The studies Increase Landing Capacity Schiphol and Increased Ground Handling Capacity Schiphol (see section 5.9 and 5.10 of this document) have identified bottlenecks in the operation under limited visibility conditions (5.9) and good visibility conditions (5.10). The study Increased Ground Handling Capacity Schiphol primarily analysed Schiphol ground capacity for 2+2 runway use under good visibility conditions while the study Increase Landing Capacity Schiphol focussed on single runway capacity under BZO-C conditions.

Due to the economic recession and the negative impact on aviation, KDC partners have stated that less priority should be given to capacity studies. The focus should now be placed on increasing the sustainability of the airport. When the results of the two studies mentioned are combined a clear conclusion about implementation steps to improve sustainability (i.e. the capacity under limited visibility conditions) to be taken could not be reached. The assignment of the current study will be to identify a coherent plan to increase sustainability for Schiphol airport, building on the results of the studies studies Increase Landing Capacity Schiphol and Increased Ground Handling Capacity Schiphol.

Short term objective:
Identify implementation steps to increase Schiphol's sustainability and develop the first step.

Assignment:
Analyse the results of the studies Increase Landing Capacity Schiphol and Increased Ground Handling Capacity Schiphol and bring the results into a coherent plan to further develop sustainability. Capacity shortfalls which were not sufficiently addressed in mentioned studies should analysed and the study thereof is part of the new assignment.
The development of an initial steep is a key element of the assignment.

Long term objective:
Ensure that Schiphol's capacity is sufficient under all weather conditions.

Involved parties:
NLR, AAS, KLM and LVNL

Source:
WG-Air letter ATM/CR/2009/657

Result Report:
Increased Sustainability Schiphol (ISS), Final Report, KDC/2010/0111, December 2010

C21: AIRE-2 trial, Trajectory Based Night Time CDA's into Schiphol Airport

Ref. Ext. Programme	SESAR	**Status**	Completed			
Project Number	PRJ-1811					
Customer	LVNL Stratcor	**Key Performance Areas**	**EFF**	**ENV**	**CAP**	~~CST~~
Assignment	CS/PPM/2010/508		**PRD**	**INT**	**SAF**	
Project Plan	SJU/LC/0039-CFP	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	02-12-2010		+	0	0	
Project Lead	Evert Westerveld (LVNL)					
Sponsor	-	**Ref. ATM System Strategy**	Not Applicable			
Financial Partner	DGB, SESAR JU	**Priority**	Normal			
TRL	3					

Introduction:
Night Time CDA's have been in operation at Amsterdam Airport Schiphol for almost fifteen years. Schiphol's CDA's have been defined with the purpose to avoid noise annoyance in the greater Schiphol airport area. For this reason the CDA's have been defined as a lateral path within the Schiphol TMA only with the aim to fly these so-called "transitions" like a CDA as much as possible. ATC The Netherlands applies night time CDA's as much as possible during the night hours, typically from 11:00 pm till 06:30 am. However, during the early morning hours, typically after 04:00 am long haul traffic arrives at Schiphol Airport in bunches. Often times it is not possible for ATC to allow traffic to continue on their pre-planned CDA due to conflicts between inbound aircraft. In these situations ATC vectors inbound traffic or uses holding patterns to delay flights to to sequence the flights and to maintain safe separation. Vectoring however creates extra track miles, disturbing the CDA, causing extra fuel burn and emissions.

Objective
The challenge is to improve the percentage of undisturbed CDA operations during the night time operations at Schiphol airport. The goal is to enable all KLM inbound aircraft within a certain period to fly an undisturbed CDA from top of descent to touchdown via the shortest published transitions, to maximise fuel savings and emission reduction and to avoid noise annoyance.

Assignment
Under the AIRE-2 call for tender KLM, ATC The Netherlands and NLR propose to introduce a system innovation during night time operations to enable inbound traffic to fly an undisturbed CDA at Schiphol Airport. The innovation consists of a modified inbound planning system which supports the air traffic controller in his task to plan inbound traffic streams. The modified inbound planning system is fed with trajectory data from KLM aircraft through KLM Operations Control (ACARS datalink). The KLM datalink information consists of at least FIR entry point and expected entry time. This data is used to make a timely inbound planning of traffic in the 03:30 to 05:30 timeframe. The inbound planning will be shared and coordinated with Maastricht UAC. Aircraft which can meet the planned entry time for the Amsterdam FIR will be cleared on a CDA from Top of Descent. A mini-SWIM system may be set-up as part of the trial.

The trial will consist of an operational set-up which manages aircraft that enter the Amsterdam FIR at sector 1, 2 and 3, i.e. traffic from the south, southeast and east . This traffic will receive a clearance onto a fixed arrival route for runway 18R or 06 well in advance of top of descent. This fixed arrival route will consist of the relevant transition to the runway in use (for traffic to RWY 18R from the east the ARTIP 1C transition (see figure 1)), which is the shortest published route to this runway from the east. Traffic that participates in the trial will be bound to meeting the pre-planned FIR entry time. The ways and means of participation of other traffic is to be investigated.

Participants
Participants are KLM, NLR, LVNL, Maastricht UAC. NLR will develop the (stand-alone) experimental inbound planner. LVNL will ensure coordination with Maastricht UAC. The trial will be open to all aircraft that operate in the trial period and that can meet the technical requirements (i.e. communicate ACARS trajectory data).

Benefits
The benefits of this trial consist of reduction in flown track miles and consequently a reduction in fuel burn and emissions. The reduction in track miles consists of two components. One component is the application of a standard (short) published route and the other component is avoiding extra track miles associated with vectoring and holding. The trial will be applicable at night time hours from 03:30 till 05:30 hours during the trial period (February – March 2011). The number of aircraft involved in the trial is estimated at 500 to 600. The fuel and emission savings during the trial are estimated at 20.000 kg and 60.000 kg respectively.

Relation to other projects
The use and evaluation of trajectory data is beneficial for the transition to the SESAR target concept which is in essence Trajectory Based Operations. As a first migration step towards SESAR the SARA arrival manager (AMAN) will be deployed. This application has a planning horizon of 12 to 14 minutes and ensures timing and sequencing of all inbound aircraft into Schiphol through route and speed advisories. SARA has been designed to be operated during the peak-traffic hours.

The AIRE-2 proposal “trajectory based night time CDA’s” will not interface with SARA because SARA will not be implemented at the time of the trial. Furthermore it will not be beneficial to the trial to issue speed and/or route advisories which have been cleared for a ToD CDA along a fixed arrival route. In essence application of SARA during the night hours would not benefit the AIRE-2 trial. It is expected however that AIRE-2 trial will be of benefit to the further Schiphol AMAN development by adding trajectory data of suitably equipped aircraft to the SARA system. This addition is expected to enhance SARA performance.

Source:
AIRE-2 Technical Proposal to the SESAR Joint Undertaking: Trajectory Based Night Time CDA’s into Schiphol Airport.

Result Report:
D-SP-12-047 120223 v1.1, AIRE-II Final Result Report

C22: A New Learning Philosophy; Dynamic Task Selection for Flexible Training

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1614					
Customer	MTA (LVNL)	**Key Performance Areas**	~~EFF~~	~~ENV~~	~~CAP~~	~~CST~~
Assignment	KDC/2007/0110		~~PRD~~	**INT**	**SAF**	
+Project Plan	KDC/2008/0509, version 1.3	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	18-12-2007		+	0	0	
Project Lead	Jeano de Bock (LVNL)					
Sponsor	-	**Ref. ATM System Strategy**	Not Applicable			
Financial Partner	DGB	**Priority**	Normal			
TRL	1					

Introduction:
This project will focus on the design of flexible systems and will especially focus on dynamic task selection and the shift in responsibility concerning this selection from the coach to the trainee. The trainees' self-directed learning skills will be taken into account in this shift of the responsibility. We expect that effectiveness (cf. pass rate) and efficiency of ATC training will be improved by giving trainees more responsibility in their own learning process, also by stimulating self-reflection, without lowering the required performance standards set by European regulations (ESARR5). The coach remains indispensable in the learning process because of the strict safety requirements, especially in on the job training (OJT). In the changing working environment of ATC, self-directed learning skills will also be helpful. Not only the changing environment but also being a trainer requires this SDL skills.

Assignment:
The aim of the PhD-project is to conduct research to design models and instruments to make the ATC-training program more flexible. The project will besides research output as scientific articles also have practical implications and output. For instance, the portfolio design will be further developed as a part of LIS, and learning tasks will be adapted, taking into account self-direct learning skills trainees need in future education and daily life. These results are worked-out cases for further development and redesign of the ATC-training and related training programs. This will not be restricted to LVNL, but the results can be useful for other ANSPs, which is especially important in a future FAB environment with more cooperation between ANSPs, and for related organizations in the Dutch aviation sector such as KLM. For instance, pilots are also trained in a learning environment (simulators, OJT) with high safety standards, and therefore similar challenges exist for airline industries. This transfer to other training domains will be part of project 2d of the program 'Human factors in future ATM'.

Short term objective:
Taken the current competences in ATC as starting point, the aim of the first study is to determine the involved SDL-skills and the standards and criteria (scoring rubrics) for assessing these skills in ATC. The standards and criteria to assess SDL skills will be used to adapt the already used portfolio (LIS) in ATC.

Midterm objective:
First, the focus is on the design of the training program. Together with different stakeholders, a part of the training will be analysed, using the 4C/ID-model (Van Merriënboer, 1997) as point of departure. The sequence of the learning tasks will be described concerning complexity, amount of support and variability. Metadata for each task will contain this information. In this and following studies, eye-tracking will be used to measure the regulation process (cued retrospective reporting). The second part of this study will focus on dynamic task selection. To select appropriate tasks learner variables as a combination of task performance and mental effort, and task variables, as complexity must to be taken into account. Using this information, stored in the portfolio (LIS), the decisions for task selection can be made. But to select tasks that are not too complex or too simple, or to select whole or part task practices rules of thumb or a heuristic is needed. This heuristic or procedure will be developed. The aim of the heuristic is, taken into account the information in the portfolio (LIS), to optimize the selection of tasks. The question in this study will be: What is the effect of the developed heuristic on trainees' task performance (learning curves), mental effort,

and effectiveness (in terms of time investment)?

Long term objective:
This PhD-project will focus on the question how a flexible training system for ATC can be developed that makes it possible to meet the individual learning needs of trainees by shifting responsibility to the trainees in such a way that they become more and more self-directed learners, and are able to monitor and assess task performance, and select learning tasks that fulfil their learning needs. The focus of the project will be on a training philosophy, based on further developments of current training methods and will use the existing learning tasks (that is simulator training tasks and part task practices) and the current portfolio (LIS) as a starting point, but will also anticipate on future competences needed in various (unforeseeable) situations. The project will build on the current innovations in ATC. That is, it will use the available standards and criteria for assessment, the assessment system and the coaching protocols. The project aims at developing general design guidelines for flexible training, especially concerning SDL in dynamic task selection.

Involved parties:
Open University of the Netherlands, Maastricht University, LVNL.

Source:
The project is a part of the Human factors in future ATM-program. The research program is proposed by the HF department of LVNL

Result Report:
Proefschrift ‘Visual Problem Solving and Self-regulation in Training Air Traffic Control’

C23: Application of Downlink Airborne Parameters

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1879					
Customer	LVNL Stratcor	**Key Performance Areas**	**EFF**	**ENV**	~~CAP~~	~~CST~~
Assignment	SCT/2011/128		**PRD**	~~INT~~	**SAF**	
Project Plan	S&P/2011/4036, version 2v0	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	27-07-2011		+	0	0	
Project Lead	David Zwaaf (LVNL)					
Sponsor	-	**Ref. ATM System Strategy**	ACE 13.2			
Financial Partner	DGB	**Priority**	Normal			
TRL	9					

Introduction:
As part of the long-range plan to improve airspace safety and efficiency, Europe has mandated the carriage and operation of Mode-S transponders for IFR flights.

An important milestone was the implementation of Mode-S Elementary Surveillance (ELS), which solves the Mode-A code shortage, enabled the Vertical Radar View application and improved Secondary Surveillance Radar performance.

- Mode-S Enhanced Surveillance (EHS) consists of the functionality of Mode-S Elementary Surveillance plus the extraction of aircraft parameters known as Downlink Airborne Parameters (DAPs):

BDS Register	**Basic DAP Set** (if Track Angle Rate is available)	**Alternative DAP Set** (if Track Angle Rate is **not** available)
BDS 4,0	Selected Altitude	Selected Altitude
BDS 5,0	Roll Angle Track Angle Rate True Track Angle	Roll Angle – True Track Angle
	Ground Speed	Ground Speed
	–	True Airspeed (provided if Track Angle Rate is not available)
BDS 6,0	Magnetic Heading	Magnetic Heading
	Indicated Airspeed (IAS) / Mach no.	Indicated Airspeed (IAS) / Mach no.
	Vertical Rate (Barometric rate of climb/descend or baro-inertial)	Vertical Rate (Barometric rate of climb/descend or baro-inertial)

The usage of DAPs by ATC provides the opportunity to increase safety and efficiency. Potential ATM applications utilising DAPS are:
- Display of DAPs to controllers (e.g. Magnetic Heading, Indicated Airspeed/Mach number, Selected Altitude, Vertical climb rate)
- Short Term Conflict Alert (STCA)
- Minimum Safe Altitude Warning (MSAW)
- Level bust alerting
- Surveillance Data Processing Systems
- Ground Based Trajectory Prediction

In general, the usage of DAPs can enhance the Air Traffic Situation Picture for the controller and can increase the performance of automated ATC tools.

For the short term the potential benefits have been identified using Selected Altitude and Indicated Airspeed / Mach Number. The foreseen applications are display of DAPs to the controller and Level Bust Alerting.

For the long term the potential applications and implementation roadmap have to be developed and the potential benefits identified for further decision making. For appropriate decision making, besides the required technical development, other topics such as the required procedures, controller responsibility and legal aspects must be taken into account.

Assignment:
Develop and validate the usage of DAPs:

- Define system requirements and system design for the usage of Selected Altitude and Indicated Airspeed / Mach Number
- Validate the data quality for Selected Altitude and Indicated Airspeed / Mach Number
- Identify and develop potential applications for the mid- and long term (incl. identification of benefits)

Short term objective:
The short term objectives are:

- Validate the quality of the data
- Define system requirements and system design for the usage of Selected Altitude and Indicated Airspeed / Mach Number
- Develop procedures for the usage of Selected Altitude and Indicated Airspeed / Mach Number
- Demonstrate and validate the usage of these DAPs in the Amsterdam Advanced ATC system

Midterm objective:
-

Long term objective:
For the long term the objective is to develop applications for the usage of the other DAPs. Identify the potential benefits and system requirements.

Involved parties:
KLM, LVNL, NLR

Result Report:
Definitief Verificatierapport PRJ 1879 Initiële implementatie van Enhanced Mode-S v1.0
NLR-CR-2010-584

C24: Go-Around Detection

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1904/PRJ-1950					
Customer	LVNL Stratcor	**Key Performance Areas**	~~EFF~~	~~ENV~~	~~CAP~~	~~CST~~
Assignment	SCT/2011/128		~~PRD~~	~~INT~~	**SAF**	
Project Plan	Deel 1 – Deel 2 to be written	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	15-11-2011 (deel 1)(datum offerte) 04-06-2012 (deel2)		+	0	0	
Project Lead	Jürgen Teutsch (NLR)					
Sponsor	-	**Ref. ATM System Strategy**	ATM Req. 2011-015			
Financial Partner	DGB	**Priority**	Normal			
TRL	3					

Introduction:
It has become evident that in some cases, the detection of a missed approach by the controller is too late. In such instances the controller becomes aware of the go-around by the notification of the pilot via RT. This late awareness of a missed approach is a safety risk, especially when convergent runways are in use. For the pilot the call to ATC is not his/her highest priority when making a go-around, as “aviate” and “navigate” go before “communicate”. So critical time may be lost to separate aircraft when the controller is unaware of a missed approach, and is dependent of an RT call by the pilot.

This study is aimed at making an inventory of technical – operational solutions which may assist the controller in a timely detection and awareness of a missed approach.

Assignment:
Make an inventory of systems and solutions which could assist the controller in a timely detection of a missed approach. The inventory should include sensors such as:
- Surveillance sensor Mode-C
- Surveillance RDP groundspeed
- Mode-S Flight status (weight on wheel switch)

Short term objective:
Provide an inventory report, advising LVNL management, on the way forward with go-around detection.

Midterm objective:
-

Long term objective:
-

Involved parties:
KLM, LVNL, AAS

Result Report:
Technical Inventory for Go-Around Detection (TIGARD) final report (KDC/2012/0025, march 2012)
PROGARD_TN-GD01-13_Final (februari 2013)

C25: Fourth Initial Approach Fix

Ref. Ext. Programme	FABEC	**Status**	Completed			
Project Number	PRJ-1761					
Customer	LVNL Stratcor	**Key Performance Areas**	**EFF**	**ENV**	**CAP**	~~CST~~
Assignment	-		**PRD**	**INT**	**SAF**	
Project Plan	CS\PPM\2010\122	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	22-03-2011 (datum offerte)		+	0	+	
Project Lead	Douwe de Vries (LVNL)					
Sponsor	-	**Ref. ATM System Strategy**	86.0			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Introduction:
Within the FABEC programme several hotspots were identified. These hotspots are characterised by the complexity of the local airspace design in combination with high traffic demand. For these hotspots redesigns have been proposed. One of the hotspot developments which affects the route design within the Netherlands FIR is the ARKON-REKKEN hotspot.

One of the consequences of the ARKON-REKKEN re-design is the need to re-locate military airspace, in particular TMA-D. Within FABEC it has been proposed to re-locate TMA-D at the TMA-C location and to create a larger crossborder military airspace also indicated as “Cross Border Area Land”. Creating a CBA Land east of ARTIP however will limit the capacity of ARTIP as one of the three TMA entry points (Initial Approach Fix). Therefore it has been proposed to create a fourth IAF south of ARTIP.

To assess the effects of a fourth IAF a study is proposed which focuses on the capacity and design of the Schiphol TMA. The study “Fourth IAF” is an LVNL study and will result in a number of design options. The KDC project will consist of the validation activities in support of the concept development.

Assignment:
Validate the design options, including a fourth IAF, for the Schiphol TMA

Short term objective:
Delivery of a validated design which will support assessment of VEM effect analysis.

Midterm/Longterm objective:
Not applicable.

Involved parties:
LVNL, KLM, NLR

Result report:
121107 Final RTS experimentplan en resultaten v1.0 (mei 2012)
PRJ-1761 Beslisdocument v1.0 (CS/PPM/2013/90, 13 december 2012)

C26: New Applications of Downlink Airborne Parameters

Ref. Ext. Programme	-	**Status**	Completed
Project Number	PRJ-1999		
Customer	B-KDC	**Key Performance Areas**	EFF ENV ~~CAP~~ ~~CST~~
Assignment	Call for Tender		PRD ~~INT~~ SAF
Project Plan	Proposal	**ATM concept**	ATS: + ; ATFCM: 0 ; ASM: 0
KDC Board Approval	11-06-2013 (TBC)		
Project Lead	Evert Westerveld (LVNL)		
Sponsor	-	**Ref. ATM System Strategy**	-
Financial Partner	DGB	**Priority**	Normal
TRL	3	**Project Risk Profile**	Low

Goal / Expected Benefit:
Improvement of operational efficiency and safety.

Introduction:
In July 2012 the implementeation of Mode S Enhanced Surveillance “Downlink of Airborne Paraments” took place at LVNL. This implementation consisted of display of DAPs to ACC controllers (Magnetic Heading, Indicated Airspeed/Mach number, and Selected Altitude were the three selected parameters). Implementation of DAP for approach controllers follows the ACC implementation as an internal project.

The full set of Mode S EHS parameters is much larger than the three parameters selected by LVNL for the initial implemenation:

BDS Register	**Basic DAP Set** (if Track Angle Rate is available)	**Alternative DAP Set** (if Track Angle Rate is **not** available)
BDS 4,0	Selected Altitude	Selected Altitude
BDS 5,0	Roll Angle Track Angle Rate True Track Angle	Roll Angle – True Track Angle
	Ground Speed	Ground Speed
	–	True Airspeed (provided if Track Angle Rate is not available)
BDS 6,0	Magnetic Heading	Magnetic Heading
	Indicated Airspeed (IAS) / Mach no.	Indicated Airspeed (IAS) / Mach no.
	Vertical Rate (Barometric rate of climb/descend or baro-inertial)	Vertical Rate (Barometric rate of climb/descend or baro-inertial)

The usage of DAPs by ATC provides the opportunity to increase safety and efficiency. Potential ATM applications utilising DAPS are:
- Display of DAPs to controllers (e.g. Magnetic Heading, Indicated Airspeed/Mach number, Selected Altitude, Vertical climb rate)
- Short Term Conflict Alert (STCA)
- Minimum Safe Altitude Warning (MSAW)
- Level bust alerting (already implemented at ACC)
- Surveillance Data Processing Systems
- Ground Based Trajectory Prediction

In general, the usage of DAPs can enhance the Air Traffic Situation Picture for the controller and can increase the performance of automated ATC tools.

For the long term the potential applications and implementation roadmap have to be developed and the potential benefits identified for further decision making. For appropriate decision making, besides the required technical development, other topics such as the required procedures, controller responsibility and legal aspects must be taken into account.

Assignment:
- Identify and develop potential applications for the mid- and long term (incl. identification of benefits)

Short term objective:
The short term objectives are:
- Assess which parameters (as defined by the EC Implementing Rule and expeanded by the EASA Notice of Proposed Rulemaking) are transmitted by aircraft visiting Schiphol airport, and the percentage thereof.
- Validate the quality of the data
- Propose potential applications of the data which have either a safety, capacity, efficiency or environmental benefit. Examples of applications which are appealing to LVNL are: Downlink of “Go-Around Mode”, Downlink of selected SID, Downlink of Altimeter Setting.

Midterm objective:
-

Long term objective:
-

Involved parties:
KLM, AAS, LVNL

Source:
-

Result report:
Rapport New applications of DAP v1.0.pdf (31 januari 2014)

C27: Datalink Business Case Study

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1945					
Customer	LVNL Stratcor	**Key Performance Areas**	~~EFF~~	~~ENV~~	~~CAP~~	~~CST~~
Assignment			~~PRD~~	~~INT~~	**SAF**	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	04-06-2012		+	0	0	
Project Lead	E. Westerveld (LVNL, TBC)					
Sponsor	-	**Ref. ATM System Strategy**				
Financial Partner	DGB	**Priority**	Normal			
TRL	3	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational efficiency and safety.

Introduction:
The EUROCONTROL Link 2000+ Programme provides enroute Controller Pilot Data Link Communication (CPDLC) services, which allow for the direct exchange of text-based messages between a controller and a pilot. The CPDLC messages automates routine tasks that can take up to 50% of a controller's time. Messages include standard ATC clearances "ACL" (e.g. "Climb to level 350") or "AMC" (e.g. microphone check). It also enables communication in case of blocked frequencies. CPDLC is further referred as 'Datalink'

Adoption of Datalink moved forward as the European Commission accepted Link 2000+ Programme's proposed Data Link Services Implementing Rule (DLS IR) EC29/2009 on January 16, 2009.

For Airspace Users the core DLS IR states that new aircraft delivered from 1 January 2011 onwards shall be equipped with Datalink while existing aircraft shall be retrofitted with CPDLC no later than 5 February 2015. Some exemption apply, mainly for aircraft which are due to retire.

For ANSPs, the DLS IR mandates installation and usage of Datalink from FL285 onwards starting 7 February 2013.

KLM is implementing Datalink to comply with the IR. The status of Datalink equipage per end of 2012 is as follows:

Aircraft	When
• B737: CPDLC/VDL mode 2	End 2012
• A330: CPDLC/ADS-C	Installed
• MD11: No datalink	-
• B777: CPDLC/ADS-C	Installed
• B747: CPDLC/ADS-C	Mid 2012
• E190: CPDLC/VDL mode 2	End 2012

The current IR is applicable above FL285 and does therefore not affect the airspace under control of LVNL. LVNL's ATM system strategy however has identified several development steps which require Datalink. This is needed to communicate dynamic route instructions (SARA concept 3), CTA's and D-TAXI instructions. Datalink is an enabler for 4D trajectory management and SWIM. Furthermore Datalink reduces controller workload for routine tasks.

The SESAR Concept of Operations states that routine voice communications shall be replaced by 2020, also in lower airspace and terminal area. It is expected that it will expand the applicability of the DLS IR and will affect LVNL in the 2020 timeframe.

Assignment:

With the advent of full (or near full) airline Datalink equipage in accordance with the Data Link Services Implementing Rule, investigate which Datalink services are beneficial to the Schiphol operation (below FL245) and are implementable in the 2013 – 2016 timeframe. Make an initial business case in which implementation costs and benefits are evaluated.

Short term objective:
A business case study, indicating services, benefits and costs of datalink implementation below FL245.

Midterm objective:
Operational trial which demonstrates the technical feasibility of routine instructions via Datalink iso. voice communications

Long term objective:
-

Involved parties:
LVNL, KLM, MUAC, and a contractor which leads the study.

Source:
-

Result Report:
131202 To70 report CPDLC Study - FINAL (december 2013)
140116 NLR report CPDLC Study (januari 2014)

C28: Vision on the implementation of new technology in the control tower

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1996					
Customer	Stratcor	**Key Performance Areas**	~~EFF~~	~~ENV~~	~~CAP~~	~~CST~~
Assignment	Call for Tender		~~PRD~~	~~INT~~	**SAF**	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	11-06-2013		+	0	0	
Project Lead	TBD					
Sponsor	-	**Ref. ATM System Strategy**				
Financial Partner	DGB	**Priority**	Normal			
TRL	3	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational efficiency and safety.

Introduction:
In recent years more and more technology has become available which can support the operational processes in the Schiphol control tower. The application of new technologies in ATC control towers has been studied and structured internationally in the so-called A-SMGCS implementation levels. The policy at LVNL has been to adopt level 1 and level 2 type applications and to delay any decision about the application of more advanced levels until the results of validation of these applications becomes available. Eurocontrol has explained the scope of level 1 and level 2 type applications on its web-site:

> *During the past decade, EUROCONTROL has developed the baseline for A-SMGCS services in Europe. Based on the provisions of the International Civil Aviation Organization (ICAO), the Agency has identified two functional levels named A-SMGCS Levels 1 & 2.*
>
> *The **first level** provides for the identification of aircraft in the movement area and transponder equipped vehicles in the manoeuvring area via a Human Machine Interface (HMI).*
>
> *The **second level** provides for an alerting function to Air Traffic Controllers (ATCOs) in case of intrusion of aircraft or vehicles in a pre-defined protected area around the runway system.*
>
> *The identification is done by using primary and secondary radar functions, data fusion and representation on an HMI to the Controller.*

LVNL's A-SMGCS policy has led to the implementation of a runway incursion alerting function in 2010. Beside LVNL's policy for A-SMGCS there is a second trend that takes its effect in the operational processes: These are the recommendations from incident investigations which lead to the decision to implement safety nets or alerting functions. A recent example is the decision to implement an alerting function for go-around detection.

Thirdly there is a need to move away from today's "paper support" in the tower, in essence to replace the current paper flight strips by a digital system. This development will enable more safety net functions to be developed and implemented.
There appears to be a trend to increasingly support the tower processes with safety net functions with a subsequent effect to shift attention ("head down") to the controller working position. Within LVNL it is felt that the current trend needs a thorough Human factor analysis.

Assignment:
Study the effect of additional safety net implementation on controller working processes, in particular:
- The effect on head down time
- The risk of multi-safety net interference

Short term objective:
- Provide an advice to Stratcor how to deal with the current trend to digitize the operational information in the tower, and added safety net functions.

Midterm objective:
-

Long term objective:
-

Involved parties:
KLM, LVNL, AAS

Source:
-

Result Report:
NLR-TR-2013-419 definitieve eindrapportage (februari 2014)

C29: Cognitive Flexibility in Response to Unforeseen Changes

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1728					
Customer	MTA (LVNL)	**Key Performance Areas**	~~EFF~~	~~ENV~~	~~CAP~~	~~CST~~
Assignment	KDC/2007/0110		~~PRD~~	**INT**	**SAF**	
Project Plan	KDC/2009/0083 version 1.0	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	18-12-2007		+	0	0	
Project Lead	Jeano de Bock (LVNL)					
Sponsor	-	**Ref. ATM System Strategy**	Not Applicable			
Financial Partner	DGB	**Priority**	Normal			
TRL	1	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational efficiency and safety.

Introduction:
Recent developments in air traffic management suggest that the role of air traffic controllers (ATCOs) will fundamentally change. Currently, ATCOs have an active role in communicating and directing pilots. In future ATC systems, many of the current tasks will likely be fulfilled by computer systems. Consequently, the-day-to-day activities of future ATCOs will shift from an active role in controlling air traffic towards a passive role of monitoring ATC systems. For safety reasons, however, future ATCOs will still need to be able to intervene when ATC systems fail. In these, presumably rare, occurrences, ATCOs need to be able to recognize a failure and be able to immediately switch to an active role. This active role might include putting backup systems into work or might include switching back to human air traffic control. A critical question for the safety and success of future ATC systems is the degree to which future air traffic controllers are able to recognize system failures and be able to switch from their passive to an active role when system failures occur. In this project, we will specifically focus on investigating cognitive and environmental antecedents of successful reactions to unforeseen changes in the context of complex on-time decision making tasks mirroring task demands in air-traffic control. We therefore use the more narrow term “cognitive flexibility” to indicate that cognitive mechanisms causing successful reactions to unforeseen changes will be the major focus of this project.

Assignment:
This project will deliver insight in factors that are relevant in terms of cognitive flexibility. Cognitive flexibility refers to the ability to deal with unforeseen changes in the environment (task). At the one hand this refers to individual characteristics (cognitive capability), but on the other hand it also addresses environmental issues, like the task, equipment and so on, that may enhance and facilitate people to deal with those changes. For instance, the changes need to be noticed before operators can deal with these changes. And how information is presented or communicated affects whether an event will be noticed, and also how people will respond to it. Therefore this project will focus on changes in tasks that are unexpected or unforeseen, and peoples’ response to these changes will be studied. The objective is formulate recommendations for training and selection systems for people that are frequently dealing with unforeseen changes, and also to look at task and system design aspects that may help operators.
The results will not be restricted to LVNL, but can be useful for other ANSPs, which is especially important in a FAB environment with more cooperation between ANSPs, and for related organizations in the Dutch aviation sector such as KLM and Amsterdam Airport Schiphol (AAS).

Short term objective:
Initially (Study 1 and Study 2), we will focus on well-established moderators of cognition-performance relations: Task complexity (Study 1) and task consistency (Study 2). We will investigate effects of task complexity and task consistency by using a so-called crossed design. Specifically, one experimental group will experience an unforeseen change from a high level of task complexity/consistency to a low level of complexity/consistency, while the other experimental group will experience a change from a low to a high level of task complexity/consistency.

Midterm objective:
In a later stage of the project (Study 3), we will shift the focus form investigating task characteristics to investigating characteristics of the change itself. Specifically, we will manipulate the degree to which persons can recognize a change. This research is particularly relevant for developing warning devices in ATC systems.

A final study (Study 4) will apply some particularly relevant findings from the first three studies to the two-person team level to gather an understanding of these effects when two ATCs work closely together. In so doing, this final study will contribute to the emerging literature on team adaptation.

Long term objective:
The project will focus on deliverables that are useful recommendations on how to design jobs, and systems so that coping with unforeseen changes is facilitated. Furthermore recommendations which are specific for air-traffic control will be formulated and consequently will help to design future ATM systems in a safe and efficient way. In addition the project will provide tools and instrument that will improve selection and training for professionals frequently dealing with unforeseen changes. This means that the results will not only be applicable for ATM, but are, in principle, generalisable to a broader group of professionals. In particular in the aviation sector, where safety is paramount, professionals need to be able to deal with unforeseen changes.

Involved parties:
Maastricht University, LVNL, KLM

Source:
The project is a part of the Human factors in future ATM-program. The research program is proposed by the HF department of LVNL.

Result Report:
Proefschrift ‘Cognitive Flexibility in response to Unforeseen Change’

C30: Low Altitude CDO on Parallel Runways

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1948					
Customer	Stratcor	**Key Performance Areas**	**EFF**	**ENV**	~~CAP~~	~~CST~~
Assignment	SCT/2012/xxx, 16-03-2012		**PRD**	~~INT~~	**SAF**	
Project Plan	-	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	04-06-2012		+	0	0	
Project Lead	David Zwaaf					
Sponsor	-	**Ref. ATM System Strategy**	TBD			
Financial Partner	DGB	**Priority**	Normal			
TRL	3	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of environmental performance.

Introduction:
Present-day parallel operations to Schiphol runways 18C and 18R adhere to ICAO guidelines for operations to parallel runways (ICAO SOIR, Annex 14, PANS-ATM, PANS-OPS). The present Schiphol procedure uses level flight separated by 1000ft for aircraft on base leg until established on the ILS, typically at 2000 and 3000ft. This level segment is undesirable for both environmental and economical reasons. The CDA by definition, as a procedure to improve on both environment and efficiency, omits level segments. Therefore, when CDA's are applied for simultaneous use of 18C and 18R, such vertical separation cannot be provided. Lateral separation may be used as an alternative; however this implies the need for staggering of the two inbound flows, thus introducing a dependency between 18C and 18R operations. Such a dependency further complicates the TMA operation, increasing workload and most probably reducing capacity. Therefore, there is a need to investigate the possibilities for *independent* parallel approach procedures.

Assignment:
This project aims at investigating the possibilities for safe and efficient independent parallel approaches at Schiphol 18C/18R from a technical, procedural and regulatory viewpoint. The assignment focusses on finding a near term solution, which can be implemented in a timeframe of 3 to 5 years. The solution must be built on the assumption that RNP technology will not yet be available. Safety compliance therefore must be demonstrated on the assumption of RNAV equipped aircraft.

Short term objective:
Inventory of viable independent parallel approach procedures for Schiphol 18C/18R, starting from low altitudes (4000 – 7000 ft) with a preliminary judgment of feasibility and efficiency.

Midterm/ Long term objective:
Validation of viable independent parallel approach procedures for Schiphol 18C/18R. Implementation roadmap strongly linked to improvements in Arrival Management that are required to enable daytime CDAs. Enabling safe and efficient independent CDAs on parallel runways 18C/18R while providing sufficient capacity.

Involved parties:
LVNL, MITRE, KLM, NLR

Source:
-

Result Report:
Low altitude CDOs Report v1.0

C31: Go-Around Detection, prototype development

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1991					
Customer	LVNL Stratcor	**Key Performance Areas**	~~EFF~~	~~ENV~~	~~CAP~~	~~CST~~
Assignment	SCT/2013/11		~~PRD~~	~~INT~~	**<u>SAF</u>**	
Project Plan	S&P/2014/4726	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	22-08-2013		+	0	0	
Project Lead	Mariska Roerdink (LVNL)					
Sponsor	-	**Ref. ATM System Strategy**	ATM Req. 2011-015			
Financial Partner	DGB	**Priority**	Normal			
TRL	6	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational safety.

Introduction:
It has become evident that in some cases, the detection of a missed approach by the controller is too late. In such instances the controller becomes aware of the go-around by the notification of the pilot via RT. This late awareness of a missed approach is a safety risk, especially when convergent runways are in use. For the pilot the call to ATC is not his/her highest priority when making a go-around, as “aviate” and “navigate” go before “communicate”. So critical time may be lost to separate aircraft when the controller is unaware of a missed approach, and is dependent of an RT call by the pilot.

The initial KDC study has shown that a meaningful and reliable detection of a go-around is possible on the basis of radar data. The proposed solution was found to be acceptable for the controllers operational supervisors, consulted as part of the initial study.

Assignment:
Develop a prototype system which can be evaluated in an operational environment.

Short term objective:
Provide an inventory report, advising LVNL management, on the way forward with go-around detection (completed).

Midterm objective:
Develop a prototype system which can be evaluated in an operational environment.

Long term objective:
-

Involved parties:
KLM, LVNL, AAS, NLR

Source:
-

Result Report:
- GARDS Specs in Cradle: in SSF onder \20 System Design\30 Functional Design (Hatley Pirhbai models)\GARDS Specs REL-48.pdf
- GARDS Rules tabellen: in SSF onder \20 System Design\30 Functional Design (Hatley Pirhbai models)\ GARDS Rules REL-48.0

C32: Applications of ADS-C

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-2044	**Research Cluster**				
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for Tender					
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	21-05-2014					
Project Lead	Ceriel Janssen					
Sponsor	-	**Ref. ATM System Strategy**	NA			
Financial Partner	DGB	**Priority**	Normal			
TRL	3					

Goal / Expected benefit:
Expected benefits are in the area of safety, efficiency and cost efficiency.

Introduction:
In 2013 two studies were conducted related to the current subject:
1) The study into new applications of Mode-S enhanced surveillance (downlink of airborne parameters) and
2) The datalink business case study

After concluding study 1 the question was raised whether or not safety applications were possible based on downlink of route or next waypoint. It turned out that not enough aircraft downlink this type of information to warrant any application to this end. An alternative solution that was proposed was use of ADS-C data, however ADS-C was out of scope of study 2.

Assignment:
Make an inventory of the current and forecasted equipage of ADS-C (VDL-2) capable aircraft operating from Schiphol and propose safety, efficiency and cost efficiency related applications based on this technology which could be warrented. FANS 1/A based ADS-C capable aircraft must be considered within scope of this study.

Short term objective (first year):
A broad inventory of ADS-C potential for Schiphol, including potential applications.

Midterm objective (two – three years) :
A more focussed pre-implementation study, simulation or trial supporting an implementation business case.

Long term objective:
-

Involved parties:
KLM, LVNL

Source:
-

Result Report:
Rapport ADS-C 1.0

C33: Improving CDM by using mobile devices in the cockpit

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1998					
Customer	KDC Board	**Key Performance Areas**	**EFF**	**ENV**	**CAP**	**CST**
Assignment	Call for Tender		**PRD**	~~INT~~	**SAF**	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	11-06-2013		+	0	+	
Project Lead	Ceriel Janssen (KLM)					
Sponsor	-	**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	3	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational efficiency.

Introduction:
The use of mobile devices in the cockpit is rapidly increasing. Many airlines introduce mobile devices in their flight operation. The main applications are in the field of digitalizing of information (paperless cockpit) and connectivity.

The use of mobile devices in the cockpit can optimize the turnaround process of an aircraft at an airport, creating benefits for all stakeholders involved (airline, ANSP, Airport). Earlier studies indicated this potential. At that time, connection with the outside world was slow and unreliable adding additional uncertainties to the turnaround process. It is considered that the connectivity possibilities nowadays suit the communication needs for fast and seamless information exchange, which increases the situation awareness of all stakeholders and provides the opportunity to increase the efficiency of ground processes.

The turnaround process can be optimized by enabling the flight crew to take notice of the status of the turn-around process via CDM and to add flight crew related information to the CDM process. This information exchange can be made possible by designing an app that allows relevant two way information to be sent in an easy, time saving manner. Especially, when external conditions such as limited runway use and weather related factors (de-icing procedures in force) are present, it is expected that flight crew involvement in the CDM process can improve turn-around efficiency. In the future SESAR concepts using the SWIM network for CDM will require involvement of flightcrew to optimize flights. The turnaround process as specified by the CDM information is fully encapsulated in the SESAR Airport Transit View (ATV). The ATV is the key concept element in the SESAR Airport Operations Planning (AOP), and a crucial element in determining the Airport Performance Framework and operating the Airport Operations Centre (APOC).

Assignment:
Develop a practical mobile device app for use by the flight crew to enhance awareness during the turn-around process. The input for the app is CDM information. The app should also enable the crew to add information from the cockpit into the CDM process.

Phase 1 (2013):
- Make a survey of specific requirements for the stakeholders involved at Schiphol airport (KLM, AAS, ATC-NL).
- Make a survey of data exchange between parties involved during the turn-around process.

Phase 2 (2013):
- Design the functionality of the app.

Phase 3 (2014):
- Production of prototype mobile device app.
- Evaluation in a cockpit environment
- Evaluation/demonstration during a KLM flight

Involved parties: LVNL, KLM, AAS, KDC partners

Source: -

Result Report:
NLR-CR-2014-023

C34: Insight in Operational Efficiency

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-2045					
Customer	KDC Board	**Key Performance Areas**	**EFF**	**ENV**	**CAP**	**CST**
Assignment	Call for Tender		**PRD**	~~INT~~	**SAF**	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	03-04-2014		+	0	0	
Project Lead	Evert Westerveld					
Sponsor	-	**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	3	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational efficiency.

Introduction:
Over the past decade LVNL has invested much effort to improve the insight in the operational performance of the ATM system. These investments were made in the different key performance areas that LVNL recognizes. These investments have led to insight in safety, efficiency/ capacity and environmental performance, in relation to the performance declaration. Furthermore the investments have led to an improved provision of management information.

The development of improved insight in operational efficiency is not considered to be completed or finished. There are still some areas where information is lacking. Furthermore, LVNL has recognized that more insight is needed in the performance areas of the main stakeholders. Thirdly there is still an insufficient coupling between the ATM development strategy and the performance of the ATM system. It is not certain that the strategy items with the highest priority generate the most benefits for the stakeholders.

Assignment:
Make a scan of operational data to investigate in which areas most efficiency gains can still be achieved. The analysis should start on the basis of previously performed KLM studie "The perfect flight" and information provided by study 8.5 *"Demonstration of arrival trajectory prediction for optimizing the Schiphol night-time arrival process"* which analysis the most optimum profile. The optimum profile (vertical and horizontal) is the baseline for the further study.
KLM will provide approximately 20 city pairs which are considered less than optimal in day to day operations. For this limited set of city pairs operational data must be studied. Factors affecting efficiency to be considered are e.g. weather, airspace/route design, runway use, regulations. Both ground and airborne phase of flight must be considered, both inbound and outbound traffic must be included.

Short term objective:
Support/feed the development of an efficiency model.

Long term objective :
-

Involved parties :
KLM, LVNL, AAS

Source:
-

Result Report:
Insight in operational efficiency 15-RA-001 v1.0

<table>
<tr><th colspan="15">C35: Forecasting LVP Conditions at Schiphol Airport (Phase 2)</th></tr>
<tr><td>Ref. Ext. Programme</td><td>Kennis voor Klimaat (Impact)</td><td>Status</td><td colspan="12">Completed</td></tr>
<tr><td>Project Number</td><td>PRJ-1684</td><td colspan="13"></td></tr>
<tr><td>Customer</td><td>Roosevelt Overleg (RVO)</td><td rowspan="2">Performance Targets</td><td colspan="3"><u>EFF</u></td><td colspan="3">~~ENV~~</td><td colspan="3">~~CAP~~</td><td colspan="3">~~CST~~</td></tr>
<tr><td>Assignment</td><td>KDC/2008-0103</td><td colspan="3"><u>PRD</u></td><td colspan="3">~~INT~~</td><td colspan="3">~~SAF~~</td><td colspan="3"></td></tr>
<tr><td>Project Plan</td><td>KDC/2008/0073, version 1.1 final</td><td>ATM concept</td><td colspan="4">ATS</td><td colspan="4">ATFCM</td><td colspan="4">ASM</td></tr>
<tr><td>KDC Board Approval</td><td>23-06-2008</td><td></td><td colspan="4">+</td><td colspan="4">0</td><td colspan="4">0</td></tr>
<tr><td>Project Lead</td><td>Lonneke Smit (LVNL)
Albert Jacobs (KNMI)</td><td></td><td colspan="12"></td></tr>
<tr><td>Sponsor</td><td>-</td><td>Ref. ATM System Strategy</td><td colspan="12">-</td></tr>
<tr><td>Financial Partner</td><td>DGB, Kennis voor Klimaat</td><td>Priority</td><td colspan="12">Normal</td></tr>
<tr><td>TRL</td><td>3</td><td>Project Risk Profile</td><td colspan="12">Low</td></tr>
</table>

Goal / Expected Benefit:
Improvement of operational efficiency.

Introduction:
Diminishing visibility conditions have a direct consequence on the available operational capacity. Prompt, unambiguous and reliable information concerning weather forecasts are crucial for decision making during bad visibility conditions. In order to minimize operational losses, it is of great importance to improve the prediction of upcoming mist and low visibility conditions. Flights can be delayed or cancelled if it is by forehand known that there will be capacity limitations at Schiphol airport. For this purpose the ''Capaciteit Prognose Schiphol'' (CPS) was developed some years ago. The effectiveness of this tool may be improved by providing more specific statements concerning probability and capacity. Therefore, the air transport sector needs a reliable visibility forecast.

Assignment:

- Gain a better insight in microclimate at SPL with regard to LVP conditions. The focus is on fundamental research on the causes as well as the possible prevention of low visibility conditions.
  A determinant factor for this research is the moment at which mist sets in and dissolves coupled to the airtransport visibility rates. Improving the sustainability implies that forecasts should be made by means of new methods. Currently, forecasts are made based on historical and actual information.
- 0-6 hr forecast: European flights can be arranged more efficiently by means of a reliable weather forecast. As a result, a faster and better implementation of tactical measures which increase capacity can be realized so that the declared airport capacity is fully exploited.
- 6-12 hr forecast: delivers optimal flow management in combination with extra fuel planning for the intercontinental flights.

Short term objective:
Objective has been achieved through short-term research project, see section completed research.

Midterm / Long term objective

- Gained insight in visibility problem and restriction problem with regard to weather phenomena, the cost/benefit ratio of restriction and diversion to airlines.
- Increase the utilization of the available capacity.
- Further increase the utilization of the available capacity.
- Decrease the costs for the sector and accommodate in the market demand.

Involved parties:
KNMI, WUR (Wageningen University), LVNL, AAS, KLM

Source:
Research proposal from KNMI, agreed by the KDC Board

Result Report:
www.kennisvoorklimaat/hotspots/schiphol-mainport

C36: Improved wind forecasting

Ref. Ext. Programme	Kennis voor Klimaat (Wind Visions)	**Status**	Completed			
Project Number	PRJ-1612					
Customer	Roosevelt Overleg (RVO)	**Key Performance Areas**	EFF	~~ENV~~	~~CAP~~	~~CST~~
Assignment	KDC/2007/0108		PRD	~~INT~~	~~SAF~~	
Project Plan	KDC/2008/0085, version 1.1 final	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	Initiative phase: 02-07-2007		0	+	0	
Project Lead	Lonneke Smit (LVNL) Oscar Hartogensis (MAQ-WU)					
Sponsor	-	**Ref. ATM System Strategy**	ACE 11.3			
Financial Partner	DGB, Kennis voor Klimaat	**Priority**	Normal			
TRL	3	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational efficiency.

Introduction:
Adverse meteorological conditions regularly reduce the capacity of Schiphol Airport. Early information regarding the severity and duration of adverse conditions is very valuable. Based on this information, capacity restrictions can be established or released in a timely manner.

Information on wind speed, direction and gusts is important for several reasons. First, the selection of runways for departure and arrival is based on this information. Secondly, the information is used in the actual operation and briefed to pilots before take-off and landing. The current ICAO regulations regarding the provision of wind information, both actual and forecasted, are not always sufficient to meet the criteria of the complex process of runway selection at Schiphol Airport. Furthermore, the ICAO method cannot guarantee a pilot that cross or tailwind limits will be exceeded on the runway which is offered.

Assignment:
This project is aimed at gaining a better understanding of the microclimate regarding wind at Schiphol Airport. This will lead to improved wind forecasts and better input for capacity prognosis. Interaction between the sector partners is needed in order to identify the critical factors and to determine the quality of the improved wind forecasts.

The results of this project have to be directly applicable in the operational process. First, actual wind and wind forecasts provided to pilots have to be more representative than what can be expected from the ICAO regulations. A forecast method has to be developed, that explicitly takes into account a probability of exceeding a cross or tailwind limit. It may be possible that modifications to measuring devices are needed. Human machine interface (HMI) aspects have to be studied as well.

Short term objective:
Development of an improved wind forecast based upon test results.

Midterm objective
Providing more accurate wind information and improvement of the presentation in decision support systems, in order to make the results directly applicable in the operational process.

Long term objective:
- Increasing capacity, increasing sustainability and reducing NOC-rate

Involved parties:
LVNL, KLM, AAS, KNMI

Source:
Research proposal from KNMI, agreed by the KDC Board

Result Report:
www.kennisvoorklimaat/hotspots/schiphol-mainport

C37: Inbound sequencing based on airline priorities

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-2118	**Research Cluster**	Airline Operational Efficiency			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for Tender			X	X	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	17-04-2015		X			
Project Lead	Ceriel Janssen (KLM)					
Sponsor	-	**Ref. ATM System Strategy**	NA			
Financial Partner	DGB	**Priority**	Normal			
TRL	3					

Goal / Expected benefit:
Expected benefits are in the area of efficiency.

Introduction:
Traffic flows inbound Schiphol are currently planned on a first-come-first-serve basis. Traffic is planned in such way to optimize runway capacity. No airline priorities are taken into account. 80% of the passengers onboard KLM aircraft are transfer passengers. Realizing passenger connections is therefore very important for KLM. Inbound KLM traffic has different values based on passenger flows and individual value of passengers.

In the future ATM system, inbound traffic flows will be handled based on the value of individual flights (ref. AAA replacement business case). The Arrival Management function will take airline priorities into account and traffic flows will be built upon these priorities. This process is dynamic, priorisation of individual flights shall be possible from preflight to the latest moment LVNL can accommodate prioritization. Priorisation of traffic flows inbound Schiphol shall be done as early as possible, the planning based on this priorisation shall be maintained in the NL-FIR.

Assignment:
Define, develop and test an experimental arrival management function which takes airline priorities into account. The study shall be done sequentially in the following defined steps:

1. Case study to identify the possibilities & benefits when LVNL prioritizes KLM flights based on airline priorities. In this initial step the studies performed in 2004/2005 (Inbound Priority Sequencing) should be taken into account as background material.
2. Identify which value information is needed to support the planning process based on airline priorities.
3. Define a concept of operations to handle KLM traffic based on airline priorities.
4. Small scale trial to test concept with KLM flights
5. Full scale trial to handle traffic based on KLM priorities
6. Define a plan including concept to enable trading of priorities between airlines.

For step 1 to 5 it is assumed that priorisation between inbound flights can only be done intra-airline.

Short term objective (first year):
Steps 1, 2 and 3 are expected in the short term objective

Midterm objective (two – three years) : Steps 4 is expected in the midterm objective.

Long term objective (> three years) : Steps 5 and 6 are expected in the long term objective.

Involved parties: KLM, LVNL, TU-Delft

Source:
1) AAA Replacement Business Case Report S&I \ ATMS \ DOC-427
2) Concept of Operation (CONOPS) for “Inbound Priority Sequencing” Document D/R&D 03/089 Release 3.0

Result Report:
KDC Inbound Priority Sequencing – Airline Priorities v1.0

C38: Applications of SWIM

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-2080	**Research Cluster**				
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for Tender					
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	01-10-2014					
Project Lead	Bertrand Baesjou					
Sponsor	-	**Ref. ATM System Strategy**	NA			
Financial Partner	DGB	**Priority**	Normal			
TRL	3	**Project Risk Profile**	Low			

Goal / Expected benefit:
Ensure that sector information exchange implemented until 2025 aligns with implementing rules and industry best practices. This should lead to efficiencies on both the short term (not re-inventing the wheel) as well as long term (least amount of re-work).

Introduction:
Increased information exchange between sector partners resulting in higher quality and efficiency of individual processes. This leads to more efficient operations, reduced staff workload and enhanced awareness which in its turn enhances safety.

Rulemaking is in progress such that by 2025 there is a mandatory introduction of SWIM (to a limited extend), a concept through which aviation sector partners European wide can exchange and request information. The current concepts and standards underpinning SWIM seem to be reaching a certain level of maturity. It is most likely SWIM concepts will become the de-facto way of exchanging aviation information in the sector.

The expectation is that up till 2025, in addition to the existing information exchanges and CDM related activities, there already will be an increased wish from sector partners to exchange information.

Assignment:
Investigate the opportunities, and associated risks and benefits, to adopt/embrace SWIM concepts sector wide in the Schiphol operation ahead of 2025. Make an inventory of data exchange/service demands in the sector up until 2025 and determine for each of those whether it is beneficial to embrace concepts introduced by SWIM. Also identify which type of infrastructure needs to be in place to support this and how eventually this integrates with European wide information exchanges.

Short term objective (first year):

- Inventory of information exchange and information service needs in the sector for Schiphol operations until 2025
- Sector wide data exchange and service architecture (conceptual and implementation/infrastructure)
- Implementation roadmap and next logical steps for SWIM in the sector

Midterm objective (two – three years) :
-

Long term objective:
Comply with European interoperability regulations.

Involved parties:
KLM, LVNL, AAS

Source:
http://www.sesarju.eu/sesar-solutions/system-wide-information-management

Result Report:
KDC Applications of SWIM final report 1.00

C39: Workloadmodel Schiphol Ground Control

Ref. Ext. Programme	-	**Status**	Completed				
Project Number	PRJ-2123	**Research Cluster**					
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env	
Assignment	Call for Tender						
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	17-04-2015						
Project Lead	Evert Westerveld						
Sponsor	-	**Ref. ATM System Strategy**	NA				
Financial Partner	DGB	**Priority**	Normal				
TRL	3						

Goal / Expected benefit:
Expected benefits are in the area of safety and (sustainability of) capacity.

Introduction:
Based on experience of last year's traffic demand and the anticipated growth, it has become clear that the current Schiphol ground operation reaching the limits to handle ground traffic in a safe **and** efficient way. Overall traffic growth is expected on a yearly basis but especially the shifts in the daily distribution of traffic (with increased bunching of traffic) have an effect on the safe and efficient handling of traffic. During summer the number of daily operations can peak significantly.

It is expected that capacity may be constrained during non-nominal operations, e.g. maintenance of the airport infrastructure, unavailability of handling positions, or even due to normal variations in traffic. Furthermore for nominal operations, it should become clear how operational aspects like runway configurations, towing of aircraft or ground controller staffing can affect capacity.

To effectively manage the ground controller's workload, constraints on capacity are necessary. Therefore it is important to understand which factors influence the ground controller's workload and assess how these factors should be integrated into a ground control workload model

A workload model has been developed by LVNL for the ACC operation. This model is used in different analyses and is currently also used in daily operations as a decision-support tool for supervisors. It is the intention to use the experiences and basic principles of this model.

Assignment:
Perform a study into ground control workload with the objective to deliver a ground control workload model that can be used in the pre-ops analysis of certain events. The study should:
- use ACC workload model as a reference.
- Identify factors that influence ground control workload
- Structure these factors relevant for ground control workload into a model
- Assess nominal ground control workload in the daily operation
- Assess the effects of non-nominal events, such as planned activities
- Validate the model in the operation.
- Assess the possibility of the use of a workload model in daily operations as a decision-support tool for TWR-supervisor and/or ground controllers.

Short term objective (first year):
- A ground control workload model should be delivered for assessments in the pre-operations phase.
- Argumentation for the decision whether use of the workload model in daily operations is possible.

Midterm objective (two – three years):
-

Involved parties: LVNL, AAS

Result Report:
20151201 werklastmodel SPL Ground Control DEFINITIEF v1.0

C40: Common GND safety model

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-2125	**Research Cluster**				
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for Tender					
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	17-04-2015					
Project Lead	Evert Westerveld					
Sponsor	-	**Ref. ATM System Strategy**	NA			
Financial Partner	DGB	**Priority**	Normal			
TRL	3					

Goal / Expected benefit:
Expected benefits are in the area of safety.

Introduction:
Over the past years a relatively large number of events in the Schiphol manoeuvring area are reported. These events range from unexpected taxi movements, unexpected tow movements, uncontrolled maneouvres of cars and push-backs without clearance. These events have an impact on the operations of multiple actors in the manoeuvring area, such as, LVNL ground control, AAS Apron Planning and Control operation (APC), KLM Jet Centre and different ground handlers.
The safety management systems of each organization will assess the safety risks of these operations to support optimization of its own operation including learning from events that have been registered and analysed internally. However it is felt that an improvement in the safety management processes is made when a sector wide, common safety model becomes available to assess how -non-nominal events in one organization can influence the operation from another organization. Such a common model also gives the possibility to gain insight in the effectiveness of sector wide mitigation measures in the form of cost benefit analysis over the individual organisations.

Assignment:
Perform a study with the objective develop a common safety model for the different encounter types in the manoeuvring area. The study should:
- Assess the different possible encounter types in the manoeuvring area
- Start from available risk analyses within the different organisations using the bow-tie methodology.
- Facilitate brainstorm sessions to develop a common safety model for each encounter type.
- Assess reports over the past years in the daily operation on applicability of hazards and causes.
- Assess potential mitigation hazards
- Support cost benefit analyses for these mitigation measures
- Interface with the decision making processes of each individual organisation

Short term objective (first year):
A common safety model should be developed supporting analysis of reports from the daily operation and cost benefit analyses on potential mitigation measures.

Midterm objective (two – three years):
-

Involved parties: LVNL, AAS

Result Report:
NLR-CR-2015-406 definitieve eindrapportage

C41: Time Based Separation

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-2117	**Research Cluster**				
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for Tender					
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	19-02-2015					
Project Lead	Evert Westerveld					
Sponsor	-	**Ref. ATM System Strategy**	NA			
Financial Partner	DGB	**Priority**	Normal			
TRL	3					

Goal / Expected benefit:
Expected benefits are in the area of (sustainability of) capacity.

Introduction:
The Pilot Common Project Implementing regulation (716/2014) states the following about Time Based Separation:
"Time-Based Separation (TBS) consists in the separation of aircraft in sequence on the approach to a runway using time intervals instead of distances. It may be applied during final approach by allowing equivalent distance information to be displayed to the controller taking account of prevailing wind conditions. Radar separation minima and Wake Turbulence Separation parameters shall be integrated in a TBS support tool providing guidance to the air traffic controller to enable time-based spacing of aircraft during final approach that considers the effect of the headwind. ATS providers and airport operators providing services at the airports as referred to […] shall operate:
– Time-Based Separation for Final Approach as from 1 January 2024"

Assignment:
Perform a study of operational data to support a performance case for Schiphol airport. The analysis should:

- use meteo data of at least ten years to indicate frequency, severity, and seasonal pattern of strong headwind conditions. If possible, specify wind conditions per runway;
- use operational data of at least ten years to indicate frequency, and seasonal pattern of forced single landing runway operations, due to wind;
- use operational data of at least ten years to indicate amount of (hourly) capacity loss due to strong headwind;
- use operational data of at least ten years to indicate amount of potential capacity gain on the basis of wake vortex category mix operating at Schiphol. These results should be compared with data available of LHR TBS operations.

Short term objective (first year):
A business case should be built supporting the investment decision to place TBS on the ATM system roadmap.

Midterm objective (two – three years):
-

Involved parties: KLM, AAS, LVNL

Source: PCP implementing Regulation 716/2014

Result Report:
Time Based Separation on Final Approach at Schiphol

C42: AMAN / SARA Development

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1855					
Customer	LVNL Stratcor	**Key Performance Areas**	**EFF**	**ENV**	~~CAP~~	~~CST~~
Assignment	SCT/2011/24		**PRD**	~~INT~~	~~SAF~~	
Project Plan	CS\PPM\2011\256, version 4.1	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	22-06-2011		+	0	0	
Project Lead	Jeroen Timmers					
Sponsor	-	**Ref. ATM System Strategy**	ACE 89.3			
Financial Partner	DGB, SESAR JU, LVNL	**Priority**	Normal			
TRL	6	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational efficiency and environmental performance.

Introduction:
The goal of the project is to set-up an LVNL AMAN platform which will enable testing and validation of SARA functionality (in any case the speed advisory functions). The goal is to provide implementaion support to SARA.
In order to achieve this goal, the development has been structured in three different phases:
- Phase 1: Installation of the DFS AMAN platform at NLR for evaluation, determining whether the DFS platform is suitable as a development platform for the LVNL AMAN. Phase 1 includes making an inventory of functional requirments for the AMAN version 1.0 baseline.
- Phase 2: Realisation of LVNL-AMAN v1.0 (including Delta-T function) and implementation of AMAN v1.0 in operations. This step is in fact a one-on-one replacement of the current AAA inbound planning function. Adjustments to the HMI, in case these are needed, are not included.
- Phase 3: Iterative development of the SARA functionality.

In parallel to the AMAN platform, the Speed And Route Advisor (SARA) function will be developed. SARA contributes to the stability and prediction of inbound traffic streams. The objective of the SARA function is to deliver advisories on speed and/or routing to (Upper) Area Controllers in order to achieve the planned arrival time(s) of the aircraft over fixes (and implicitly via the inbound planning function over the runway threshold). In addition to meet the planned arrival time, suggested trajectories are probed for conflicts and resolved where necessary.

In support of the envisaged ATM System Strategy the SARA function will contribute to a more accurate delivery of traffic at the metering fixes (IAFs) and cause less workload for the controllers involved. It is expected that the SARA function will overall reduce the number of tactical clearances (and thus the radio-telephony load), because of its ability to generate a single, comprehensive, conflict-free, meet time solution 20 to 40 minutes upstream of the IAF. This expectation is supported by the findings on similar functionality like the En-route Descent Advisor (EDA) developed by NASA. In order to meet the evaluation and demonstration objectives, a simulation (and later an operational trial) in the northern and eastern sectors is foreseen with Maastricht Upper Area Control (MUAC).

The development of SARA is a pre-requisite to the further development and implementation of fixed arrival routes in the Schiphol TMA.

Assignment:
Evaluate and develop the DFS AMAN function as a baseline for the AMAN v1.0 AMAN function for LVNL. Develop and document the AMAN functional requirements.

Short term objective:
Support the implementation of initial SARA functionality, by means of improved Inbound Planning and Trajectory Predictor functionality.

Midterm objective:
For the medium term the objective is to develop more advanced SARA functionality including the conflict management function and dynamic route advisories. Increase of the planning horizon is built on the achievements of the Traffic Management activities with adjacent centres (in particular ground system changes for delay sharing, cross border arrival management, XMAN).

Long term objective:
For the long term the goal is to develop and implement a SESAR compliant and interoperable Arrival Management function as part of the iTEC Industrial Based Platform.

Involved parties:
LVNL, NLR, Ferway, Sogeti

Source:
CS/PPM/2011/256, Project Plan AMAN Development

Result Report:
Brief KDC 20150052 afsluiting PRJ1855 AMAN Ontwikkeling

C43: 4D Navigation Business Case: Benefits of SESAR Concept (Validation exercise VP-030, i4D + IOP)

Ref. Ext. Programme	SESAR WP4.3	**Status**	Completed
Project Number	PRJ-2013/ (PRJ-1846)		
Customer	LVNL Stratcor / SESAR PMB	**Key Performance Areas**	**EFF** **ENV** ~~CAP~~ ~~CST~~
Assignment	-		**PRD** **INT** ~~SAF~~
Project Plan	Not Applicable	**ATM concept**	ATS / ATFCM / ASM
KDC Board Approval	22-08-2013		+ / 0 / 0
Project Lead	Theo Verhoogt (NLR)		
Sponsor	-	**Ref. ATM System Strategy**	-
Financial Partner	DGB, SESAR JU	**Priority**	Normal
TRL	6	**Project Risk Profile**	Low

Goal / Expected Benefit:
Improvement of operational efficiency and environmental performance.

Introduction:
LVNL has decided to join the iTEC consortium as part of its AAA replacement strategy. This approach will ensure commonality and interoperability of the LVNL (technical) ATM system in the future and will ensure access to innovative system components developed by the SESAR programme.

In order to make sure that vital system components meet the requirements of the Netherlands ATM stakeholders, LVNL participates in the development activities in the SESAR programme. One of the crucial areas in which LVNL is actively involved is the development of the Arrival Management system (AMAN). The AMAN system is an important building block in the ATM strategy for the Netherlands as it is an enabler for fixed arrival routes and continuous descent approaches. The AMAN development takes place against the background of Schiphol specific requirements such as peak hour capacity and operational complexity.

In the SESAR Concept development steps, the transition to time based operations is the first step towards performance based operations. The transition to time based operations is labelled as initial 4D operations or i4D operations within the SESAR programme. Within SESAR workpackage 4.3 the en-route validation activities have clustered. An significant portion of the requirements set to the en-route environment WP4 (En-route) come from WP5 (TMA) and in particular from the AMAN functions.

The validation exercise of i4D + IOP is part of the SESAR programme. The activity has been delegated by ENAV to Consortium LVNL. The i4D + IOP validation is preceded by a i4D validation performed by MUAC. The addition IOP refers to the interoperable platform to be used by this second validation step. LVNL is free to fill in the validation exercise, provided that the high level validation objectives are met.

The availability of Initial 4D data and an improved mechanism to distribute information provide an opportunity to set up specific validation exercises related to the validation of an integrated concept related to the use of a subset i4D information distributed through the network of interoperable flight data processing prototypes.

The first set of basic i4D information to be considered as part of the Flight Object and distributed through the network of FDP-IOP prototypes will be agreed with SESAR Project 10.2.5. The use of different systems/prototypes to be fed with the subset of i4D information and to support en-route and/or TMA operations will be evaluated.

The operational validation will be conducted in an integrated way at Schiphol using a complex integrated technical platform composed of:

- iTEC Industry Based Platform
- IOP ATC-ATC and ATC-ATFCM Industrial Based Platform provided by Project 10.2.5.
- Enhanced datalink prototype provided by Project 10.7.1
- Airbus mainline integration simulator provided by Project 9.1
- Airbus test aircraft provided by Project 9.1

Assignment:
Support the iCAS Business Case by demonstrating the benefits of SESAR implementation in the Netherlands. Validate the i4D concept, within the context of arrival management, on LVNL's interoperable Industrial based Platform.

Short term objective:
The objective is to perform a pre-operational validation of the integrated elements of the En Route operating context to provide information about the potential performance of the overall ATM system according to SESAR System Engineering Management Plan and E-OCVM methodology. The focus will be on integrating operating procedures using realistic scenarios that are representative of what the concept must be able to manage in the target end-system. Not the entire en-route operating context is subject to validation but only areas presenting potential concept elements integration problems. The areas of potential integration problems have to be indicated by Project 4.2. Validation will be performed as close as possible to the target deployment environments.

For step 1 of the SESAR Concept Story board the following five validations are foreseen:

- Operational validation of IOP (ATC-ATC and ATC-ATFCM)
- i4D trials
- Initial Integration of IOP and Initial 4D
- Initial use of complexity management
- Co-operative decision making tools and sector team operations Conflict Management trails

Consortium LVNL will lead the “Initial Integration of IOP and Initial 4D” validation exercise. The execution of this validation exercise will take place at the beginning of 2013 at Amsterdam, The Netherlands.

The validation exercise will build on the experiences and results of the stand-alone IOP and i4D validations that will take place before this validation exercise.

Consortium LVNL will as part of this validation exercise integrate and configure an IBP IOP prototype (developed in WP3.3.2) in the network of prototype IOPs that are used in the stand-alone IOP and i4D

Midterm / Long term objective:
-

Involved parties:
Participating partners in the validation exercise are Airbus, DFS, Eurocontrol and Indra. ENAV is managing WP4.3.

Source:
WP4.3 Project Initiation Report, Integrated and pre-operational validation & cross-validation

Result Report:
Brief afsluiting project Benefits of SESAR concept

C44: AMAN AIO

Ref. Ext. Programme	-	**Status**	Completed
Project Number	-		
Customer	B-KDC	**Key Performance Areas**	**EFF** **ENV** ~~CAP~~ ~~CST~~
Assignment	KDC 2012005		**PRD** ~~INT~~ ~~SAF~~
Project Plan	TSD	**ATM concept**	ATS / ATFCM / ASM
KDC Board Approval	22-06-2011		+ / 0 / 0
Project Lead	E. Westerveld		
Sponsor	-	**Ref. ATM System Strategy**	
Financial Partner	DGB, TU Delft, NLR	**Priority**	Normal
TRL	3	**Project Risk Profile**	Low

Goal / Expected Benefit:
Improvement of operational efficiency and environmental performance.

Introduction:
Currently, air traffic controllers perform a sector-based tactical form of control. They are responsible for planning and managing traffic within their assigned airspace, often with little help from automated tools. In the coming decades, the task of an air traffic controller is predicted to undergo a significant transformation. The pull for this change comes from the increasing demands placed on the air traffic management (ATM) system. A push is provided by technological advances on the air- and ground sides of the ATM system, which make new forms of air traffic control possible.

The proposed transformation of the ATM system itself mainly focuses on increasing capacity, safety and efficiency, enabled by an increased amount of data exchange between the ground- (control centers, operations, airports) and air segments (aircraft). For this purpose, the four-dimensional trajectory (4DT) is introduced, which specifies an aircraft's planned trajectory in three spatial dimensions and in time. In a mature state, at all times, and for all controlled aircraft, the 4DTs are envisioned to be available to both the control centers and the aircrew involved.

Both the air traffic controller and the aircrew will be able to negotiate changes to the plan via data-link, for instance to avoid bad weather, to assure separation, or to manage arriving and departing traffic. As a consequence, the task of an air traffic controller is expected to shift to one of strategic four-dimensional trajectory-based control. In this form of control, time is added as an explicit control variable, which will make the planning more flexible and accurate.

Assignment:
Candidate AMAN system designs will be evaluated using thorough scientific methods in a realistic test environment (the NARSIM air traffic simulator of NLR). It will be the main goal of this project to provide the scientific basis for human-centered automation requirements that can guide the development of a new AMAN system.

Short term objective:
Due to the additional level of abstraction, the new 'time-based' form of air traffic control is no longer possible without the support of automated tools. Here, the design of a Arrival Management System that is able to visualize the 4DT's, and including the tools to support the air traffic controller in planning and managing the air traffic, is essential. One of the main considerations in the design of the automation and the interface that TU Delft and NLR propose in this project, is to keep the controller fully 'in the loop' of the decision-making process, and to put him or her in the position of the key decision maker, i.e., develop "human-centered automation".

Midterm / Long term objective:
-

Involved parties:
TU-Delft, NLR, LVNL

Result Report:
1. M. Tielrooij, C. Borst, M.M. van Paassen, M. Mulder, (2015) "Predicting Arrival Time Uncertainty from Actual Flight Information", US/Europe ATM Seminar, Lisbon, Portugal
2. De Wit, J., Tielrooij, M., Borst, C., van Paassen, M.M., Mulder, M. (2014). "Supporting runway planning by visualizing capacity balances of arriving aircraft streams", IEEE Conference on Systems, Man, and Cybernetics,

San Diego, CA
3. Tielrooij, M., Borst, C., Nieuwenhuisen, D., & Mulder, M. (2013). “Supporting arrival management decisions by visualising uncertainty”. In D. Schaefer (Ed.), Proceedings of the SESAR Innovation Days. Stockholm, Sweden.
4. M. Tielrooij, C. Borst, M.M. van Paassen, M. Mulder, (2013) “Supporting arrival management decisions by visualising uncertainty”, International conference on Aviation Psychology, Dayton, OH

C45: Traffic Merging in TMA

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-2015					
Customer	LVNL Stratcor	**Key Performance Areas**	**EFF**	**ENV**	**CAP**	~~CST~~
Assignment	Call for Tender		**PRD**	**INT**	~~SAF~~	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	28-11-2013		+	0	0	
Project Lead	Juergen Teutsch (NLR)					
Sponsor	-	**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	6	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational efficiency and environmental performance.

Introduction:
The vision for the future Schiphol TMA operation contains elements such as fixed arrival routes and low altitude CDA operations (CDO) for environmental purposes. The enablers for these innovative developments in the TMA are improved arrival management which will improve the traffic delivery to the TMA. In the current situation traffic delivery to the TMA (and even more so to the AMS FIR) is unpredictable and irregular. As a result delay needs to be absorbed with the AMS FIR and Schiphol TMA. In the future Schiphol TMA concept delay absorption will take place outside of the TMA, enabling fixed arrival routes and CDO.

One of the challenges of operating fixed arrival routes with high capacity is that traffic streams need to be merged within the TMA. Typically four traffic streams, coming from four Initial Approach Fixes, need to be merged into two traffic streams to two runways, with high capacity.

In the SESAR concept ASAS Interval Management techniques are foreseen, in which aircraft can merge behind another aircraft by means of aircraft surveillance equipment. In this concept tasks are delegated to the cockpit to enable fixed arrival routes operations and CDO with high capacity. These techniques however rely on new technology which will not be available before 2025.

However, Schiphol expects to start a gradual introduction of high capacity Fixed arrival routes and CDOs in day time operation in the next 2 years. Eventhough merging may not be immediately necessary in the first step, the expectation is that concept solutions are needed soon and ready to be implemented within a 3 year timeframe. These near term solutions will need to be based support tools for the controller.

Assignment:
Demonstrate a merging solution to support the APP controller in his/her task to merge two traffic streams into a single traffic stream with high capacity. The demonstration must be based on existing European research in this field and must be performed on a high fidelity ATM simulation facility. The outcome of the demonstration will be input for the definition of a development project.

Short term objective:
Demonstrate the feasibility of a controller support tool which enables merging of traffic streams with high capacity in the Schiphol TMA.

Midterm / Long term objective:
Development of a controller support tool which enables merging of traffic streams with high capacity in the Schiphol TMA.

Involved parties:
LVNL, KLM, AAS, KDC partners of choice

Source:
KDC Independent Parallel Low Altitude CDO

Result Report:
NLR-CR-2014-092_KDC-Merge_Final_Report_V1-0

C46: Alerting based on flight plans

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-2126	**Research Cluster**	Safe Airspace and Airport Navigation			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for Tender					
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	02-06-2015					
Project Lead	Bob Gimberg (AAS)					
Sponsor	-	**Ref. ATM System Strategy**	NA			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Goal / Expected benefit:
Expected benefits are in the area of efficiency and safety.

Introduction:
LVNL and AOCS NM have the legal task to take care of alerting based on submitted VFR flight plans to and from airports (in accordance with the broad definition in the RBML) in the Amsterdam FIR. The current alerting task leaves room for improvement.

Assignment:
Perform a study that can give answers to the following questions:
- Which legal requirements exist for alerting based on flight plans?
- What are the problems why LVNL and AOCS NM can´t perform their alert task based on submitted flight plans well?
- Is automation of alerting based on the flight plans the most desired and appropriate solution?
- With what system (or systems) - for LVNL, AOCS NM, airports, harbor masters and pilots - can automation be realized?
- Who can/should develop such a system (systems)?
- Is national (LVNL and AOCS NM) and international cooperation (for example with DFS) in this appropriate?
- Which parties can/should contribute to the cost of automation?
- What laws and regulations, procedures and/or agreements should be customized and/or made to let the (automated) alerting process go smoothly?

The initial study should take into account the study material made available by LVNL and should focus on practical and creative solutions to fill in the requirements.

Short term objective (first year):
Directions of solutions should be delivered to improve the (efficiency of) the alerting process.

Midterm objective (two – three years):
-

Involved parties:
KLM, AAS, LVNL, Min. I&M, AOCS NM

Source:
-

Result Report:
15 282 04 Einddocument Alerting Services obv vliegplannen

C47: De-icing Planner, phase 3

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1997	**Research Cluster**	Schiphol Airport Meteo Development			
Customer	Stratcor	**Key Performance Areas**	EFF	ENV	~~CAP~~	~~CST~~
Assignment	Call for Tender		PRD	~~INT~~	~~SAF~~	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	11-06-2013		+	+	0	
Project Lead	Ceriel Janssen (KLM)					
Sponsor	-	**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	6	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational efficiency.

Introduction:
The KLM De-Icing department has supporting meteo tools available to predict De-Icing capacity required 12h/24h hours before operations. Based on those predictions required resources are determined. Adequate De-Icing resources ensure a smooth and predictable De-Icing flow for all stakeholders (LVNL, AAS) with minimal effects on airport capacity.

The current meteo tools are accurate when precipitation is predicted. However when no precipitation is predicted De-Icing can be required due to frost build-up on aircraft wings in cold conditions. The current tools are not precise enough to accurately detect those conditions.

Assignment:
Develop a prototype tool to better predict frost build-up on aircraft wings to ensure that in those conditions required De-Icing resources can be allocated for a seamless De-Icing flow.

Short term objective (first year):
Based on measurements on a prototype wing determine the thermal characteristics. Build a prototype system to better predict frost build-up on aircraft wings.

Midterm objective (two - three years):
Implement the system.

Long term objective:
-

Involved parties:
LVNL, KLM, AAS, KDC partners

Source:
-

Result Report:
Report KLM KDC de-icing PRJ-1997

C48: RECAT EU Benefits Schiphol

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRA-2181	**Research Cluster**	Airport Capacity			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for Tender			✓		
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	03-11-2015		✓			
Project Lead	Hans van den Bos					
Sponsor	-	**Ref. ATM System Strategy**	NA			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Goal / Expected benefit:
A study by EUROCONTROL has indicated that RECAT-EU can generate an increase of the hourly capacity up to 8%. This benefit is dependent on local procedures and traffic mix. Therefore the benefit potential of RECAT EU for Schiphol must be assessed on the basis of the actual Schiphol procedures and traffic mix

Introduction:
Wake vortex generated by aircraft on departure or final approach is one of the main factors defining safe separation minima between two aircraft. Existing ICAO Wake Vortex separation rules (based upon the Heavy, Medium and Light categorisation) were implemented over 40 years ago and have in some respect become outdated, resulting in States introducing their own local amendments.

EUROCONTROL has completed a RECAT EU safety case, which was confirmed by EASA in a letter of recommendation to Member States on October 10, 2014. LVNL has been requested to consider implementation of the European scheme for the re-categorization of wake turbulence separation minima (RECAT-EU) in a EUROCONTROL letter, on April 2, 2015 (DGD15_0119).

Assignment:
Study the benefit potential of RECAT EU for Schiphol airport, taking into account applicable procedures and traffic mix. The benefit study is input to a RECAT EU business case to be developed by LVNL.

Short term/Midterm objective:
Implementation of RECAT EU on the basis of a positive business case.

Midterm / Long term objective:
Implementation of RECAT-2 on the basis of a positive business case.

Involved parties:
KLM, AAS, LVNL, Min. I&M

Source:
-

Result Report:
NLR-CR-2016-131

C49: Operational requirements Schiphol ground infrastructure 2016-2020

Ref. Ext. Programme	-	**Status**	Completed				
Project Number	PRJ-2124	**Research Cluster**	Airport Capacity				
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env	
Assignment	Call for Tender						
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	17-04-2015						
Project Lead	Evert Westerveld						
Sponsor	-	**Ref. ATM System Strategy**	NA				
Financial Partner	DGB	**Priority**	Normal				
TRL	3						

Goal / Expected benefit:
Expected benefits are in the area of efficiency and safety.

Introduction:
Early 2015 an agreement at the ‘Tafel van Alders’ was established over the potential traffic growth of Schiphol Airport to 500.000 movements in 2020. Current daily operations show however that the ground infrastructure can be a bottleneck to accommodate the current operation with a reliable performance. The effects of additional demand are not yet known. Therefore a study is foreseen to identify operational requirements for the Schiphol ground infrastructure in the period 2016-2020.
The study should simulate the increase in traffic using the prognosis from the Schiphol Sector Planning Process for the years 2016, 2018 and 2020 in order to identify potential bottlenecks in the infrastructure. Besides the quantitative methodology to predict potential bottlenecks, also a qualitative process using operational expertise should be included. The study should look at both nominal and non-nominal operations. The operational requirements should enable a predictable and reliable ground operation in 2020 given the anticipated traffic growth.

Assignment:
Perform a study with the objective to develop/identify operational requirements for the ground infrastructure at Schiphol Airport. The study should:
- Identify earlier applicable studies and analyse the applicability of the results;
- Use the results of the Sector planning Process as a baseline;
- Use fast time simulations to identify potential bottlenecks in the ground infrastructure in nominal and non-nominal situations;
- Facilitate brainstorm sessions to qualitatively validate the results and identify additional operational requirements
- Assess the effects of potential mitigation measures (remote holdings, buffers, double taxi lines at aprons, etc.)
- Develop cost benefit analyses for these mitigation measures.

Short to Midterm objective (two – three years):
- Identify requirements related to Schiphol ground infrastructure to accommodate future traffic growth in the period 2016-2020.

Involved parties:
LVNL, AAS

Source: Concept of Operations / VEMER, Verhoging van de grondafhandelingscapaciteit op basis van het huidige banenstelsel, Ontwikkeling van een strategie voor verhoging VEM van het grondsectorsysteem in 2015 – 2020

Reference: In 2008 already a study was conducted to identify bottlenecks in the ground infrastructure in the period up to 2020 (Verhoging van de grondafhandelingscapaciteit). However, this study focused on a foreseen change of runway use (2+2 runway use), which did not materialize. Therefore the results of the 2008 study are no longer valid. The material of the 2008 study is available for information.

Result Report:
15.282.05 Schiphol Grond Infra – Eindrapport
15.282.09 160902 Grond Infra Eindrapport meerwerk

C50: Traffic Merging Support for Schiphol Approach

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	PRA-2210	**Research Cluster**	AMAN Cluster including iCAS development			
Customer	LVNL Stratcor	**Key Performance Areas**	**EFF**	**ENV**	**CAP**	~~CST~~
Assignment	Call for Tender		**PRD**	**INT**	~~SAF~~	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	21-04-2016		+	0	0	
Project Lead	Bianca de Wit					
Sponsor	-	**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	6	**Project Risk Profile**	Low			

Goal / Expected Benefit:
Improvement of operational efficiency and environmental performance of the Schiphol Night operation.

Introduction:
The vision for the future Schiphol TMA operation contains elements such as fixed arrival routes and low altitude CDA operations (CDO) for environmental purposes. The enablers for these innovative developments in the TMA are improved arrival management which will improve the traffic delivery to the TMA. In the current situation traffic delivery to the TMA (and even more so to the AMS FIR) is unpredictable and irregular. As a result delay needs to be absorbed with the AMS FIR and Schiphol TMA. In the future Schiphol TMA concept delay absorption will take place outside of the TMA, enabling fixed arrival routes and CDO.

One of the challenges of operating fixed arrival routes with high capacity is that traffic streams need to be merged within the TMA.

A previous KDC study made an inventory of options to support Schiphol approach with a merging support function. The main conclusions of the study are:
- Merge the support must be distance-based, not resolution-oriented but informative for the controller.
- The information should be presented on the radar screen of APP.
- Relative Position Indicator (RPI) by MITRE and Converging Runway Display Aid and Approach (CORADA) NLR are promising solutions for the Schiphol operation.

Assignment:
Develop the merge support function to a pre-implementation level, using a distance-based merge support, answering the following questions:
1. What are the preferred HMI options?
2. What are the system requirements, related to the preferred options?

The merging support should be evaluated in any case for the night-transition design with ARTIP3B, as currently used during night-OPS, and with ARTIP2C; both for RWY 18R. Evaluation of the merge support function for RWY 06 should be considered as an option. Effects of strong wind at intermediate altitudes (between 3000 ft and 10.000 ft) should be evaluated.

Short term objective:
Determine HMI and system requirements.

Midterm / Long term objective:
-

Involved parties:
LVNL, KLM, AAS, KDC partners of choice

Source:
KDC Independent Parallel Low Altitude CDO

Result Report:
KDC Merge – final report 1.0

C51: Schiphol Noise Predictor

Ref. Ext. Programme	-	**Status**	Completed				
Project Number	PRA-2182	**Research Cluster**	Environmental Information Development				
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env	
Assignment	Call for Tender		-	-	-	✓	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	03-11-2015		✓	-	-		
Project Lead	Bianca de Wit (LVNL)						
Sponsor	Jasper Daams (LVNL)	**Ref. ATM System Strategy**	NA				
Financial Partner	DGB	**Priority**	Normal				
TRL	6						

Goal / Expected benefit:
Transparency about Schiphol airport operations in as much as these concern aircraft noise in the greater Schiphol area. Goodwill towards Schiphol airport in surrounding communities.

Introduction:
Currently a number of communication means have been provided by the aviation sector partners and (local) government about noise effects of Schiphol operation. These means consist of web-sites explaining airport runway utilization strategy, actual runway in use, noise dose limits, actual aircraft movements, etcetera. All these means have in common that they focus on either the actual operational situation or historic data. What is lacking is information about predicted runway use in the next few hours / day or the noise levels which can be expected, given a certain location.

Transparency about expected runway use areas where noise is to be expected will enable individuals to anticipate Schiphol operation and to take into account this information when planning activities. The Schiphol sector partners KLM, AAS and LVNL have indicated that they wish to improve the provision of information to the surrounding communities. Furthermore the Schiphol sector partners have indicated that they wish to rationalize the provision of information, focussing on means of communication which really does increase transparency.

The goal of the KDC study “Schiphol Noise Predictor” is rapid prototyping of an app for mobile devices with the aim to facilitate requirements capturing. The prototype app will be evaluated by an internal/external user group.

Assignment:
Develop a user friendly prototype app for mobile devices for evaluation purposes. The prototype app should predict runway use and areas where aircraft noise is expected. The look ahead time should be at least 24 hours.
Assess performance of the app predictions.

Short term
Deployment of a Schiphol Noise Predictor app within applicability in the greater Schiphol area.

Midterm / Longterm objective:
Development of predictive functions which increase transparency of Schiphol airport operations in surrounding communities.

Involved parties:
KLM, AAS, LVNL, Min. I&M, ORS

Source:
-

Result report:
NLR-CR-2017-050-1.0

S52: Evaluation of WLM ACC performance using MUAC flight data

Ref. Ext. Programme	-	**Status**	**Stopped**					
Project Number	-							
Customer	KDC Board	**Performance Targets**	S	Ec		Es		Env
Assignment	Call for tender		✓	✓		✓		✓
Project Plan	Proposal	**ATM concept**	ATS		ATFCM		ASM	
KDC Board Approval	27-10-2016		✓		✓		✓	
Project Lead	Dragana Mijatovic (LVNL)							
Sponsor	Jasper Daams (LVNL)	**Ref. ATM System Strategy**	-					
Financial Partner	DGB	**Priority**	Normal					
TRL	6							

Goal / Expected benefit:
Improvement of effectiveness of capacity management.

Introduction:
In the past five years LVNL has started with the deployment of workload modeling (WLM) in support of operational capacity management. This development was driven by the known inaccuracies of conventional capacity management which is the use of sector-entry counts based on ETFMS Flight Data (EFD). The conventional method of capacity management had two weak areas:

1) The use of predicted sector entry counts or occupancies does not provide an accurate forecast of the sector workload. So sector counts in themselves do not give sufficient indication that a traffic regulation is necessary to manage workload. For this reason the WLM has been developed as a support tool for ACC supervisors and FMP controllers.
2) The EFD can be inaccurate for airborne flights and very inaccurate for flights which have not yet departed the originating airport. Improvement in flight predictions can be very valuable for better monitoring of traffic counts and for the more accurate determination of controller workload (WLM)

WLM is currently used operationally at Amsterdam ACC and is only based on EFD data. This allows for further development and refinement of this capacity management support tool.
Maastricht UAC has invested very heavily in capacity management over the years, which has resulted in a very elaborate airspace- and capacity planning operation. Capacity planning at MUAC however, has suffered from the same EFD inaccuracies as LVNL is experiencing. MUAC therefore has invested in enriching EFD with their own traffic forecasts. MUAC has offered LVNL to use their Flight Data to improve capacity management. The MUAC offer is part of their strategy to obtain a common traffic situation picture.

Assignment:
Evaluate the performance of ACC WLM with and without MUAC flight data, in order to establish whether or not MUAC data has added value for LVNL's capacity management operation.
Research if the sector entry counts provide better and more accurate data to be used in the determination of the workload in the ATC sectors of LVNL.

Midterm objective (two – three years):
Improved WLM performance input by using flight data from MUAC.

Long term objective (> three years):
Improved WLM performance input by using flight data from adjacent centres, CDM airports and secondary European airports of interest.

Involved parties:
LVNL, KLM, AAS, KDC partners

Source:
-

C53: Optimisation Runway Maintenance Planning

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	-	**Research Cluster**	Airline Operational Efficiency			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for tender		-	✓	✓	-
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	16-02-2017		✓	-	-	
Project Lead	Ceriel Janssen (KLM)					
Sponsor	Maarten Oort (KLM)	**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Goal / Expected benefit:
Due to a prediction of runway combinations during heavy runway maintenance, impact on expected capacity can be forecast. This may lead to a maintenance strategy based on the impact on performance in specific periods during the day and during the year.

Introduction:
The current Runway Forecasting tool limits its prediction of used runway combination and corresponding capacity forecast to 20 to 30 hours in advance. It is desired to expand the forecast period using average climatological data in order to forecast the effect of runway maintenance at Schiphol.
It is also desired to add the option to de-select active runways to simulate the maintenance situation.
The combination of these two enhancements should give the user forecast chance of the effect of runway maintenance and remaining runway combinations and corresponding capacity levels.

The chance of capacity drops in a specific period or during the day gives the user more information what the effect is of the planned runway maintenance. The output can be used in the consideration of the best maintenance strategy per runway based on historical data.

Assignment:
Develop a prototype that includes the enhancements of selecting periods (weeks/months/other) and active runways.
The prototype shall provide a forecast capacity chance based on runway closures.
The prototype shall include a logging functionality to facilitate analysis of recent predictions.
The prototype shall provide a forecast capacity chance based on historic weather for the selected period under analysis.

Mid term objective (two – three years) :
Establish a prototype runway & capacity prediction to facilitate planning for all KDC partners.

Long term objective (> three years) :
-

Involved parties:
LVNL, KLM, AAS, KDC partners

Source:
-

Result report:
17.282.02 Optimisation Runway Maintenance Planning - Draft

C54: Optimisation Outbound Cluster

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	-	**Research Cluster**	Airport Capacity			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for tender		-	-	✓	-
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	15-07-2016		✓			
Project Lead	Fredrik Eriksson (MovingDot)					
Sponsor	Jasper Daams (LVNL)	**Ref. ATM System Strategy**	NA			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Goal / Expected benefit:
Reduction of the use of RTF in the outbound process through employing new digital communication possibilities resulting in a decrease of workload and efficient use of qualified personnel.

Introduction:
At Schiphol Airport the pre-departure clearance is given via datalink or RTF by the Delivery controller working in the tower. At Schiphol the ARINC (Aeronautical Radio, I NC) protocol is used. This protocol is the global standard. Flight management systems of most aircraft and air traffic control systems are equipped for this global standard.

Not all pre-departure clearances are given by means of datalink because not every aircraft has an ACARS unit. The supposed reason for this is the relatively high cost of the messages for airlines and the costs of equipping the aircraft. Datalink communication is used for almost 65-70% of all pre-departure clearances at Schiphol. For the other 30% of the pre-departure clearance RTF is used. Therefor delivering pre-departure clearances still takes a considerable amount of time of the responsible functionary.

The desired situation is that every pre-departure clearance can be delivered digitally. This desired situation can be achieved by further stimulation of the use of ACARS. The desired situation can also be accomplished by using other suitable ways of digital communication for the delivery of pre-departure clearances.

Assignment:
- Study the options for means of digital communication, accessible for every airline.
- Study the options to further stimulate the use of ACARS.
- Study the options to use digital communication for other types of clearances in the outbound process.
- Study the options to combine digital clearances with the CDM process.
- Develop a proposal how to arrange the processes of the outbound cluster in the future.

Short term objective
Decrease the use of RTF for delivering clearances in the outbound process.

Midterm / Longterm objective:
Efficient process of outbound cluster.

Involved parties:
LVNL

Source:
-

Result report:
KDC-SPL DCL Utilisation – v1.1

C55: Business Case Electronic device pushback driver

Ref. Ext. Programme	-	**Status**	Completed			
Project Number	-	**Research Cluster**	Airport Capacity			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for tender		✓	✓	✓	-
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	27-03-2017		✓	-	-	
Project Lead	Evert Westerveld (LVNL)					
Sponsor	Jasper Daams (LVNL)	**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Goal / Expected benefit: Improved airport safety and efficiency.

Introduction:
Within the VpS Ground Movement Safety Team the action plan ‘Pushback Improved!’ has been prepared. This action plan aims to reduce the number of incorrectly executed push backs. In 2016, a total of 219 reports were made, of which 121 times a wrong executed standard push back. One of the measures for improvement is the use of an electronic device by the pushback driver. The idea is that the then current prevailing pushback standard for a specific gate is quickly available at any moment. Just before the actual pushback the pushback driver requests the standard through this electronic device. This way, the standard is always and for every gate known to the pushback driver. At Schiphol pushback standards are frequently changed for a certain period. This is mainly due to activities. It has been found that this can cause confusion in the operation.
An electronic device for the pushback driver also has benefits for CDM. First, the predictability of the operation increases, the driver can indicate if he takes an airplane under treatment, go to a VOP route, arrives at a plane, when the pushback truck is coupled, when the pushback is complete and when he is in transit to the next plane ("best planned, best served"). With a device in any pushback truck, the pushback planner of any ground handler is able to control the drivers and monitors better. Secondly, a device provides increasing awareness about the TSAT and a shorter communication range at gates where no VGDS is available. The advantage for ATC is the certainty that an airplane is "ready" when an airplaine is reported "ready”. This point in time is the Actual Ready for Departure Time (ARTD) and is important in order to avoid on the one hand the loss of runway capacity, and on the other hand in order to make optimal use of the runway capacity. A device in the pushback truck is the perfect opportunity to express the ARDT to the Outbound Planner (OPL). Namely, when the pushback truck is attached and a “ready” signal of the pilot is received. The pushback driver is, therefore, next to the pilot, the only person who can see if an airplaine is actually ready. If the driver notices that all the processes are done, he can send a ARDT through the device to the OPL.

Assignment:
Drawing up a business case for installing and maintaining an electronic device for the pushback driver. This device must both be used to request the current pushback standard and also be linked to CDM. The business case should be based on the following principles:
• All handlers at Schiphol;
• Software and hardware;
• Installation and maintenance.

The business case should work out the following three options:
• Do nothing. This serves as a baseline scenario;
• Solution using the current resources available for the pushback drivers;
• New fit-for-purpose devices.

Mid term / Long term objectives:
Not applicable.

Involved parties:
LVNL, KLM, AAS

Source:
-

Result report:
17.282.05 Business case electronic device pushback v2.0

C56: Functional analysis of Schiphol Tower-C

Ref. Ext. Programme		**Status**	Completed			
Project Number		**Research Cluster**	Airport Capacity			
Customer	KDC board	**Key Performance Areas**	S	Ec	Es	Env
Assignment	Call for tender		✓	✓	✓	✓
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	22-05-2017		+	0	0	
Project Lead	Mariska Roerdink	**Involved LVNL process**	“Besturen”			
Sponsor		**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Goal / Expected benefit:
The goal for this activity is to create an overview of the tasks that are executed from Schiphol Tower-C, including the responsible agents for these tasks. This includes the tasks executed by human operators and tasks performed by technical systems. The assignment covers the various organisations (LVNL, AAS, KLM) working from TWR-C. This overview is input for further development of the control tower operations, including the development of ground control clusters and restructuring the layout of the 12th floor of TWR-C.

Introduction:
Tower-Centre (TWR-C) is the main control tower at Schiphol Airport. This control tower provides working positions for employees from LVNL, AAS and KLM. LVNL is responsible for the safe and efficient guidance of traffic in the manoeuvring area. This does not only concern aircraft, it also concerns aircraft tows and vehicles. The guidance to tows is currently delegated to AAS Apron Control (APC). The guidance of taxiing aircraft is done by Ground Control from TWR-C on the 12th floor. The guidance of the tow movements is done by APC on the 10th floor of TWR-C. The separation of the two functionalities impede the mutual coordination of the two. In addition to guidance of traffic in the manoeuvring area, LVNL also provides aerodrome and runway control services. Furthermore, AAS and KLM have various planning functions located at TWR-C. The operational personnel is supported by various technical systems in the execution of the tasks. The traffic growth at Schiphol has resulted in a need to evaluate the operations from TWR-C. The distribution of tasks over the various operational functions has changed over the last years. Operational experience including reporting of occurrences has pointed at possibilities for improvement of the operational process. For example, providing the start-up clearance is moved from the start-up controller to the ground controller and providing clearances for tows crossing runways that are not in use is transferred from APC to LVNL. The expected further traffic growth imposes additional demands on the operational process. Currently, studies are performed to investigate ways to support the operational process in the future. For example, the introduction of ground clusters in which a Ground Controller and a Ground Assistant, are responsible for the guidance of all ground movements including tows and vehicles in one sector is considered. A restructuring of the layout of the 12th floor of TWR-C, including the creation of additional working positions is also under investigation.
There is a need to have a clear overview of the tasks that are performed from the Schiphol control tower and the functions that currently execute these tasks. Such an overview can be used as input for studies mentioned above.

Assignment:
Execute a functional analysis of the tasks and functions at Schiphol Tower-C. This should include:

- Provide an overview of the tasks currently executed from Schiphol Tower-C.
- Identify the responsible functions for these tasks, including human operators and technical systems.
- Identify relations and dependencies between the various tasks and agents.

Mid term objective (two – three years) :
Tbd

Long term objective (> three years) :
Tbd

Involved parties:
LVNL, KLM, AAS, KDC partners

Source: -

Result Report:
Rapport-Functional Analysis SPL TWR-C v1.0

C57: Optimizing Ground Capacity (FtG)

Ref. Ext. Programme	-	**Status**	Completed				
Project Number							
Customer	KDC board	**Key Performance Areas**	**EFF**	**ENV**	**CAP**	**CST**	
Assignment	Call for tender		**PRD**	~~INT~~	**SAF**		
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	27-03-2017		+	0	+		
Project Lead	Eugene Leeman	**Involved LVNL process**					
Sponsor		**Ref. ATM System Strategy**	-				
Financial Partner	DGB	**Priority**	Normal				
TRL	6						

Goal / Expected benefit:
Expected benefits are in the area of safety and efficiency in relation to the Schiphol taxiway system.

Introduction:
Due to increased number of ground movements in the manoeuvring area the airport throughput is being challenged and workload for ATC and pilots increasing. During low visibility conditions, the ground capacity in the manoeuvring area is one of the most important restrictive elements. In view of this, and PCP requirements (conflict alerting/avoidance, and routing/planning functions) there is an opportunity to define and update criteria in order to improve safety (avoiding conflict, reducing controller workload, reducing runway incursions) and/or reduce taxiway congestion (airport throughput). In view of anticipated growing traffic volume there is an increased need to optimize airport throughput at Schiphol airport.

Assignment:
Conduct a study/simulation for Schiphol of the following aspects under various visibility conditions (good, marginal, poor) in order to provide answers for following questions :
- What are the present separation criteria (safe taxi speeds and distances), control mechanisms and capacity figures ?
- What are clear definitions of conflict in relation to aircraft/vehicle separation and taxi speeds, and how are these integrated in the current procedures ?
- What could be the potential benefits and risks in terms of safety and capacity based on the simulations of different separation criteria (safe taxi speeds and distances) ?
- Provide a proposal for the revision of the present definitions / criteria (if appropriate) in order to enhance airport throughput and/or improve safety level.
- Determine the maximum taxi ground capacity for different visibility conditions (scenarios).

Midterm objective (two – three years) :
- Potential safety benefits in combination with routing and planning functions (PCP)
- Reduce workload for ground controllers during peak hours or adverse conditions

Long term objective (> three years) :
- SESAR PCP Routing and Planning functions

Involved parties:
LVNL, KLM, AAS, KDC partners

Source:
-

Result Report:
NLR-CR-2018-075 v1.0

C58: Business case expansion of AMAN radar horizon

Ref. Ext. Programme		**Status**	Completed				
Project Number		**Research Cluster**	AMAN Cluster				
Customer	KDC board	**Key Performance Areas**	S	Ec	Es	Env	
Assignment	Call for tender		✓	✓	✓	✓	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	13-07-2017		+	0	0		
Project Lead	Alina Zelenevska						
Sponsor		**Ref. ATM System Strategy**	-				
Financial Partner	DGB	**Priority**	Normal				
TRL	6						

Goal / Expected benefit:
The goal for this activity is to provide quantitative data in support of a business case for the expansion of the radar horizon for arrival management purposes. The expectation is that the performance of the arrival management system improves are a result of early trajectory prediction, which is enabled by radar horizon expansion. The question is whether the performance improvement is sufficient to justify investment in the horizon expansion before 2024, when the expansion becomes mandatory under the PCP.

Introduction:
In 2024 the expansion of the AMAN planning horizon to 200NM becomes mandatory under the PCP. The expansion of the AMAN planning horizon is very much in line with LVNL’s vision and strategy for Schiphol’s arrival management system. Managing air traffic of the biggest and most complex hub airport in Europe’s smallest airspace is a big challenge and it is therefore imperative for LVNL’s air traffic controllers to influence arriving traffic as early as possible, to maintain an acceptable workload in the TMA and extended TMA.

European law dictates a 200NM planning horizon, but the benefits of a larger planning horizon depend very much on the stability of the planning. The stability of the planning in turn depends very much on the accuracy of the prediction of arrival time of the inbound aircraft. Therefore much depends on the quality of the AMAN trajectory predictor (TP) and the availability of sensor data, as input to the TP.

It is clear that LVNL is currently lacking radar data in the west, north-west area to comply with the 200NM horizon *(it should be noted that the system interoperability between ATC centres is not available in 2024, as an alternative to local AMAN TPs based on radar data).* This lack of radar coverage has the effect that traffic entering ACC sector 4 and 5 behaves as “pop-up traffic” in the AMAN. Other factors than radar horizon may also play a role. The occurrence of pop-up traffic destabilized the planning and in effect impedes the expansion of the horizon.

The expansion of the planning horizon in the west and north-west areas will be needed in any case by 2024. However, there may be a business case to expand the horizon much earlier. What will be required to expand the radar horizon is a service level agreement with NATS for the provision of data. There will be a cost component, which is not part of this assignment (to determine the cost of the radar data horizon expansion). The focus of this assignment is to determine the benefits that can be expected from an extended AMAN horizon facilitated by the SLA with NATS for the provision of radar data.

Assignment:
Determine the benefits of radar data expansion in the west / north-west area of the AMS-FIR and beyond (up to 200 NM), in terms of predictability of the traffic, the expansion of the horizon, and the efficiency of flight profiles. Identify any other limiting factors on the extension of the planning horizon when increasing the radar horizon.

Scenarios:
Three scenarios must be evaluated:
a) The current situation, providing a reference for subsequent extended horizon scenarios
b) Horizon expansion to the benefit of AMAN 1.0 with low-res meteo TP
c) Horizon expansion to the benefit of AMAN 1.0 with hi-res meteo TP

Quantitative aspects:
- What are the expected effects on safety, efficiency and workload?
- What are the benefits to the airspace users?
- What are pre-conditions that need to be met to realise the benefits?

Involved parties:
LVNL, KLM, AAS, KDC partners

Source:
-

Result Report:
Extending AMAN Radar Horizon v1.1, Business Case Extension AMAN Radar Horizon - WP2 V2.0, Business Case Extension AMAN Radar Horizon - WP3 v1.0

<table>
<tr><th colspan="8">C59: Managing of Turnaround priorities (gate stands)</th></tr>
<tr><td>Ref. Ext. Programme</td><td>-</td><td>Status</td><td colspan="5">Completed</td></tr>
<tr><td>Project Number</td><td>-</td><td>Research Cluster</td><td colspan="5">Airport Capacity</td></tr>
<tr><td>Customer</td><td>KDC Board</td><td>Performance Targets</td><td>S</td><td>Ec</td><td colspan="2">Es</td><td>Env</td></tr>
<tr><td>Assignment</td><td>Call for tender</td><td></td><td>✓</td><td>✓</td><td colspan="2">✓</td><td>-</td></tr>
<tr><td>Project Plan</td><td>Proposal</td><td>ATM concept</td><td>ATS</td><td colspan="2">ATFCM</td><td colspan="2">ASM</td></tr>
<tr><td>KDC Board Approval</td><td>27-03-2017</td><td></td><td>✓</td><td colspan="2">-</td><td colspan="2">-</td></tr>
<tr><td>Project Lead</td><td>Eugene Leeman (AAS)</td><td colspan="6"></td></tr>
<tr><td>Sponsor</td><td>Koos Noordeloos (AAS)</td><td>Ref. ATM System Strategy</td><td colspan="5">-</td></tr>
<tr><td>Financial Partner</td><td>DGB</td><td>Priority</td><td colspan="5">Normal</td></tr>
<tr><td>TRL</td><td>6</td><td colspan="6"></td></tr>
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Goal / Expected benefit:
Expected benefits are in the area of efficiency in relation to the Schiphol aircraft stand optimization.

Introduction:
As a result of an ongoing tendency for increased runway, taxiway and gate occupancy, the need for smart use of available assets is more important than ever. Example 1: Airlines and airport operator generally want a departing aircraft to be off the gate as soon as possible, ATC however wants to keep the taxiway system as less occupied as possible in order to optimize taxi flows. Example 2: Airlines rather have outbound flights to wait at a remote holding for departure, instead of inbound aircraft waiting at a remote holding location. ATC however has other priorities and may decide differently. Example 3: as as result of limited gate capacity, the need for towing movements has increased (and will continue to increase). For ATC, towing movements has a low priority (tow movements only approved if destination gate is free, for fear of taxiway congestion if gate is still occupied when tow arrived). All reasons are relevant, but what is optimum operating model, with less burden for the A-CDM sector as a whole?

Assignment:
Conduct a study / simulation based upon typical (general used) traffic scenarios for Schiphol in order to :
- Determine the most limiting capacity element (runway, taxiway, gate availability)
- Define a set of general applicable priority rules to be followed by all A-CDM stakeholders, contributing to optimise the airport throughput (and therefore minimise negative impact)

Midterm objective (two – three years) :
- Reduce ground movement delays
- Find optimum balance between available capacity (runways, taxiways and aircraft stands) en traffic demand.
- Reduce workload for ground controllers (…)

Long term objective (> three years) :
SESAR PCP Routing and Planning functions

Involved parties:
LVNL, KLM, AAS, KDC partners

Source:
-

Result Report:
Managing of Turnaround Priorities report MD NLR v1.0.pdf

C60: ASAS Interval Management

Ext. Programme	-	**Status**	Completed			
Project Number	PRJ-1844	**Research Cluster**	AMAN Cluster			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment			✓	✓	✓	✓
Project Plan	KDC/2010/0091	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	22-06-2011		✓	-	-	
Project Lead	Nico de Gelder (NLR)					
Sponsor	Maarten Oort (KLM)	**Ref. ATM System Strategy**	-			
Financial Partner	DGB, SESAR JU	**Priority**	Normal			
TRL	3					

Goal / Expected Benefit:
Improvement of operational efficiency.

Introduction:
There is an urgent call from government and surrounding Schiphol communities to implement Continuous Descent Approaches (CDA) in the upcoming years. Such procedures would be based on partly fixed routes which will be introduced at Schiphol Airport as a result of an agreement between the Dutch regulator and the aeronautical sector ("Alders Advice till 2020"). Continuous Descent Approaches will improve fuel efficiency and environmental aspects, such as noise annoyance and emissions, compared to traditional step-down approaches. However, it is also anticipated that the introduction of CDAs, with a fixed lateral flight path, will have negative capacity consequences. Reduction of peak-hour capacity will hurt KLM/AF's network operations and will jeopardize Schiphol's future. For the Dutch aviation sector the introduction of CDAs without mitigating procedures or technology to alleviate the foreseen capacity drop is unacceptable.

In order to introduce CDAs with a high hourly capacity (>30 landings per hour) additional measures are required. ASAS Interval Management (aka ASAS Sequencing and Merging in SESAR) is regarded, according to current internationally accepted view, to be the most appropriate to address this shortfall. Interval Management (IM) is a concept in which aircraft exchange ADS-B data to control their distance or time interval with a lead aircraft. Initial operational trials are being conducted by United Parcel Services (UPS), in co-operation with the FAA, at Louisville Airport using Class III Electronic Flight Bags (EFB) and an ASAS Guidance Display (AGD). Results indicate a substantial reduction in flight time, fuel burn, noise and emission compared to normal operation.

Assignment:
This project aims to develop, demonstrate feasibility and validate an IM concept of operation at Schiphol, including the transition from current operation towards the introduction of high capacity CDA operations. This assignment will focus on the operational and technical implications of IM and will address the mixed environment (i.e. including non-IM equipped aircraft), taking into account required ATC support. In anticipation of SESAR the project is specifically considering local environmental and operational conditions at Schiphol, aiming for an IM concept that seamlessly links up with the SESAR Sequencing and Merging developments. The project will closely monitor the relevant SESAR projects (P9.05, P5.6.6) to avoid parallel developments and it will assure interoperability with international standards currently under development by RTCA SC-186/EUROCAE WG-51.

The general set-up is to go from a modelling approach, via human-in-the-loop simulations, to operational trials with revenue aircraft. The expected outcome of the project is a validated concept that addresses both environmental and capacity aspects.

Phase 1 objective: Operational Performance Assessment – concept feasibility demonstration on performance aspects (duration of approx. 1 year)
Some key issues for the use of IM at Schiphol are related to the local operational and environmental conditions -- e.g. existing TMA size, preferential runway system, traffic demand; and anticipated fixed arrival route structure, continuous descent procedures, deployment of SARA, traffic demand-- and have to do with (1) acceptable system performance for aircraft strings of at least N aircraft (stability of aircraft strings) and (2) the ability of ASAS IM to provide the operationally required spacing performance to support undisturbed continuous descent procedures while (at least) maintaining capacity, with controller intervention by exception. To address these two major issues the following activities are proposed:

a. Define ASAS IM concept of operation. The ConOps defines continuous descent procedures for Schiphol in combination with the use of ASAS Interval Management. The continuous descent procedures include vertical path and speed profile definitions and assumptions on standard operating procedures for example with respect to aircraft configuration changes. The ASAS IM operation will be described including the level of automation (IM speed advisories vs. IM speeds coupled to the autopilot/auto throttle) and again assumptions on standard operating procedures.

   In particular the ConOps provides a design for high density inbound traffic flows accommodating undisturbed continuous descent approaches to the greatest extent possible. The ConOps includes the IM application definition (operational scenarios) and relevant local operational and environmental conditions.

b. Define desired performance level. The desired performance level will be based on the operational goals from the ConOps, and it defines the operationally required spacing performance and the acceptable system performance for aircraft strings of N aircraft. This will be based on an analysis of radar data during today's arrival peaks. The current spacing performance on final approach will be analysed to obtain an appropriate reference to select the operationally required spacing intervals between aircraft pairs for an appropriate set of landing rates (e.g. 34, 37 and 40).

c. Perform Operational Performance Assessment (OPA). A methodology will be used along the lines of RTCA SC-186/EUROCAE WG-51 activities which address and set global IM performance requirements. A suitable tool (e.g. NLR's Traffic Manager, AIRTOPS, AIRSIMS) will be selected with the capability to perform Fast Time Simulations in accordance with the ConOps. This tool will be used to determine the achievable performance of IM operations at Schiphol for the selected operational and environmental conditions defined in the ConOps.
   The OPA will address spacing errors introduced by operational uncertainties related to surveillance (e.g. position accuracy, quality of ADS-B data), environmental conditions (e.g. wind experienced by different aircraft) and aircraft performance (e.g. differences in vertical trajectories, decelerations and turns) and error correction mechanisms by means of the on board ASAS IM equipment.

The question to be answered is whether the achievable performance is equal to or exceeds the operationally required performance level, both to support 34-40 landings per hour per runway and to provide stable aircraft strings of at least N aircraft. Is the performance aspect of the concept successfully demonstrated in the local setting of Schiphol; is the ASAS IM concept feasible from a performance point of view? In other words: will ASAS IM deliver?

Phase 2 objective: Validate working procedures and determine controller (and pilot) acceptance – concept feasibility demonstration on operational aspects (duration of approx. 1 year)
Define detailed working procedures and capture ATC system requirements (controller support tools). Perform real-time simulation trials to demonstrate operational feasibility.

Phase 3 objective: Operational Validation – concept validation on operational, performance and interoperability aspects (duration of approx. 1 year for small scale operational trials and 1.5-2 years for large scale trials)
System development (air and ground); airworthiness approval; IM flight trials with controller support tool(s) for IM operations. Demonstrate technical feasibility and perform concept validation from an operational, performance and interoperability point of view.

Involved parties:
NLR (project lead), KLM, LVNL, Schiphol Group, TU Delft
Possibly expanded with partners like Rockwell Collins, EUROCONTROL, Boeing and Airbus.

Source:
-

Result Report:
KDC_ASAS-IM_FT_Result Report_v1.0

C61: Vision on the role of technology demonstrations in ATM innovation						
Ref. Ext. Programme		**Status**	Completed			
Project Number		**Research Cluster**	AMAN Cluster			
Customer	KDC board	**Key Performance Areas**	S	Ec	Es	Env
Assignment	Call for tender		✓	✓	✓	✓
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval			+	0	0	
Project Lead						
Sponsor		**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Goal / Expected benefit:
The goal for this activity is to develop a vision on the role of technology demonstrations in ATM innovation. This vision is the initial phase as a step up to a next phase: the development of the actual x-environment demonstration.

Introduction:
Bridging the gap between study and implementation is felt by many European ANSPs and is also felt by LVNL and the aviation sector partners. There are many aspects that make it difficult for a new idea or concept to make it from the design table to live OPS. These difficulties or challenges were discussed between the aviation sector partners KLM, LVNL and Schiphol Group, and the knowledge partners in the KDC. The KDC knowledge partners proposed two enablers to overcome the gap to implementation:

1. Adoption of the Lean Innovation Methodology
2. Development and implementation of an X-environment, an environment to demonstrate new technology in a high fidelity environment and in live-OPS

Assignment:
Develop a vision on the role of technology demonstrations in ATM innovation. In addition: develop a proposal for the development and trial of an actual prototype system, a technology demonstrator. The scope of the demonstration project must be interpreted in a broad sense: it can pertain to any of the sector partners' operational or operational planning processes.

Involved parties:
LVNL, KLM, AAS, KDC partners

Source:
-

Result Report:
20180420 Vision on the role of technology demonstrations in ATM innovation.pdf

C62: Demonstration of arrival trajectory prediction for optimizing the Schiphol night-time arrival process (Night-Optimal Way to Land)

Ref. Ext. Programme	-	**Status**	**Completed**			
Project Number	PRJ-2058	**Research Cluster**	AMAN Cluster			
Customer	Stratcor	**Performance Targets**	S	Ec	Es	Env
Assignment	Boeing KDC JDA-4		✓	✓	✓	✓
Project Plan	TBW	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	13-02-2014		✓	-	-	
Project Lead	Alina Zelenevska (LVNL)					
Sponsor	-	**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	3					

Goal / Expected Benefit:
Fuel and emission savings, controller workload reduction.

Introduction:
The current planning system that ACC controllers use for arrivals into Schiphol airport is not optimized for night time operations. The varying altitude profiles at night time are not accurately modeled. As a result, the planning system outputs inaccurate predictions that can cause the controllers to use tactical means to manage traffic. For example, arriving aircraft may be vectored, assigned a less efficient arrival route, or given a crossing constraint that pushes the arriving aircraft lower than optimal.

Description of the activity:
The purpose of the activity is to demonstrate a capability that provides guidance to the ACC controllers for planning night-time arrival trajectories in the iCAS-demonstrator environment (and optionally the LVNL OPS-room). The guidance will decrease vectoring and allow more efficient routes and vertical profiles for aircraft operators at Schiphol.

Boeing's TAD suite includes a trajectory predictor that can be optimized to accurately model night time operations at Schiphol. The Boeing TP can provide more accurate predictions for arriving aircraft's time at the stack and altitude at the stack. More accurate predictions will enable the controller to make more efficient planning decisions for arrivals. For example, the controller may allow the arrival to cross the stack higher than otherwise, and/or the controller may need to vector less often.
Additionally, the TAD controller interface can allow inputs from the controller for direct routing, descent speed assignments, and altitude constraints. These inputs will be used in the TAD TP's calculations, allowing the controller to see how different instructions will influence the arriving aircraft's profile. The end goal is to save airlines fuel by decreasing vectoring and allowing more efficient routes and vertical profiles. Furthermore better predictions are expected to have a beneficial effect on the capacity of night time arrivals.

Assignment:
Evaluate Boeing Trajectory Predictor Prototype.

Short term objective:
1. Final validation of the requirements for the prototype;
2. Subject to definition of the Ops Floor demonstration, validate potential annual fuel savings.

Midterm objective:
1. Validate capacity effects;
2. Implement validated solution.

Involved parties:
LVNL, Boeing

Result:

C63: Business case for the introduction of runway status lights (RWSL) and Final Approach Runway Occupancy signal (FAROS) at SP

Ref. Ext. Programme	-	**Status**	**Completed**				
Project Number	-	**Research Cluster**	Safe Airspace and Airport Navigation				
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env	
Assignment	Call for tender		-	✓	-	-	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	30/03/2018		✓	-	-		
Project Lead	Jan Smeitink (AAS)						
Sponsor		**Ref. ATM System Strategy**	NA				
Financial Partner		**Priority**	Normal				
TRL	6						

Goal / Expected benefit:
The goal for this activity is a business case which describes and compares the given options for improving runway safety by introducing Runway Status Lights (RWSL) and FAROS at Amsterdam Airport Schiphol. The outcome of the business case should enable decision makers to make a well-considered decision on which of the options are seen to suit safety in the daily operation/operational concept best.

Introduction:
LVNL is responsible for the safe and efficient guidance of traffic in the manoeuvring area. This concerns aircraft as well as vehicles.

A runway incursion is one of the major risks at an airport. The number of category D runway incursions at Schiphol over the last few years is steady but fairly high compared to other major airports. A most seen runway incursion category here is traffic that enters (including landing and take-off) or crosses a runway unintentionally and/or without clearance from Air Traffic Control. Runway Status Lights (RWSL) as well as FAROS are two of the promising mitigation measures/options that can help to reduce this type of runway incursions and the associated risk of collision and/or severity. The Runway Safety Team sees the introduction of RWSL and/or FAROS at Schiphol as structural solutions to the aforementioned issue.

In short: RWSL and/or FAROS has been proposed as a method of preventing, or reducing the severity of this kind of runway incursions at Schiphol by providing an independent alert to flight crews and vehicle drivers when a runway is being used by other traffic.

Assignment:
Compose a business case which gives insight in the benefits and costs of the introduction of runway status lights (RSWL) and FAROS at Schiphol. The business case should particularly define the pros and cons of such systems at Schiphol' runways as well as the associated costs. Furthermore; The business case should take into account the following aspects:

Qualitative aspects:
- How do the several RWSL options (REL's, THL's, RIL's) as well as FAROS fit into the operational concept?
- To what extent do these options reduce the risk? To this end it is strongly suggested to review all runway incursions over the past three years, thereby assessing whether RWSL/FAROS would have provided an additional safety barrier.
- Include an assessment of recent experiences with RWSL/FAROS at other airports.
- Consider any possible undesired interaction between RWSL/FAROS and RIASS.
- Consider a Human Factor analysis for the future use of RWSL/FAROS at Schiphol.

Quantitative and non-financial aspects:
- What are the expected side effects (on safety) regarding the introduction of RWSL and/or FAROS?
- What is the timing and throughput time for the different options?

Quantitative and financial aspect:
- What are the costs of each option, split into initial investments or capital expenditures (APEX) and operating expenditures (OPEX)?
- Consider whether the use of RIASS logics can be beneficial when implementing and tuning RWSL/FAROS at

Schiphol.

Mid-term objective (two – three years):
Realise implementation of RWSL's/FAROS at critical positions and runways at Schiphol where maximum safety benefit can be attained.

Long term objective (> three years):
Realise implementation of RWSL's/FAROS at other positions and runways at Schiphol where significant safety benefit can be attained.

Involved parties: LVNL, AAS, KLM

Result:
NLR-CR-2018-217 Business case for the introduction of Runway Status Lights and Final Approach Runway Occupancy Signal at Schiphol Airport

C64: Capacity and Runway predictions - phase 4 (final)

Ref. Ext. Programme		**Status**	**Completed**			
Project Number						
Customer	KDC board	**Key Performance Areas**	**EFF**	**ENV**	**CAP**	**CST**
Assignment	Call for tender		**PRD**	~~INT~~	**SAF**	
Project Plan	Proposal	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval			+	0	+	
Project Lead	Coen Vlasblom (KLM)	**Involved LVNL process**	"Besturen"			
Sponsor		**Ref. ATM System Strategy**	-			
Financial Partner	DGB	**Priority**	Normal			
TRL	6					

Goal / Expected benefit:
Due to more accurate prediction of runway combinations 20-30 hours in advance, advantages in flight planning and fuel calculations can be achieved optimizing the flow of traffic inbound Schiphol. This will subsequently lead to less specific aircraft requests for priority ensuring stable inbound flows.

Introduction:
Dynamic use of active runway selections is a denominating aspect of the Schiphol operation. Selection of active runways is done on a number of criteria including required capacity, wind, visibility, and influence of maintenance works on taxiways and runways.

For optimal flightplanning it is important to have insight in the active runway use and capacity 20 to 30 hours in advance. In this timeframe the flight planning process starts for intercontinental flights inbound Schiphol. Insight enables the airline to adjust fuel planning and in case of capacity bottlenecks to apply measures to mitigate disruptions at Schiphol airport.

Assignment:
The current runway & capacity tool is lacking a few functionalities which restricts KDC partners to use the tool in all circumstances. In order to achieve the midterm objective the following functionality shall be adopted in the current runway & capacity tool.

- It shall be possible to temporary exclude runways in the calculation. Temporary closed runway shall be selectable by end users. The current runway & capacity tool shall exclude these runways in its output figures. This facilitates the use of the runway & capacity tool during short runway closures.
- It shall be possible to display an approximate delay when demand exceeds capacity.
- Demand should indicate scheduled and cancelled flights. Current display shows all flights at Schiphol Airport obtained through their API irrespectively of their status. To estimate an approximate delay this needs to be filtered.
- QRC capacity figures shall be loadable by senior end users. This functionality ensures capacity displayed in the runway & capacity tool matches the LVNL capacity guidelines at all times.
- Peaktime table should be loadable by senior end users. This functionality ensures peaktimes matches the one used by LVNL which ensures consistency in runway combination forecasts during peaktimes.
- Role based login shall be incorporated to enable use of the runway & capacity tool by senior management, including user account management.
- New parallel approach criteria at Schiphol shall be incorporated in the runway & capacity tool.
- Based on EHAM NOTAM feeds, switch automatically to another runway model when runways are closed or opened. This ensures the predicted runway combination are viable runway combinations. Currently this is a manual effort and could have a latency of a few days.
- Manually train or automatically train runway models after each runway model switch to ensure these models incorporates the latest operational runway usage.
- Extend predictions with theoretical runway combinations, based on historic weather, when predictions cannot be made during extreme weather conditions. This ensures that the application always returns an answer, even in extreme weather conditions. Furthermore, distinction between prediction and theory should be clearly visible.
- The graphical user interface shall be optimized for use on tablets.
- Evaluation form integrated in application to provide feedback when the application has contributed to decision making.

- All changes required to externally host the runway & capacity tool by KDC partners shall be taken.

Those changes will increase the chance to successfully implement the runway & capacity tool at one or several KDC partners.

Mid term objective (two – three years) :
Establish a prototype runway & capacity prediction tool to facilitate planning for all KDC partners.

Long term objective (> three years) :
-

Involved parties:
LVNL, KLM, AAS, KDC partners

Result:
AFOS v04 Admin User Manual

C65: Sensitivity study high-res meteo for ATM

Ref. Ext. Programme	AMAN-roadmap	**Status**	**Active**			
Project Number	-	**Research Cluster**	AMAN Cluster including ICAS			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	-		-	✓	✓	-
Project Plan	Ferway offerte hi-res resolutie studie 2018_v0.1	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	December 2018		✓	-	-	
Project Lead	Ilse Megens (LVNL)	**TRL**	3			
Sponsor	Maartje van der Helm (LVNL)	**Lifecycle phase**	Feasibility assessment			
Financial Partner	DGB	**Priority**	Normal			

Introduction:
In order to handle traffic conform schedule, the sector is working on improving arrival management. A new arrival management system has been operational at LVNL since November 13, 2018. With this, steps have been taken to make new developments possible, for example cross border arrival management (XMAN). A new step in further development is the implementation of Hi-res meteo.

Hi-res meteo provides more accurate weather information, which increases the predictability of the operation. The benefits of hi-res meteo have been described earlier as part of the KDC study "Demonstration of arrival trajectory prediction for optimizing the Schiphol night-time arrival process".

Goal / Expected benefit:
Before introducing hi-res meteo into the ATM system, choices must be made for the sake of accuracy. The proposed research "Sensitivity study high-res meteo for ATM" highlights the impact of different options. This research therefore provides decision information for arrival management system choices.

Assignment:
Perform a sensitivity study and write a report.

Involved parties:
KLM, AAS, LVNL, Min. IenW, KNMI

Source:
-

C66: XMAN trial Reims-Amsterdam, CONOPS

Ref. Ext. Programme	Airspace programma van LVNL	**Status**	**Active**			
Project Number	-	**Research Cluster**	AMAN cluster			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for tender		-	✓	✓	✓
Project Plan	Offerte 18.282.03 CONOPS XMAN Trials Reims-Amsterdam	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	July 2018		✓	-	-	
Project Lead	Alina Zelenevska (LVNL)	**TRL**	6			
Sponsor	Michiel van Dorst (LVNL)	**Lifecycle phase**	Pre-industrial development & integration			
Financial Partner	DGB	**Priority**	Normal			

Introduction:
Reims has offered LVNL to put the inbound Schiphol traffic in Reims on the required speed. LVNL is interested in this offer as a potential means to de-bunch traffic in sector 3. The Reims-Amsterdam XMAN concept is new since four centers should work together to manage the speed from TOD until the touch down. Before this new concept can be implemented, the concept and the expected benefits should be validated. LVNL wants to do it based on life trials. During the trial, Reims would put aircraft on the speed requested by LVNL ACC in order to absorb all or a part of the delay in the descend mode. This should result in less vectoring in the Dutch FIR, an efficient flight profile for the airlines and a lower workload for the controllers.

Goal / Expected benefit:
To be able to perform the trial, many things need to be done. The goal for this activity is to describe the new concept of operations in the preparation of the XMAN trial with Reims, MUAC and Belgocontrol in Sector 3.
The goal of the trial itself is to assess whether the influence of the traffic just before the TOD leads to the decrease of workload of the ATCOs and efficiency of the flight profiles.

Assignment CONOPS of the XMAN trial:
The agreed CONOPS is an enabler for holding the trial. Development of the CONOPS should be performed in several steps to include input of all stakeholders. The first draft should be ready on the 1st of September to be able to use it during the meeting on September 13th. The writer of the CONOPS should be able to attend the meeting at LVNL on the 13th of September to get the feedback from all involved ANSPs. During the meeting the next steps will become clear. The expectation is that two or three follow-up meetings will be necessary to finalize the CONOPS. The meetings will probably take place at Belgocontrol, Reims and MUAC. The dates are not known yet.

This trial will be a first example of an XMAN trajectory based concept. The Heathrow XMAN concept, which has already been implemented, is a flow management concept in which the whole flow of traffic gets delayed in order to reduce the delay in the holding. The demand and supply balance at Schiphol airport is of high quality, therefore there is no need for LVNL to influence the whole inbound stream. To improve flight efficiency and to decrease workload, LVNL needs to spread bunches of traffic.

In order to agree on the operational concept with the involved ANSPs, LVNL has to prepare a first draft of the operational concept document, based on the high level description provided below and other available FABEC XMAN documentation such as XMAN Advanced Step CONOPS. The operational concept document will be a trial concept, and will serve as input to an update of the more general XMAN Advanced Step CONOPS after the trial.

Concept of Operations (first high level sketch):

- LVNL freezes the planning horizon at 18 min from the IAF;
- Based on the delay value, LVNL ATCO takes a decision to ask MUAC and Reims to influence a certain aircraft or not:
  - If the delay is less than X minutes, the delay will be absorbed in the Dutch FIR;
  - If the delay is more than X but less than Y minutes, ATCO will ask MUAC and Reims to put the concerned aircraft on a fixed Mach speed and descend speed. Reims, MUAC and Belgocontrol will keep the aircraft on the requested speed when possible (best effort, not mandatory).
    An option can be to add one more step: if the delay is more than X but less than Y', ATCO will

provide the speed request to MUAC; if the delay is more than Y' but less than Y, ATCO will provide the requested speed to Reims and MUAC.

  - If the delay is more than Y minutes, LVNL will use holding in the Dutch FIR to absorb the delay.

- The trial will be a "single shot" concept. If a speed has been requested, no new requests will come to adjust the speed;
- The speed is individual for the individual aircraft, but it is possible to agree on several standard speed values that can be requested;
- If Reims and MUAC were not able to put the aircraft on the requested speed, Belgocontrol will not do it either because of the proximity of the Dutch FIR and the short time aircraft is under the control of Belgocontrol (3 minutes);
- If possible, the adjacent centres will let the aircraft fly CDA
- The AMAN system of LVNL looks at the traffic in Reims, MUAC and Belgocontrol airspace and presents ATCO an inbound planning. ATCO does not see the traffic of adjacent centres on the radar, only the planning.

C67: XMAN trial Reims-Amsterdam, KPIs

Ref. Ext. Programme	Airspace programma van LVNL	**Status**	**Active**			
Project Number	-	**Research Cluster**	AMAN Cluster			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for tender		-	✓	✓	✓
Project Plan	NLR proposal 15262_ XMAN KPI's	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	July 2018		✓	-	-	
Project Lead	Alina Zelenevska (LVNL)	**TRL**	6			
Sponsor	Michiel van Dorst (LVNL)	**Lifecycle phase**	Pre-industrial development & integration			
Financial Partner	DGB	**Priority**	Normal			

Introduction:
Reims has offered LVNL to put the inbound Schiphol traffic in Reims on the required speed. LVNL is interested in this offer as a potential means to de-bunch traffic in sector 3. The Reims-Amsterdam XMAN concept is new since four centers should work together to manage the speed from TOD until the touch down. Before this new concept can be implemented, the concept and the expected benefits should be validated. LVNL wants to do it based on life trials. During the trial, Reims would put aircraft on the speed requested by LVNL ACC in order to absorb all or a part of the delay in the descend mode. This should result in less vectoring in the Dutch FIR, an efficient flight profile for the airlines and a lower workload for the controllers.

Goal / Expected benefit:
To be able to perform the trial, many things need to be done. The goal for this activity is to describe the new concept of operations in the preparation of the XMAN trial with Reims, MUAC and Belgocontrol in Sector 3.
The goal of the trial itself is to assess whether the influence of the traffic just before the TOD leads to the decrease of workload of the ATCOs and efficiency of the flight profiles.

Assignment XMAN trial KPIs:
An agreed set of KPIs is an enabler for holding the trial. The right KPIs will provide the evidence of the benefits. Development of the KPIs should be performed in several steps to include the input of all stakeholders. The first draft should be ready on the 1st of September to be able to use it during the meeting on September 13th. The writer of the KPIs should be able to attend the meeting at LVNL on the 13th of September to get the feedback from all involved ANSPs. During the meeting it will become clearer whether more steps will be required. The expectation is that one or two more meetings will be necessary to finalize the KPIs. The meetings will probably take place at Belgocontrol, Reims and/or MUAC. The dates are not known yet.

This trial will be a first example of an XMAN trajectory based concept. The Heathrow XMAN concept, which has already been implemented, is a flow management concept in which the whole flow of traffic gets delayed in order to reduce the delay in the holding. The demand and supply balance at Schiphol airport is of high quality, therefore there is no need for LVNL to influence the whole inbound stream. To improve flight efficiency and to decrease workload, LVNL needs to spread bunches of traffic.

The expectation is that XMAN will provide benefits for the airlines and for the ANSPs. To implement the XMAN concept after the trial, evidence is required that shows the impact of the new concept on all parties involved. Therefore LVNL needs a good set of KPIs, which have been agreed with those parties involved. Each KPI should be accompanied by a use case that will explain what kind of benefits we expect and how these benefits can be achieved during the trial (use examples from FABEC use cases). Once the KPIs have been defined, a baseline measurement will need to be performed.

Ideas named during the kick off meeting:
- Overall vectoring time;
- # track miles/delay;

In order to define the best suitable moment for the trial, LVNL needs the answers to the following questions:
1. What is the timeframe when the majority of the delay in Sector 3 occurs?
2. What is the estimated percentage of flights that will be affected during the trial? This is necessary for the involved ANSPs in order to assess the workload impact on their side.
3. Are there any other parameters that help to define a suitable time for the trial?

C68: Schiphol Target Time of Arrival (TTA) Concept

Ref. Ext. Programme	-	**Status**	**Active**			
Project Number	-	**Research Cluster**	Airline Operational Efficiency			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	Call for tender		-	✓	✓	-
Project Plan	Feasibility study of TTO/TTA concept for Amsterdam Airport Schiphol to improve capacity and reduce ATFM delay	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	7-12-2018		✓	✓	-	
Project Lead	Coen Vlasblom (KLM)	**TRL**	3			
Sponsor	Maartje van der Helm (LVNL)	**Lifecycle phase**	Feasibility assessment			
Financial Partner	DGB	**Priority**	High			

Goal / Expected benefit:
More effective EHFIRAM regulations, less Airport ATFM delay and (in longer term) increased capacity

Introduction:
In 2017 traffic numbers for LVNL peaked at their highest on record. More than 600,000 flights were handled by Amsterdam ACC and almost 500,000 commercial flights (without general aviation) arrived and departed at Schiphol Airport. These record traffic numbers resulted in a significant increase in delay as well. To counter these delays and looking to improve its performance.

In current operations LVNL is facing traffic demand well above the declared capacity on daily basis. Regulations are put into place to counter these Schiphol inbound traffic peaks. As such safety and orderly handling of traffic are ensured. With the increase in traffic, the delay caused by these regulations has increased as well. In 2017 Amsterdam Airport generated 13.8% of all European airport arrival ATFM delay (ATFM stands for Air Traffic Flow Management). According to the Network Manager, Schiphol Airport is one of the most congested airports in Europe and its generated delay has the largest impact on the network.1 ATFM delays are a problem for the aviation business mainly for the airline operators. Delays increase airline operating costs (cost of ATFM delay is around €80-€100 per minute2) and it disrupts airline operations (including reactionary delay). Furthermore delays can disrupt airport operations (need for use of less environmentally preferable runways, gate planning, planning of ground handling, etc.). Finally the use of ATFCM-measures (regulations) decreases the planning flexibility of the European Network (due to the increased issuing of CTOT's).

To counter these delays, LVNL is seeking to increase capacity and to balance capacity & traffic demand in more efficient ways. One of the potential improvements is the use of "less stringent" regulations (potentially using higher rates and/or smaller regulation periods) by increasing the effectiveness of these regulations. In current operations, LVNLs experience is that regulations, used to reduce traffic peaks / bunches, do not always results in a sufficient safeguard for traffic overloads. Often traffic peaks reoccur because airlines try to recover any endured delay by flying faster and/or using shorter routings. Furthermore ATC in enroute sectors can issue directs to aircraft, resulting in further deviations. Therefore regulations (and capacity) are managed with some conservatism to overcome these effects.

KDCs is interested in the concept of TTO/TTA as a measure to increase effectiveness of regulations by preventions of bunching. TTO stands for Target Time Over (TTA Target Time Arrival) and represents the target time for a flight to enter an (regulated) airspace according to the flight profiling done by Network Manager. When pilots are able to operate more according to these times, risk of traffic bunches occurring may decrease.

In Europe some ANSP's have conducted trials for TTO/TTA (Target Time Arrival). TTO/TTA is incorporated in SESAR as one of the future operational concepts. Therefore it is expected that understanding of this concept can be acquired by a short study of already available information and trial experiences.

Assignment:
KDC requires a short study addressing the following topics

What is the TTO/TTA concept, how does it work?

- SESAR concept

- Trials at ANSP's
- Collaboration between Network Manager, ANSP's and Airlines

Which performance benefits can TTO/TTA deliver
- Effectiveness of ATFCM measures (regulations)
- Performance effects on capacity and ATFM-delay
- Effects on runway usage

Feasibility of TTO/TTA use at Amsterdam Airport Schiphol / Amsterdam ACC
- Incorporation of TTO/TTA in current and/or future operations
- Possibilities to conduct trials in current operations
- Effectiveness for non-regulated flights (e.g. intercontinental traffic)
- Relations with current and future developments (like AMAN 2.0 and XMAN-trials)

Short term objective:
Delivery of a report addressing the benefits and feasibility of TTO/TTA at Amsterdam Airport Schiphol and Amsterdam ACC

Midterm/Long term objective:
Depending on the feasibility study:
Midterm objective is the conducting of one or multiple trials at Amsterdam Aiport Schiphol and Amsterdam ACC

Depending on trial results:
Long term objective is to introduce TTO/TTA at Amsterdam Airport Schiphol and Amsterdam ACC

Involved parties:
KLM, AAS, LVNL, Min. IenW

Source:
-

1 Source: PPR2017, Performance Review Report 2017, https://www.eurocontrol.int/sites/default/files/publication/files/prr-2017.pdf
2 Source: European airline delay cost reference values Final Report (Version 3.2), https://www.eurocontrol.int/sites/default/files/publication/files/european-airline-delay-cost-reference-values-final-report-v3.2.pdf
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C69: Holding support for area control

Ref. Ext. Programme	-	**Status**	Initiative				
Project Number	-	**Research Cluster**	AMAN Cluster including ICAS				
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env	
Assignment	-		-	✓	✓	✓	
Project Plan	-	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	31-1-2019		✓	✓	-		
Project Lead	T.b.d.	**TRL**	3				
Sponsor	KDC board	**Lifecycle phase**	Feasibility assessment				
Financial Partner		**Priority**	Normal				

Goal / Expected benefit
Holding patterns are mainly flown in non-nominal situations in order to deal with adverse weather, wind, emergencies or delays. Flying holding patterns have significant environmental, cost impact and plan stability. Optimizing the holding operation could lead to a better flow of traffic, less fuel use and improves accurate delivery for approach Schiphol.

Introduction:
Holding procedures keep aircrafts within a specified airspace by proscribing speed, hold entry procedures, timing and rate of turn. AMAN tools for area control do not offer any decision support for flying a holding pattern. Area controllers use only their expertise for an efficient holding. Awaiting further clearance from ATC, aircrafts can safely and orderly be sequenced to the runway.

Assignment:
- Research possibilities to provide area controllers decision support while holding (speed, timing and rate of turn while holding, taking in account separation minima). Also, take in account the available vertical view tool.
- Assess the performance of relevant options.

Short term objective:
Creating an overview of the available options to provide ATCOs with decision support during holdings.

Midterm/Long term objective:
Provide ATCOs with more convenient procedures or decision support tooling in flying holding patterns

Involved parties:
KLM, AAS, LVNL, Min. IenW, KNMI

Source:
-

C70: CCO High altitude SIDs

Ref. Ext. Programme	-	**TRL**	3			
Project Number	-	**Lifecycle phase**	Feasibility assessment			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	-			✓		✓
Project Plan	-	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	31-1-2019					
Project Lead	Maarten Tielrooij (To70)	**Status**	Completed			
Sponsor	-	**Research Cluster**	Environmental Sustainability			
Financial Partner	DGLM	**Priority**	Normal			

Introduction:
The PCP and PBN Regulation require to implement RNAV routes in the Schiphol TMA with defined lateral navigation standards. SIDs at EHAM are already designed to RNAV1 standards. The goal is to design routes with a minimum 6% fixed climb profile for all aircraft types. The SIDs will be vertically and horizontally constrained with PBN design criteria, separated from all other routes. This 3D separation of inbound and outbound routes is expected to de-complex the TMA operations, and to deliver the maximum benefits in terms of safety, capacity and environmental sustainability.

It is foreseen that departure routes will be optimized above an altitude of typically 6000 ft. The connection to this upper layer in the TMA must be made by means of optimized continuous climb profiles.

Goal / Expected benefit:
Optimization of departure routes in the Schiphol TMA, based on continuous climb departures, making use of the advantages of precision navigation and increased trajectory uniformity. The goal is to support design options for the TMA with increased performance with respect to environmental sustainability and capacity.

Assignment:
Develop departure route design options for the top four preferential runway combinations at EHAM considering the following aspects:

1. RNP1 navigation performance
2. Increased climb profile uniformity:
    a. Climb profiles that at least 95% of the aircraft can fly
    b. Climb speed restrictions (if required)
3. Traffic bundling: Extended centre-line climb options (varying from 3000 ft – 6000 ft)

The route design options need to be assessed in terms of capacity, track-miles and noise effects (indicative).

Short term objective:
Feasibility of the concept as a major building block in airspace restructuring for the 2023+ deployment timeframe.

Midterm/Long term objective:
A safe and environmental sustainable TMA route structure that takes advantage of new technologies, providing high capacity to the airspace users.

Involved parties:
KLM, AAS, LVNL, Min. I&M

Source:
-

<table>
<tr><td colspan="9">C71: Multi-airport concept</td></tr>
<tr><td>Ref. Ext. Programme</td><td>Project Luchtruim Herindeling</td><td>TRL</td><td colspan="6">3</td></tr>
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<tr><td>Project Lead</td><td>Tom Verboon (To70)</td><td>Status</td><td colspan="6">Completed</td></tr>
<tr><td>Sponsor</td><td>-</td><td>Research Cluster</td><td colspan="6">Capacity Management</td></tr>
<tr><td>Financial Partner</td><td>DGLM</td><td>Priority</td><td colspan="6">Normal</td></tr>
</table>

Introduction:
Schiphol as well as regional airports grow. Traffic streams from different airports use the same airspace. Therefore it is needed that, parallel to a new airspace design, airports are jointly managed, to efficiently use the available airspace. This concerns strategic, pre-tactical as well as tactical planning. In the strategic domain for example, currently schedules of slot regulated airports do not take other airports' schedule into account. In the pre-tactical domain, the Schiphol D-1 planning, Schiphol sector briefings, LVNL workload model, and management of disruptions can be studied.

Goal / Expected benefit:
The goal of this study is to propose measures for an efficient use of airspace with multiple airports. This concerns strategic, pre-tactical as well as tactical planning measures.

Assignment:
- Research how the management of traffic flows in Dutch airspace can be improved, taking in account the location and function of Dutch airports. Options under consideration are: alignment of flight schedules, coordination of peak hours, refinement of flow measures, tactical complexity management measures.
- Develop a concept for the planning and management of traffic flows.

Short term objective:
Produce measures that streamline the multi airport operation with regard to the project of airspace redesign.

Midterm/Long term objective:
-

Involved parties:
KLM, AAS, LVNL, Min. IenW

Source:
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C72: Runway sequence bays

Ref. Ext. Programme	-	**TRL**	6			
Project Number	-	**Lifecycle phase**	Feasibility assessment			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	-		-	✓	✓	✓
Project Plan	-	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	3-12-2019					
Project Lead	René van den Berg (To70)	**Status**	Completed			
Sponsor	-	**Research Cluster**	Airport Capacity			
Financial Partner	DGLM	**Priority**	Normal			

Introduction:
The current departure manager, the CPDSP, will be replaced by a new departure manager, the outbound sequencer. One of the improvements that will be incorporated in the new outbound sequencer is to make the departure manager more simple. It was recognized by the CDM program that the CPDSP performed sequence optimizations that were in fact not warranted. For instance WTC sequence optimizations were sometimes not realistic due to uncertainty about taxi-time. In fact some of the sequence optimization is also performed at the runway. The new outbound sequencer therefore acts more of a “faucet” regulating the flow to the runway, and less of a sequence optimized. The purpose of this development is to create more stability in the outbound planning and to better align the planning with operational practice.

One of the ways to optimize the WTC sequence at the runway is to use intersections. However, there are limitations to the use of intersection take-offs. When visibility drops below phase-A intersection take-off are not allowed. Furthermore, intersection take-off are not allowed during night-time. When runway 36L is operated from TWR-C, intersection take-offs are also not allowed from runway 36L.

In the US, so-called sequence bays are used. A sequence bay consist of a widened runway entry, at the runway head, which allows for two aircraft to hold side by side. A sequence bay allows for the same WTC sequence optimization as intersection take-offs, but with a number of advantages.

Goal / Expected benefit:
1) Sequence bays lead up to the same line-up point on the runway and can be used under all visibility conditions. WTC optimization therefore can be done at all times, which makes the outbound capacity less dependable on visibility.

2) Departures from the runway head will be higher on the SIDs than departures from an intersection. Thus sequence bays reduce noise in the areas close to the SIDs.

3) Sequence bays avoid the risks associated with intersection take-offs.

Assignment:
- A noise impact analysis when runway sequence bays are in use
- Model the capacity benefit of runway sequence bays
- Model the safety benefit of runway sequence bays.
- Feasibility assessment for the implementation of runway sequence bays

Short term objective:
Capacity increase of runway throughput

Midterm/Long term objective:
Noise decrease for close surroundings

Involved parties:
KLM, AAS, LVNL, Min. IenW

Source:
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C73: ASAS Interval Management Business Case

Ref. Ext. Programme	-	**TRL**	6			
Project Number	CR-2019-506	**Lifecycle phase**	Pre-industrial development & integration			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	-		✓	✓	✓	✓
Project Plan	-	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	31-1-2019					
Project Lead	Peter van der Geest (NLR), Maarten Tielrooij (To70)	**Status**	Completed			
Sponsor	-	**Research Cluster**	Fixed Arrival Routes and CDA's			
Financial Partner	DGLM	**Priority**	Normal			

Introduction:
The airspace vision for the Netherlands (2012) has adopted a concept for the Schiphol TMA, the area around Schiphol with a 50 km radius, which is based on fixed arrival routes and low altitude continuous descent approaches. The concept is founded on accurate delivery of traffic to the TMA, typically within 30 seconds of the planned TMA entry time. However, there is a concern that fixed arrival routes negatively affect arrival capacity, compared to the current arrival capacity which is based on vectoring traffic to the runway.

It is expected that the airspace redesign project that takes place in the 2019 – 2023 timeframe will be based on the principles laid-out in the airspace vision. Note: The implementation of fixed arrival routes is also demanded by the European PCP regulation (716-2014). Thus the future relationship with the surrounding communities in the greater Schiphol area is based on (carefully designed) fixed arrival routes and (the already existing) standard instrument departure routes (SIDs). This will enable better planning of areas that are affected by (some level of) noise annoyance and areas that are not affected.

Besides the planning of noise affected areas in the greater Schiphol area, the Schiphol operation is bound by rules and regulations for use of the runways. These regulations ensure that the noise preferred runways (the Kaag runway 06/24 and Polder runway 18R/36L) are used as much as possible to protect communities close to Schiphol. Furthermore, how these runways are used follows the pattern of arrival and departure peaks as much as possible, in essence the 2 + 1 runway concept. In addition, the use of a fourth runway in the overlap of arrival and departure peaks is limited.

The key point is: The demand for air travel keeps growing, also at Schiphol airport. If Schiphol is to accommodate greater volumes of air traffic, runway capacity needs to be increased to operate within 2 + 1 runway concept, and within the boundaries of the runway use regulations. However, to meet environmental requirements of the greater Schiphol area, and to comply with European regulations, fixed arrival routes need to be implemented which tends to drive down the arrival capacity. Thus the future of Schiphol airport is defined by two requirements which are difficult to reconcile.

Interval Management (IM) is a technology that can increase safety and capacity of fixed arrival route operations. IM requires technology on board of the aircraft which supports the time/distance achieving and keeping functions. This technology has been developed but airline equipage levels are currently zero. However, American Airlines decided in 2018 to equip some 200 A321 aircraft with ADSB-IN technology in order to fly IM procedures into Phoenix, Arizona, becoming the first early adopter of the IM concept

In the 2009 – 2016 timeframe an NLR led consortium has looked into the potential of IM for Schiphol, through fast-time and real-time simulations. The technology looks promising in terms of capacity benefits, but a business case has not been made yet. It is apparent that the dominance of KLM in the arrival peaks poses a business opportunity for IM deployment. It may turn out that, similar to the Phoenix situation, equipage of only KLM aircraft is sufficient to carry the business case.

Goal / Expected benefit:
Fixed arrival routes and low altitude CDA's with high capacity. Stable, safe and environmental friendly TMA operations with high capacity.

C74: RECAT-EU for departures

Ref. Ext. Programme	-	**TRL**	6				
Project Number	FWY-2020-01	**Lifecycle phase**	Feasibility assessment				
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env	
Assignment	-		-	✓	✓	✓	
Project Plan	-	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	3-12-2019						
Project Lead	Ferdinand Dijkstra (FerWay), Nienke Jester (MovingDot)	**Status**	Completed				
Sponsor	-	**Research Cluster**	Airport Capacity				
Financial Partner	DGLM	**Priority**	Normal				

Introduction:
EUROCONTROL has developed a re-categorization of the wake turbulence categories as defined by ICAO. The initiative splits the “Heavy” and “Medium” categories into “upper” and “lower”. This results in new longitudinal separation minima for traffic. The new categories yield lower separation minima for certain traffic combinations. This can potentially benefit runway throughput, while still maintaining acceptable safety levels.

Goal / Expected benefit:
Implementing the new wake turbulence categories are expected to lower the separation minima for certain traffic combinations. It is expected that Schiphol airport will see a runway throughput increase, as the traffic combinations are expected to be positively affected by the new separation minima.

Assignment:
Assess the performance of RECAT-EU time table implementation for departure capacity at Schiphol. The following aspects must be taken into account:

a) Benchmarking expected benefits with EUROCONTROL experience (runway through-put programme)
b) Operational limitations which stem from SID design (respecting separation minima on climb-out)
c) Airline company procedures

Short term objective:
Quantify the capacity increase which can be expected when implementing RECAT-EU for departures.

Midterm/Long term objective:
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Involved parties:
KLM, AAS, LVNL, Min. IenW, EUROCONTROL

Source:
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C75: Transition to high capacity fixed arrival routes (part 1: proposal)

Ref. Ext. Programme	-	**TRL**	3			
Project Number	-	**Lifecycle phase**	Feasibility assessment			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment	-		✓	✓	✓	✓
Project Plan	-	**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	3-12-2019					
Project Lead	Evert Westerveld (LVNL)	**Status**	Completed			
Sponsor	-	**Research Cluster**	Fixed Arrival Routes and CDA's			
Financial Partner	DGLM	**Priority**	Normal			

Introduction:
In the national ATM strategy it is outlined that in 2024 traffic in the TMA is guided over fixed arrival routes with low altitude CDA's. This measure is meant to reduce noise annoyance and gaseous emissions, as the fixed arrival routes will be optimized to avoid overflying of habited areas.

Currently LVNL has published one fixed arrival route for daytime use in the Schiphol TMA: the ARTIP1X approach from ARTIP to runway 36R. In practise this fixed arrival route is not used because runway 36R is a secondary runway and can only be used during inbound peak periods: The demand during these periods is too high relative to the capacity of the ARTIP1X arrival route.

The capacity of ARTIP1X is estimated to be about 30 movements per hour. This figure however has not been validated and may also be lower. In order to be able to use fixed arrival routes in the daily operation, the capacity of fixed arrival routes needs to be increased. There are several measures to increase capacity of fixed arrival routes, for example:

1) Improved delivery accuracy at the IAF
2) Allowance of flexibility (e.g. tromboning)

For fixed arrival routes to the primary runways, merging support for approach will be required, as these routes merge traffic from two IAFs.

Goal / Expected benefit:
Calculate and validate the capacity of fixed arrival routes for Amsterdam airport and the benefit to capacity of the aforementioned optimizations.

Assignment:
- Design a rough concept of fixed arrival routes for EHAM that resemble 2024 implementation.
- Perform a real time simulation to validate the capacity of ARTIP1X and the proposed arrival routes.
- Optimize the capacity of the fixed arrival routes before Interval Management implementation, and validate the capacity benefit of the optimizations.

Short term objective:
Defining the expected capacity for fixed arrival routes at Amsterdam airport.

Midterm/Long term objective:
Capacity increase for fixed arrival routes.

Involved parties:
KLM, AAS, LVNL, Min. IenW

Source:
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C76: Night-time CDAs

Ref. Ext. Programme	-	**TRL**	3				
Project Number	-	**Lifecycle phase**	Feasibility assessment				
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env	
Assignment	-		-	-	✓	✓	
Project Plan	-	**ATM concept**	ATS	ATFCM	ASM		
KDC Board Approval	3-12-2019						
Project Lead	Maarten Tielrooij (To70), Ferdinand Dijkstra (FerWay)	**Status**	Completed				
Sponsor	-	**Research Cluster**	Environmental Sustainability				
Financial Partner	DGLM	**Priority**	Normal				

Introduction:
At night, Schiphol airport is far less busy than during the day. This allows for more room to fly efficient Continuous Descent Approaches (CDA's). However, to do so, the ATCo should have its traffic synchronised in an early stage. By giving the planner a very accurate arrival time. The accuracy of the arrival time can potentially be improved by importing the ETA that is calculated on board by the FMS. With this information the ATCo can synchronise traffic such that CDA's can be flown.

Goal / Expected benefit:
Currently many aircrafts fly unnecessarily inefficient when approaching Schiphol at night. Deployment of continuous approaches at night, will result in:
- Reduction of noise nuisance during nights
- Improved efficiency for airlines

Assignment:
- Develop an implementation concept that enables night-time traffic to fly CDA's based on the FMS data.
- Develop a trial and validation plan for the implementation concept.

Short term objective:
Study the feasibility of synchronizing traffic for CDA's during night operations.

Midterm/Long term objective:
Design and implement operational support by support tools or straightforward procedures. Implement the concept for flying CDA's during night operations. Alternatively, operations can be supported by a tool during approaches at night.

Involved parties:
KLM, AAS, LVNL, Min. IenW

Source:
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C77: Business case - Optimising preferred use of Schiphol runways through flexible ILS maintenance (project OPUS)

Ref. Ext. Programme	-	**TRL**	3			
Project Number	CR-2019-507	**Lifecycle phase**	Feasibility assessment			
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env
Assignment			-	-	✓	✓
Project Plan		**ATM concept**	ATS	ATFCM	ASM	
KDC Board Approval	Sept 2017					
Project Lead	Jaap Heijstek (NLR)	**Status**	Completed			
Sponsor		**Research Cluster**	Airport Capacity			
Financial Partner	DGLM	**Priority**	Normal			

Goal / Expected benefit:
The goal for this activity is to assess the feasibility of additional permanent ILS signal quality monitoring, enabling a more flexible planning of ILS ground inspections at Mainport Schiphol Airport. If this study proves that additional ILS monitoring is technically feasible, this will allow the ground inspections deadlines to be loosened, and hence reducing the risk that ground inspections interfere with operational use of preferred runways.

These inspections are necessary to guarantee the required performance for ILS installations (per ICAO Annex 10). In current practice, they are done periodically using a special measurement vehicle on the runway for several hours and thereby blocking the runway for operational use. Most inspections are performed quarterly, within strict deadlines.
With the increase of traffic this is increasingly conflicting with the preferred use of runways at the airport, especially with the use of the busy primary runways and night preferential runways 06 and 18R. At Mainport Schiphol these preferences are related to noise abatement and optimizing the airport capacity.
It is expected that this activity will demonstrate that additional ILS monitoring is technically feasible and will provide an improved status of the ILS signal quality, allowing the ground inspections deadlines to be loosened, and hence reducing the risk that ground inspections interfere with operational use of preferred runways.
In potential, and subject to follow-up studies, this additional way of ILS monitoring can be used diagnostically, as a trigger for a-periodic ground inspections. As the ILS installations are highly stable and ground inspections seldomly reveal any problems, a large reduction of ground inspections can be achieved.

Background:
The ILS is a safety critical system enabling aircraft to land in adverse weather conditions. In order to guarantee the extremely high ILS performance in terms of accuracy, integrity and continuity, an ILS is designed with multiple layers of performance monitoring, each covering different types of failure modes. As a final check, it is required to periodically measure the ILS Signals-in-Space in the EM far field (at a distances where aircraft receive the ILS signals). This is done by both flight inspections and ground inspections, requiring special measurement vehicles physically present at locations on the runway and in the ILS coverage area in the air.
The rationale for periodical inspections is that the confidence about the ILS signal quality is decreasing with time. Once an inspection is done this confidence is restored. Historically, the ILS inspection deadlines are such that the uncertainty is retained within limits acceptable to LVNL.
Alternatively, if ILS Signals-in-Space quality properties can be monitored in a permanent way, this will provide permanent additional insight in the ILS signal quality, which allows for a reconsideration of the inspections deadlines, leading to an increased sustainability of the Mainport Schiphol (reduced risk of conflicts between inspections and use of preferred runways).
This activity fits in the LVNL Roadmap for Navigation Maintenance Management.

C78: Optimize ground movements in relation to taxiway renovation

Ref. Ext. Programme	-	**TRL**	3							
Project Number	20-RA-021	**Lifecycle phase**	Feasibility assessment							
Customer	KDC Board	**Performance Targets**	S	Ec	Es	Env				
Assignment	-		-	✓	✓	-				
Project Plan	-	**ATM concept**	ATS	ATFCM	ASM					
KDC Board Approval	3-12-2019									
Project Lead	Justin The (MovingDot)	**Status**	Completed							
Sponsor	-	**Research Cluster**	Airport Capacity							
Financial Partner	DGLM	**Priority**	Normal							

Introduction:
Ground movements have increased in recent years. This has also put pressure on execution of taxiway renovation works and modifications. However, renovation works are inevitable in order to maintain a safe, compliant and sufficient quality taxiway system. Recently, renovation of taxiway A8 showed that maintenance often conflicts with operational performance. Following on the runway maintenance strategy, AAS initiated a program for optimization of the taxiway maintenance strategy within a sector wide perspective.

Goal / Expected benefit:
The goal is to define an optimal long term taxiway maintenance strategy in which operational use and capacity, risks and costs have been considered sector wide. Expected benefits are in the area of efficiency of use of the Schiphol taxiway system and maintaining runway capacity during taxiway renovation.

Assignment:
The assignment is to set up a model as means for an optimal long term taxiway maintenance strategy, by conducting a study/simulation of taxiway renovation scenarios under various conditions (e.g. traffic, visibility (good, marginal, poor), runway use and type of maintenance). Thereby analysing:

- Capacity impact
- Aircraft routing alternatives
- Possible benefits of temporary taxi lanes
- Maintenance phasing alternatives
- Technical system configurations (e.g. lighting)
- Safety issues

Midterm objective (two-three years):

- Optimisation of the maintenance strategy for the total Schiphol taxiway system based on model outcomes
- Implement the strategy for each section of the system
- Development of a long term (<15 year) taxiway renovation plan within sector wide criteria as ground movement and runway capacity, safety and costs.

Long term objective (> three years):

- Monitoring, optimisation and adjustment of the model, simulations, maintenance strategy and plan based on advanced insights.

Involved parties:
KLM, AAS, LVNL, Min. IenW

Source:
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