EUROCONTROL

EDEP PROJECT

PROJECT MANAGEMENT PLAN

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DOCUMENT CONTROL

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0.2	26/10/01	D.Smith	Planning Updates
0.3	14/11/01	D.Smith	Revised Budget (340->315)
04.	27/11/01	D.Smith	Updates following official PMP review

Acknowledgements

Name	Location

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EXECUTIVE SUMMARY

The EEC currently advocates a 'one-platform-for-all' policy that forces all ATM related projects to use ESCAPE/EAT as their unique development platform.
The current ERIS platforms (ESCAPE, AVENUE) are ideal for the demonstration, evaluation and validation of mature concepts. However, these platforms have been repeatedly shown to be inadequate for the needs of long-term research and advanced concept definition (difficult to use, costly, lack of flexibility, long delays for change requests). Moreover, there exist a number of in-house projects (INO, ACS) that require such a flexible platform.
The fundamental problem is that a single platform cannot realistically satisfy such a wide spectrum of projects from long-term research to pre-ops. However, in the past, management has been reluctant to allow the development of multiple platforms, due to the risk of duplicated and wasted effort.
The Early Demonstration & Evaluation Platform (e-DEP) attempts to answer this problem. This low-cost, lightweight platform shall offer an ideal environment for research (INO) and advanced concept projects (ACS) which require a flexible, portable, open ATM software platform. However, eDEP shall be built very much from an ERIS perspective (with full ERIS support), ensuring ESCAPE interoperability in the long term.
The driving eDEP philosophy is platform 'right-sizing'. In order to remain flexible and to avoid 'feature creep', eDEP shall only fund the development of broad yet low fidelity ATM functionality. Projects that require high fidelity ATM functionality (e.g. a precise aircraft model) shall be satisfied via the integration of ESCAPE components into eDEP.
The ultimate goal is that eDEP shall bridge the gap between research and large-scale simulation, providing a low-cost environment for initial concept work, yet offering an integration/transition path into the real-time simulator.

1. INTRODUCTION

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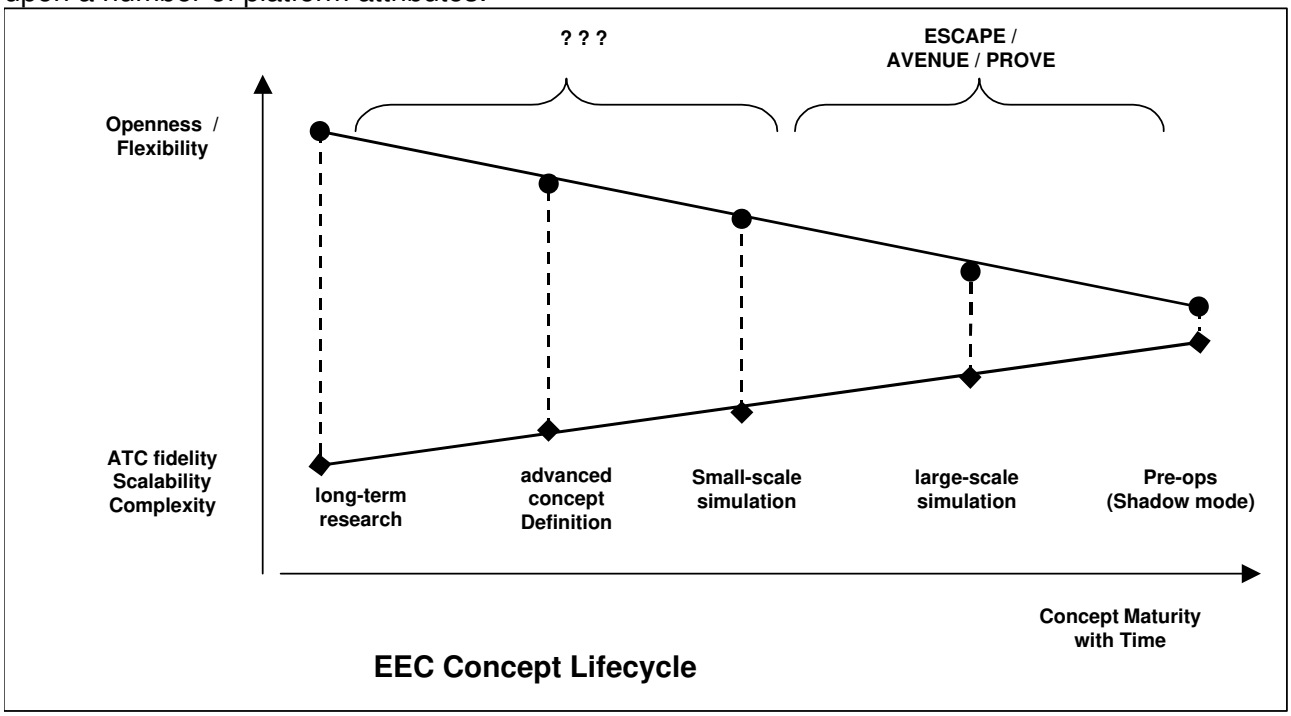
1.1 Context

This document proposes a new project, called "**E-DEP,**" within EEC/INO.

The EEC houses a large number of projects, ranging from long -term research / advanced concept definition through to large-scale simulation / pre-operational trails.
Many of these projects require an ATC simulator environment in order to perform scientific experiments. However, the platform needs of a research project vary greatly to that of a pre -ops project. Key platform attributes include

- flexibility
- scalability
- openness (e.g. ability to test new ideas, new algorithms)
- complexity / size
- functionality
- data richness (real-world ATC fidelity)

The following diagram illustrates the research / experimentation process found within the EEC, presenting a macroscopic vi ew of concept development through time, and the impact upon a number of platform attributes.



EEC Concept Lifecycle

The current ERIS platforms (ESCAPE, AVENUE) are ideal for the demonstration, evaluation and validation of mature concepts. However, these platforms have been repeatedly shown to be inadequate for the needs of long -term research and advanced concept definition (difficult to use, lack of flexibility, long delays for change requests). Moreover, there exist a large number of in-house projects (see below) that require such a flexible platform.
The fundamental problem is that a single platform can never realistically satisfy such a wide spectrum of needs– from long-term research to pre-ops. However, in the past, management

has been reluctant to allow the development of multiple platforms, due to the risk of duplicated and wasted effort.
Within this current context, long -term research and concept projects react in one of several ways – using ESCAPE or avoiding ESCAPE, with the following results,

- *Concept Specification and Big-bang ESCAPE simulation*
  - *poorly defined requirements, incomplete specifications*
  - *difficult ESCAPE software evolutions*
  - *mutual misunderstanding / unsatisfied (external) customers*
- *Concept 'prototyping' using ESCAPE*
  - *Long learning curves*
  - *Long development times*
  - *Long delays for core functionality changes*
  - *Costly small-scale simulations (approx. same cost as large-scale simulations)*
- *Concept development avoiding ESCAPE*
  - *'Hidden' development of quick-and-dirty mini-platforms*
  - *'hidden' duplication of work*
  - *no inter-project co-ordination : hence no software re-use*

Hence, following several years of a 'one-platform-for-all' policy, a number of business areas, including ERIS, recognise the need for a lightweight alternative to ESCAPE.

However, once the decision is taken to build a mini-platform a number of constraints appear. Firstly, this mini-platform should not grow with time into yet another complex ATM system – the principles of 'right-sizing' and controlled software growth must be applied. Secondly, it should integrate into the above macroscopic concept lifecycle, assisting project teams with the transition from laboratory (eDEP) to large-scale simulation (ESCAPE). Hence, this mini-platform should simplify the issues of knowledge transfer (software reuse, requirements capture, design reuse) into the main simulator.

1.2 Objectives

1.2.1 Primary Objectives

The INO Business Area proposes the development of an Early Demonstration and Evaluation Platform (eDEP). This platform shall,

- satisfy the needs of long-term research and concept development projects
  - flexible & iterative development environment
  - allow proof of concept demonstrators to be build quickly and at low cost
  - provide a rich HMI & basic ATC framework
  - provide facilities for limited small-scale experiments
- (medium term) offer a migration path into the main EEC simulator
  - the eDEP architecture shall be AVENUE-like (assists knowledge transfer)
  - the eDEP platform shall be placed in ke y projects (AMAN, CORA2) where future RTS simulations are planned. Hence, valuable lessons may be learnt early on.
  - offer ESCAPE interoperability

1.2.2 Secondary Objectives

Secondary objectives include

- provide Java ATM toolkit facilities to other in-house developments (encourage eDEP software re-use in other projects)
- prove the Java technology for use in real time simulator environment

- integrate eDEP with internet technologies (such as Java Web Start) allowing client projects to have an early web presence (e.g. similar to the eCockpit principle).

1.3 Purpose

The eDEP toolkit is intended as an EEC -wide enabler, allowing projects to develop ATM demonstrators rapidly and at low-cost. This is done through

- extensive software reuse (i.e. framework / toolkit architectures)
- software right-sizing (providing only the necessary level of complexity)

With time, the toolkit may be integrated into the EEC simulation process, allowing advanced concept projects, through early prototyping, to provide ERIS with clear user and software requirements. It is anticipated that such an integrated process shall reduce overall ERIS development costs and mitigate risks.

1.4 Scope

The e-DEP platform should not be seen as a new large-scale development, resulting in yet-another parallel platform. This will not occur because,

- The project has support from all concerned BAMS – from INO and ACS through to ERIS.
- This multi-BAM support will translate into a number of constraints
  - mandatory e-DEP / ESCAPE interoperability with time
  - internal pressure for integration & software re-use & architecture reuse
- The eDEP platform will eventually form an integral part of the lifecycle process which takes concepts from research through to large-scale simulation
- The eDEP platform shall focus principally on the GRD / CWP functionality. A limited amount of effort shall be spent on providing simple prep and piloting HMIs.

The eDEP project is concerned primarily with building the ATM toolkit. It is expected that client projects wishing to use eDEP shall provide the necessary developer effort.

1.5 Project description

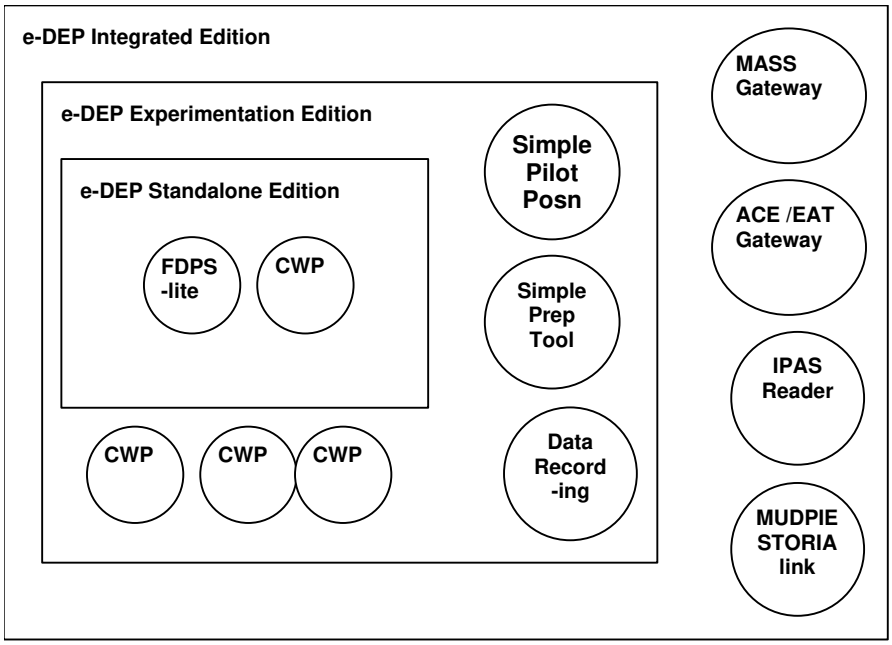
1.5.1 Platform Versions

The e-DEP platform is proposed in a number of incremental versions,

- eDEP Standalone Edition
  - light-weight demonstrator facility
  - ideal for portable PC, PC or web-based demonstrations
  - consists of single CWP and FDPS components
  - already partly developed (80%) – brought as input to the eDEP project
- eDEP Experimentation Edition (2002)
  - build upon the Standalone edition
  - provide distribution support for multiple CWPs (expected average number of positions 5-15)
  - provide an simple preparation tool
  - provide an simple piloting tool
- eDEP Integrated Edition (2003)

- IPAS support
  (the eDEP preparation tool shall read IPAS data)
- MASS Support
  Ability to replace the eDEP Piloting tool with MASS
- ACE/EAT Support
  Ability to plug the eDEP HMI into the GRD subsystem

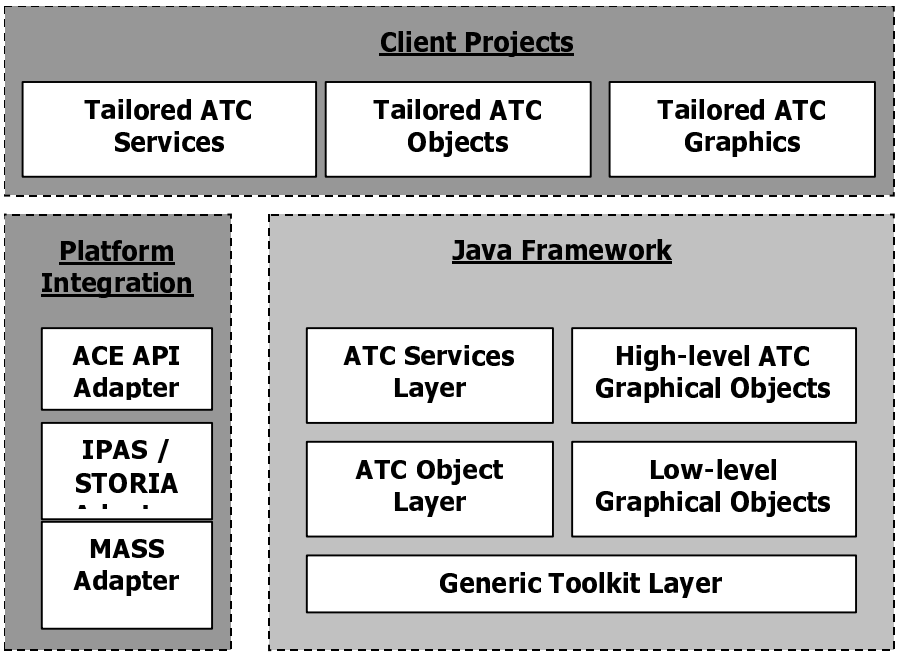
The following diagram illustrates the principle,



It is expected that w ith time, concept / long -term research projects move from the Standalone, to the Experimentation and finally to the Integrated platform versions.

1.5.2 eDEP Architecture

The eDEP platform is built, and shall continue to be built, following solid software engineering principles. In order to manage complexity and encourage software reuse the internal architecture is composed of a number of layers

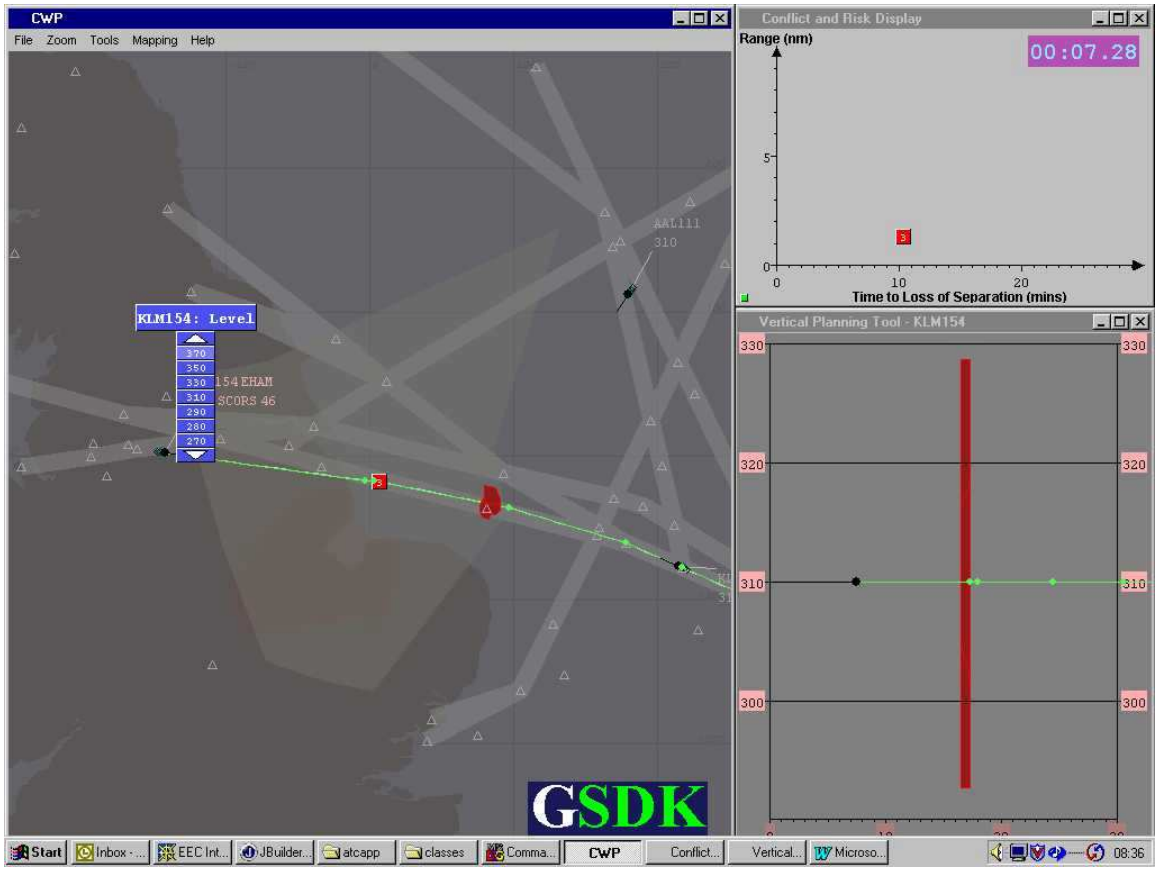


- generic toolkit layer (ATC independent, geographically oriented)
  - Geometry, Projection functions
  - Map management functions
  - Model View Controller framework
  - Rich Graphics Toolkit (transparency management, various widgets)
  - Event management, Service provision management
- ATC Object Model layer
  conceptual ATC objects such as Aircraft, Trajectory, Track, Sid, STAR, Airport, Runway
- ATC Service Layer
  light-weight ATM functional components following an AVENUE/ESCAPE architecture.
  - ASP (Airspace Component)
  - TME (Time Component)
  - ATG (Air Traffic Generator)
  - IFPL (Initial Flight Plan Component)
  - TP (Simple 3D Trajectory Predictor Component)[1]
  - FM (Flight Manager Component)
  - COORD (intra-centre co-ordination Component)
  - MTCD (Medium Term Conflict Detection Component)
  - STCA (Short Term Conflict Alert Component)
  - FPM (Flight Path Monitoring)
  - HIPS Conflict Zone Engine[2]
- ATC HMI (CWP) Layer
  - Low-level Graphical Objects
    - Various Menu mechanisms
    - Various Trajectory Editors, Elastic vector tools
    - Configurable Labels
  - High-level Graphical Objects
    - PVD (Plan View Display)
    - Vertical Profile Window
    - Conflict Risk Display

The following screen shot demonstrates the current capability –

[1] based upon a nominal B737 aircraft performance model

[2] currently disconnected.



1.6 Lifecycle main deliverables & milestones

1.6.1 Graffica Tasking Contract

The Graffica tasking contract, providing the core eDEP functionality has the following delivery schedule,

Due Date (T0 +)	Work Package	Deliverable Description
1.5 months	Standalone Edition (1st Delivery)	Architecture Document Draft Design Document (focusing on FM, COORD, CWP design issues) Draft Test Plan Document (developed in collaboration with the EEC) Initial prototype delivery
3 months	Standalone Edition (2nd Delivery)	Updated Documentation (Architecture, Design, Test, and User manual) Tested Software (GRD and CWP functionality)[3] • full ATC object model • ATC core service s upgrade (COORD, FM) • EATMP CWP
4.5 months	Experimentation Edition (1st Delivery)	Architecture, Design and Test Plan Document draft updates for • AIR focus (HMI + Pilot Manager) • Distribution Support • ATC Tool Services Upgrade (STCA, FPM)
7 months	Experimentation Edition (2nd Delivery)	Document Updates Software (GRD focus) • Distribution Support • ATC tool Services Upgrade (STCA, FPM) Software (AIR focus) • Pilot HMI (PWP) • Initial Pilot Manager logic • CWP upgrade (e.g. Feed / non -feed issues)
10 months	Experimentation Edition (General Availability)	Document Updates Full Software Delivery including • Full Pilot Manager Logic (inc. basic 4D TP) • Performance Issues

1.6.2 EEC based Work

The experimentation centric work (prep, data recording) shall be developed at the EEC. The delivery schedule is as follows,

Due date (T0 + ...)	Work package	Deliverable Description
3 Month	Data Prep Tool (1st iteration)	Initial Software Delivery Draft Design Document
6 Month	Data Prep Tool (2nd iteration)	Finished Software product (with `javadoc` comments) Design & User Documentation
8 Month	Data Recording Framework	Software (with javadoc comments) eDEP Design document update
11 Month	Replay Application	Software (with javadoc comments) eDEP Design Document update eDEP Test Plan Document update

[3] AIR behaviour is simulated through FM (i.e. aircraft immediately flies controller entered orders)

1.6.3 Overall Deliverable Viewpoint

The EEC and Graffica work is consolidated into a single delivery stream,

- Baseline Standalone Edition (eDEP v1.0)
  stable and documented toolkit sufficient for the development of ATM demonstrators
  Focus on core FDPS functionality (FM / COORD) and EATMP-like CWPs
- Experimentation Edition (eDEP v2.0*)
  - v2.0a – prep tool
  - v2.0b – v2.0a + piloting HMI v1
  - v2.0c – v2.0b + final pilot HMI + data recording framework
  - v2.0 GA – v2.0c + replay facility + simple analysis tool
- Integrated Edition (eDEPv3.0)
  ACE/ESCAPE, MASS, IPAS connectivity

Deliverable	Date
Baseline Standalone Edition (eDEPv1.0)	end March 2002
eDEPv2.0a	June 2002
eDEPv2.0b	end July 2002
eDEPv2.0c	end Sept 2002
eDEPv2.0 General Availability (GA)	Dec 2002
Integrated Edition (eDEP3.0)	Q2 2003

1.7 Stakeholders

The eDEP project has the support of all relevant Business Areas,

- ERIS Business Area
  ERIS management supports the activity, recognising that certain advanced projects such as CORA2 require a prototyping phase before reaching large-scale simulation.
  EDEP is complementary to ESCAPE, reducing the risks of poor user/software requirements capture.
  The MASS team would like to re-use the Pilot HMI for MASS testing
- ACS Business Area
  ACS wishes to deploy the eDEP platform within the CORA2 and AMAN projects.
  Equally, the Human Factors Lab intends to use eDEP in 2002-2003.
  The eCockpit project may reuse parts of eDEP in 2002.
- INO Business Area
  The Sectorless project assumes the presence of the eDEP platform
- PFE Business Area
  The FAM project has shown initial interest in the eDEP platform.
- CNS Business Area (TALIS project)
- SFM CoE
- OPS

1.8 Opportunities

As outlined in the secondary objectives, there is an opportunity for promoting real software reuse in the EEC.

1.9 Funding and finance

1.9.1 2001 Effort

This effort is already financed in the context of SCS funding (Open CWP).

1.9.2 2002 Effort

The project cost has been estimated with required resources, both from internal EEC staff and from external support. The project requires a financing of **315** K € for external effort. The required internal effort to perform the work reaches an equivalent amount of **70** K€.

	Cost (K€)		**Work** (weeks)		Equipment	**Total K€**
	Internal	External	Internal	External		
Internal Staff	70 K€		42			70 K€
Operating		105 K€		38		105 K€
Investments		210 K€		72 (Tasking)		210 K€
Total	**70 K€**	**315 K€**			**0 K€**	**385K€**

The EEC mission cost is expected to be 3 K€ (3 missions to Malvern).

The Graffica tasking contract (210K€) is broken down as follows

Resource	**Rate (€)**	**Real Effort 2002**	**Carry Over from 2001 contracts**	**2002 Budget Effort**	**Cost (K€)**
Mike Vere	600	197days	36 days[4]	**161 days**	96.6 -> 97
Rob Aynsworth	550	74 days	4 days	**70 days**	38.5
James Gamble	550	134 days	4 days	**130 days**	71.5
Missions (3)	1000				3
Total				**361 days**	**210**

The EEC Contractor resource (Sophie Carlier) has an expected start date of 05/0 1/01, at a 500€/day rate.

1.9.3 2003 Effort

For the moment it is difficult to predict future effort requirements.

[4] at 570 K rate

The core development shall be complete and consolidated in 2002.

Hence, the effort in 2003 shall be linked to

- existing client projects such as Sectorless
  (support and evolutionary maintenance)
- new clients (within the scope of prototyping activities or toolkit reuse)
- ERIS (IPAS, ACE, MASS) connectivity

Current estimates assume funding until August 2003 in order to complete quantifiable tasks (Sectorless support, and ERIS connectivity).

	Cost (K€)		**Work** (weeks)		Equipment	**Total K€**
	Internal	External	Internal	External		
Internal Staff	70 K€		42			70 K€
Operating		60 K€		24		60 K€
Investments		72 K€		24 (Tasking)		72 K€
Total	**70 K€**	**132 K€**			**0 K€**	**202K€**

1.10 Document structure and evolution

1.10.1 Document organisation

Standard Organisation.

1.10.2 Evolution of the document and change control

The PMP shall evolve as required.

1.11 Applicable documents and standards

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1.12 Definitions, abbreviations and acronyms

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2. PROJECT ORGANISATION

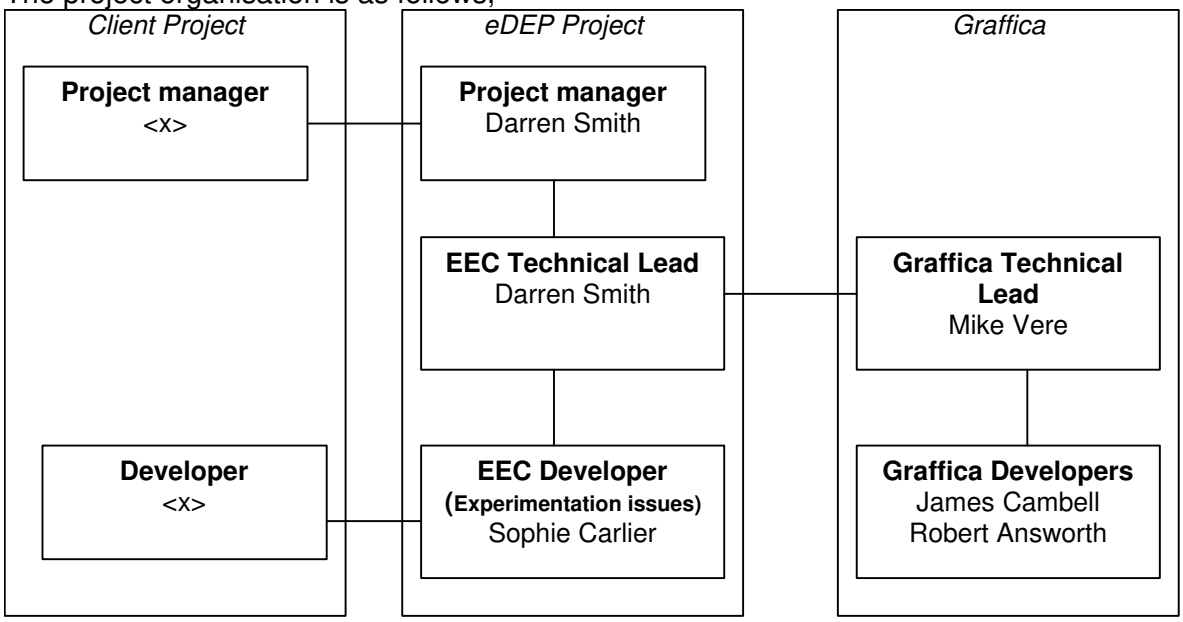
2.1 General (RACI)

The core toolkit software development shall be subcontracted to Graffica Ltd. However, the EEC shall actively participate and have ultimate control over the toolkit design process. Developments that are closely linked to the use of the toolkit within an 'experimentation' context shall be performed at the EEC (e.g. preparation / analysis issues, ESCAPE integration).

2.2 Organisational Structure of the Project

2.2.1 Project Internal Organisation

The project organisation is as follows,



2.2.2 Roles and Responsibilities

Activity	D. Smith	S. Carlier	Graffica	Client Project
Core Toolkit Design	A / C	C	C / R	I
EEC Experimentation / Integration Issues	A / C	R / C	I	I
Support / Training / Bug Fix	A / I	R	R	C
Client Project Development s (see following note)	I	I	-	A / R

Legend : (A)ccountable, (C)onsulted, I(nformed), (R)esponsible
Note : Client projects are expected to behave in a particular fashion. See section 4.3.3.

2.2.3 Organisation of Associated Parties

Not Applicable.

2.2.4 External Contracts

The eDEP platform is being jointly developed between the EEC and Graffica Ltd.
Graffica Ltd is a small company, associated to QinetiQ, consisting of seasoned contractors having extensive ATC experience (PD1, PD3, real operational systems). Over the past 2-3 years, in the context of various ATC/military contracts, Graffica has developed a flexible java-based toolkit (named GSDK).
This GSDK toolkit forms the heart of the eDEP platform (which explains why only 5 man months of effort was required to achieve the current platform functionality).
Based on previous COTS experience, the EEC placed importance on the issues of licence cost (runtime and development) and vendor lock-in. Hence, the EEC and Graffica negotiated a Bretigny-wide source code licence. Thus the EEC is free to extend / modify the toolkit (avoiding vendor lock-in) and deploy the runtime free of charge.
Graffica intends to further market the GSDK toolkit within other projects / markets. This is actively supported by the EEC, since it guarantees high motivation (i.e. Graffica is not just another body-shoppping contractor company).

2.2.5 Lifecycle

Developing successful open toolkit frameworks that gain developer/community acceptance is a non-trivial activity. Following the example of other toolkits and current IT industry trends (e.g. Java Community Process) the eDEP toolkit is being developed as follows,

- Iterative development process
  following a development iteration the resulting design is reviewed, and if necessary corrected in the following iteration. This process recognises that successful toolkits are never built top-down, but rather evolve over time in a hybrid top-down/bottom-up fashion.
- Early toolkit deployment in various EEC projects
  the toolkit is currently being used by 3 EEC projects. The relevant developers shall provide feedback on the platform's usability

3. MANAGERIAL ASPECTS

3.1 Assumptions, dependencies and constraints

The following projects expect to use eDEP in 2002

- Sectorless (INO)
  - development using eDEP from Q1 2002 (until end 2004)
  - first experimentation Q3 2002
- CORA2 (ACS)
  - development using eDEP from March 2002 (through until April 2003)
  - first experiment Q3 2002
- AMAN
  - simple HMI demonstrator Q1 2002

Hence, the main deliverables are timed to fit these client constraints

It is assumed that the INO Business Area shall re-deploy the necessary equipment to the project (PCs and Flat screens).

3.2 Project reporting

Project reporting shall be monthly.

3.3 Managing and control mechanisms

Graffica / EEC shall have weekly progress conference calls, complimented by missions every 8 weeks.
Graffica shall provide monthly progress reports.

3.4 Contract management

The majority of the eDEP platform development shall be subcontracted to Graffica Ltd. However, the EEC (Darren Smith) shall actively participate in the iterative toolkit design process.
Namely, for each development task the process is as follows,

- initial Graffica / EEC discussion on the exact nature of the task (e.g. deviations from original software development plan)
- Graffica conducts the initial design work (UML model, major interfaces / classes)
- Joint Graffica / EEC design review
- Graffica conducts the implementation phase
- Joint Graffica / EEC code review

The TRS is supported by a 45 page technical annex and various EUROCONTROL documents (MASS HMI Specification, EATMP Generic HMI Specification, ESCAPE FM SRD..) which define the eDEP software requirements.

3.5 Procurement

Not Applicable.

3.6 Risk Management Data Base

A Risk management plan shall be maintained.
The main risks are as follows,

Risk Description	Impact	Prob.	Mitigation Strategy
Dependency on the Graffica company	High	Very Low	The EEC already has a source -code licence for the Graffica toolkit, which allows for EEC on -site maintenance. This licence agreement shall be extended to permit 3rd party off -site maintenance. The EEC shall direct the eDEP design process and part of the development work shall be done at the EEC with non -Graffica contractors.
Maintenance Problems	Medium	Low	The EEC shall maintain design and implementation knowledge. Good engineering practices shall be applied – UML design process, documentation, coding standards, test plans The EEC shall begin d iscussions with QinetiQ (Graffica's contract partner) concerning eDEP maintenance
Technical Risks	Medium	Low	Many of the technical / architecture issues were resolved in 2001.

3.7 Human resources management

The EEC has ensured that Graffica has well experienced developers (including operational system experience).

3.8 Stakeholder sign-off

Software deliveries shall be only be accepted by the project manager, following

- Execution of the Test Plan at the EEC site
- Analysis of software code (coding style, comments, coherence with design documents)
- Analysis of associated documentation (Architecture, Design, User and Test Plan documents)

3.9 Project close out

This is currently an issue. The eDEP project is product oriented, which implies that its continued existence in 2003 onwards depends on client project use.

Hence, the project shall focus in 2002 on consolidating the basic platform, providing important input into 2003, where upon the current PMP shall be revised.

4. TECHNICAL ASPECTS

4.1 Methods, tools and techniques

The eDEP project shall use the following tools–

- JBuilder 5 – java software development tool
- Junit – software unit testing environment
- Graffica-chosen UML Modelling tool

The software shall be designed / developed / reviewed following an iterative approach. This reflects the current industry trends with respect to open framework developments.

4.2 Documentation

The eDEP software shall contain full `javadoc` comments.
The following documents shall be produced,

- *Architecture Document*
  - high-level document considering ATC components as black-boxes
  - ATC component context diagrams (data flows)
  - ATC Component interfaces
  - Important UML sequence diagrams (FPL creation, Controller orders, significant events)
- *Toolkit Design Document*
  - medium-level document outlining the major design centres (e.g. GSDK layer, ATC object layer, ATC Services layer, ATC HMI Layers)
  - internal component design issues
    - component design patterns (UML),
    - threading issues / component dynamics
    - distribution considerations
  - this document should be at a higher level compared to the HTML javadoc documentation.
- *Developer's User Guide*
  - step-by-step tutorials on how to build ATC and HMI components.
  - administration issues – installation, configuration, launching
- *Comprehensive HMTL javadoc documentation*
- *Test Plan Procedure Documentation (with EEC participation)*

4.3 Project support functions

4.3.1 Data management

Remedy shall be used for software problem reporting.
That is, both eDEP (EEC & Graffica) and client project developers shall submit and monitor Problem Reports (PRs) via Remedy.

4.3.2 Configuration management

The eDEP project (EEC & Graffica) shall use a software configuration tool.
The EEC shall use the centre standard tool, Continuus.
Graffica shall use the popular tool CVS.

4.3.3 Additional procedures for the conduct of work

The eDEP project shall build an open ATC toolkit, and not a 'finished' software product. Hence, the interface between eDEP and its client projects needs careful definition. This is especially true when client projects are confronted with a deficiency (missing or inappropriate functionality) in the eDEP toolkit. Who should correct this deficiency and under what conditions?

The following table attempts to define the client -eDEP working relationship in relation to the eDEP architecture,

Architecture Layer	Software Upgrade Type	
	Correction / Modification	New Code
High Level ATC HMI Layer	eDEP / Client	eDEP / Client
Low-level ATC HMI Layer	eDEP Preferred	eDEP / Client
ATC Service Layer	eDEP / Client[5]	eDEP/ Client
ATC Object Layer	eDEP Only	eDEP Preferred / Client
Generic Toolkit (GSDK)	eDEP Only	eDEP Only

5. WORK PACKAGES AND SCHEDULE

5.1 Project work breakdown structure

This section documents the technical content of the pr oject, based on the project work breakdown into Work Packages.
The project consists of 4 work packages:

- WP1 – Management and Design Overview
- WP2 – Standard Edition Development
- WP3 – Experimentation Edition Development
- WP4 – Integrated Edition Development

The 4th Work package is considered optional. That is, following the 2002 development work, and the effective use of eDEP, a decision shall be taken concerning the need for WP4.

5.2 WP 1 : Management and Design Overview

The majority of the eDEP platform development shall be subcontracted to Graffica Ltd. However, the EEC (Darren Smith) s hall actively participate in the iterative toolkit design process.

[5] Client allowed - assuming that only the service implementation changes (and not the interface)

5.3 WP 2 : Standalone Edition Developments

The eDEP project shall commence building upon previous 2001 EEC/Graffica work, which constitutes approximately 80% of the intended Standalone Edition.
The main 2002 tasks include,

- *EATMP-like CWP*
  the current eDEP CWP application shall be upgraded to be partially EATMP compliant. Areas of work include
  - EATMP Compliant ACC Labels
  - Addition of EATMP Co-ordination windows (Sector Inbound List, Message In/Out windows)
  - Initial PVD Toolbox functionality
  - EATMP-like popup menus
- *ATM improvements*
  - ATC Entity Model upgrade
    addition of Route, Route Segment, Letters of Agreement, Airport, Runway entity objects
  - *Flight Manager upgrades*
    - improved Constraint list management
    - COORDination considerations (XFL influence of GRD trajectory – following ESCAPE FM AR40 model)
  - *COORDination server upgrade*
    upgrade of current co-ordination server to support the EATMP HMI. Work includes,
    - improved state machine (closer to OLDI)
    - enriched co-ordination data calculation (COP, XFL, 4d boundary point)
    - manual controller intervention (FORCE ACT, TRANSFER/RELEASE/ASSUME)
    - automatic mode for unmanned sectors
- *Graphics Subsystem improvements*

This work package is allocated to Graffica Ltd.

5.4 WP3 : Experimentation Edition Developments

This work package shall build upon the Standalone Edition.
Due to client constraints, this experimentation edition shall be delivered in incremental phases (see section 1.6 for more information)
Tasks include,

- *Simple AIR subsystem (Graffica)*
  - Pilot Manager
    Basic Piloting functionality with some initial support for combined / delayed orders (see MASS specification for more information)
  - Pilot HMI
    Basic HMI following the MASS PWP specification
- *FDPS work (Graffica)*
  - ATC Services Improvements (STCA, FPM)
  - Performance Issues (Screen Size, Traffic Size, Number of CWPs)
- *Simple Preparation tool (EEC)*
- *HMI Improvements (Graffica)*
  - Anti-overlap
- *Distribution (Graffica)*
  - RMI work
  - Synchronisation Issues
- *Analysis / Data Recording needs (EEC)*
  - Data Recording Framework

- Replay Facility
- Simple Analysis tool

The EEC (Darren Smith) shall lead this work package, with the tasks being shared by both the EEC and Graffica.

5.4.1 Air Subsystem sub work package

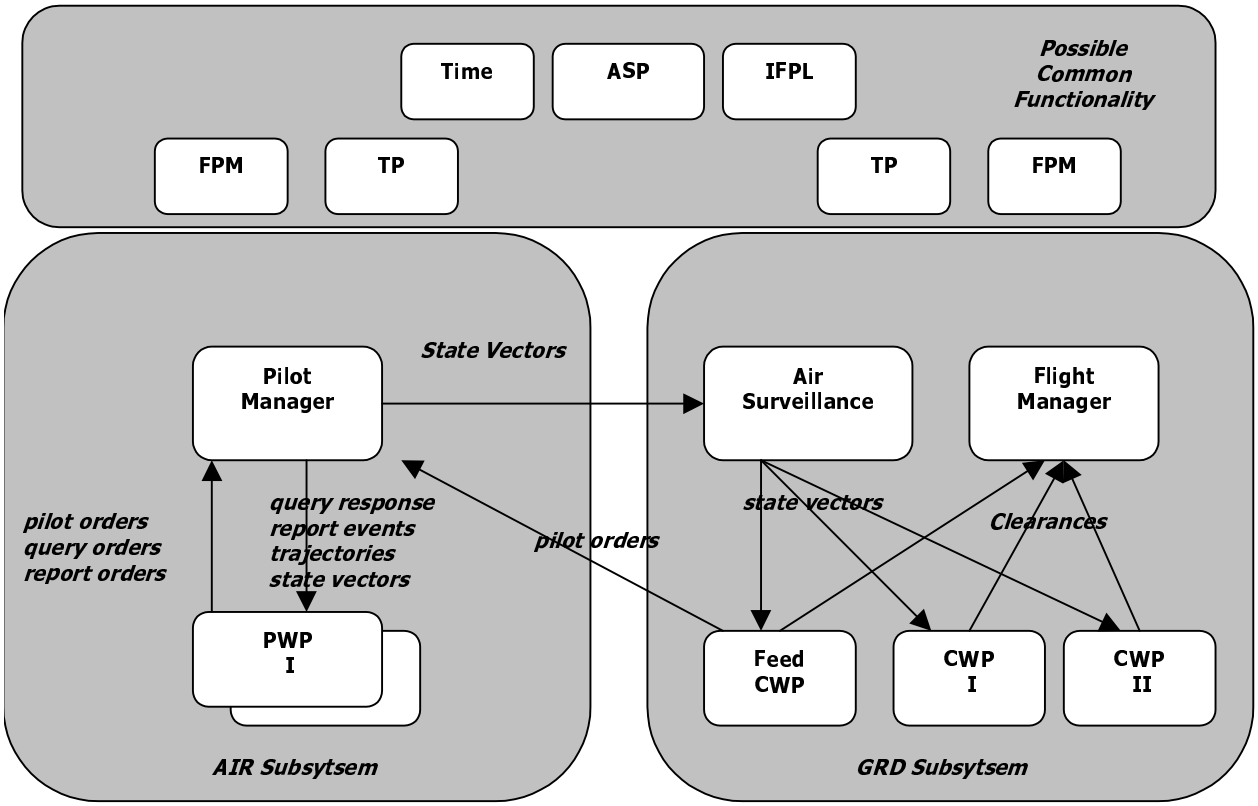
5.4.1.1 Objective

The overall architecture is expected to be as follows,

- *Common Functionality*
  the AIR and GRD subsystems may share common eDEP functionality[6] where possible.
- *AIR subsystem*
  - *Pilot Working Position (PWP)*
    Graphical Piloting HMI containing limited (or even no) ATM logic
  - *Pilot Manager*
    the pilot manager shall contain all the AIR-side ATM logic. This includes
    - navigating aircraft & state vector generation
    - pilot order processing & aircraft trajectory management
    - query processing (e.g. simple data access)
    - asynchronous report processing (e.g. inform pilot posn 3 when a/c XXX reaches FL 200)
    - maintaining the aircraft->pilot position mapping (with the necessary transfer logic)
- *GRD Subsystem*
  - *Flight Manager (FM)*
    processes CWP generated orders/clearances. Maintains GRD trajectories
  - *Integrated Air Surveillance (IAS)*
    generates the 'radar' a/c state vectors from the air-provided state vectors
  - Controller Working Positions (CWP)
    measured CWP positions, connected to the Flight Manager
  - *Feed CWP*
    hybrid non-measured CWP positions which act as both pilot and controller working positions

The following diagram summaries the expected architecture

[6] Sharing component functionality does not necessarily imply sharing component *instances* at runtime.



In terms of pilot orders the following MASS subset is expected

Category	Flight Order	Implement
Navigation Start Orders	Start Nav, Delay Nav, Modify Initial FL, Modify SID	No
Report Orders	Report Passing Level	**Yes**
	Report <Time> / <Dist> before beacon	**Yes**
Query Orders	Query posn, time at beacon, time at level	Time permitting
Speed Control Orders	Change Speed, Maintain Speed	**Yes**
Level Control Orders	Change Level , Maintain Level	**Yes**
	Reach Level	**Yes**
	Change Climb / Descent Rate	Time permitting
Direction Control Orders	Resume Normal Navigation Change Heading Maintain Heading Turn Order Direct To	**Yes**
	Intercept Localiser	No
Hold and Orbit Orders	Hold, Orbit, Cancel Hold	No
Time Constraint Orders	Reach Waypoint	No
Flight Plan Modification	Offset Rejoin Route Modify STAR New Route Go -Around	No
Avionics Orders	Set SSR Transponder, Squawk Ident	No
Flight Supervision	Transfer Flight, Kill Flight	**Yes**
Data Link ACL		No
ASAS Orders		No

5.4.1.2 Major Design Risks

The following issues have been identified by the EEC and should be addressed in the overall design –

- *Richness of Pilot Order Object Model*
  The MASS system supports a wide variety of pilot orders which can be combined in a number of ways (e.g. change [level] and heading) . Equally, Pilot Orders may be delayed or constrained (e.g. reach [level] at beacon [ref point]).
  Even though the eDEP AIR subsystem shall not implement all these pilot order combinations, the overall design shall support the notion of combined, constrained/delayed orders. Equally, a small subset of these combined/delayed orders shall be implemented.
- *Relationship between Pilot Order Object Model and Trajectory Constraints*
  The issue of mapping pilot orders (possibly composite and delayed) to trajectory constraints requires careful consideration.
- *Open ended orders (Heading)*
  The Pilot Manager will eventually need to support open-ended orders (e.g. heading orders). This will become especially true if weather conditions shall be simulated within the AIR subsystem[7]
- *Improved TP functionality*
  It is assumed that the current 3D TP will need to be upgraded. We need to determine to what extent
  - *4d constraints (time, rate of climb, rate of turn)*
  - *constraint application : before / after point*
- *Pilot HMI*
  The HMI should be designed (especially the order and data input windows) with extensibility in mind. That is, once the HMI framework is in place, it should be easy to add new order types.
- *Feed CWP*
  In simple demonstrations (e.g. internet) the Piloting HMI positions would not be used. Hence, a flexible mechanism is required which allows the PilotManager to be driven via CWP clearances

5.4.1.3 Deliverables

The following iterations are expected (see schedule for dates),

- 1st iteration –
  - major design work (demonstrating the feasibility of delayed and composite orders)
  - Pilot Manager - basic order functionality
  - Pilot HMI – initial HMI (EEC)
  - RMI support
- 2nd iteration
  - TP improvements for speed related orders
  - limited composite pilot order support
  - limited delayed order support
  - other pilot orders ('High' priority work) such as Reporting

5.4.2 FDPS Improvements Sub Work Package

A number of FDPS components require minor upgrades. This includes STCA and FPM. Equally, the eDEP platform (and in particular the FPDS) shall be analysed and improved for the following performance criteria,

[7] An aircraft on-plan will follow a fixed track to next waypoint (i.e. track not affected by wind). However, an a/c following a heading order will be affected by wind (i.e. track will be affected by wind).

- screen size – eDEP clients intend to use 2k screens
- traffic sample size (number of active aircraft)
- number of controller working positions

5.4.3 Preparation Tool Sub Work Package

5.4.3.1 Objectives

The eDEP platform requires a simple preparation tool that allows static and traffic data to be loaded, modified and saved. Such a tool shall be intuitive and efficient to use offering the following

- Geographical view – PVD-style view of airspace and traffic
- Vertical profile view – for viewing trajectory profiles
- tabular views – for viewing data in tabular format

Within the geographical view we shall find,

- Static data layer
  - Map layer – filled or outline map data
  - Sector layer
  - Point layer (beacons, fixes, airport / runway points)
  - Route Layer (SID, STAR, route)
- Traffic layer (aircraft trajectories)

5.4.3.2 Deliverables

Given the richness of the ATM data and its strong interdependence (e.g. moving a beacon point implies that all dependent routes and flights are equally moved?), such a preparation tool can become rapidly very complex.
This is especially true when flights are represented not as simple 3d trajectories, but rather as realistic Initial Flight Plans (IFPLs). That is, a sequence of 2d route segments with indirect application of Letters of Agreement (for the dynamic calculation of the 3rd dimension – flight levels).
Hence, the software shall be developed in iterations

- 1st iteration (mandatory)
  - core HMI development
  - flights represented as a sequence of 3d points
  - basic efficiency enhancing tools for traffic definition
    - some copy/paste functionality (e.g. copying flights)
    - Concept of flight templates
      i.e. ability to define a template flight, which can be instantiated a number of times with some random factor (e.g. start time).
      Updates to the template flight (e.g. profile change) are then carried into all flight instances
- 2nd iteration (mandatory – although exact nature of work shall be re-evaluated)
  - flights represented as 3d points or as realistic Initial Flight Plans – 2d route segments with LoA application
  - dynamic part to tool (running the eDEP platform within the prep tool)
    - route expansion / strategic constraints / trajectory calculation from IFPL
    - conflict calculation (with ability to dynamically change flight start times in order to generate conflicts)
    - CWP visualisation
- 3rd iteration (work to be performed by the EEC in WP4)
  - Refactoring of the Entity Load/Save functionality into a Data Source plug-in framework
  - Development of an EEC IPAS Data Source plug-in

5.4.4 Distribution Sub work package

This sub-work package focuses on distributing the eDEP components via RMI into a number of independent processes (running on different machines). These include,

- Simulation Engine process – contains all FDPS & Pilot Manager components
- CWPs – running on separate machines
- PWPs – running on separate machines

This work package shall perform the minimum amount of work required. Namely this includes,

- build the above mentioned application processes
- provide a control panel window (start timer, freeze timer, stop)
- resolve any synchronisation issues introduced by RMI

5.4.5 Analysis / Data Recording Sub work package

5.4.5.1 Objectives

The eDEP platform shall include a general data -recording framework that provides access points to key areas of the system such as,

- Entity Model updates
- inter component communication
- HMI View interactions

This framework shall then be employed to implement the following eDEP applications,

- recording / replay facility
  the ability to replay a given experiment, seeing the CWP orders entered over time
- recording / analysis facility
  A simple analysis tool shall be developed

5.4.5.2 Deliverables

The software shall be delivered in two parts,

- General data recording framework
- Application layer (playback and analysis tools)

5.5 WP4 : Integrated Edition Developments

This work package concentrates on integrating eDEP with main simulator functionality (i.e. ACE or ESCAPE).
This work package is currently optional, dependent on the effect ive use of eDEP by client projects.
Potential tasks, based on client demand include,

- IPAS Integration
  the reuse of IPAS generated data (static and traffic) either directly within the runtime platform or via the eDEP preparation tool.
- MASS Integration
  integration of real MASS pilot positions. This may equally correspond to the use of GAME as the GRD Aircraft Model[8]
- ESCAPE/ACE Integration
  the possible integration of simulator components into eDEP
  the possible integration of eDEP HMI into ESCAPE
- Analysis tool integration (e.g. MUDPIE / STORIA)
- full EATMP oriented HMI components (TDB : based on ERIS funding)

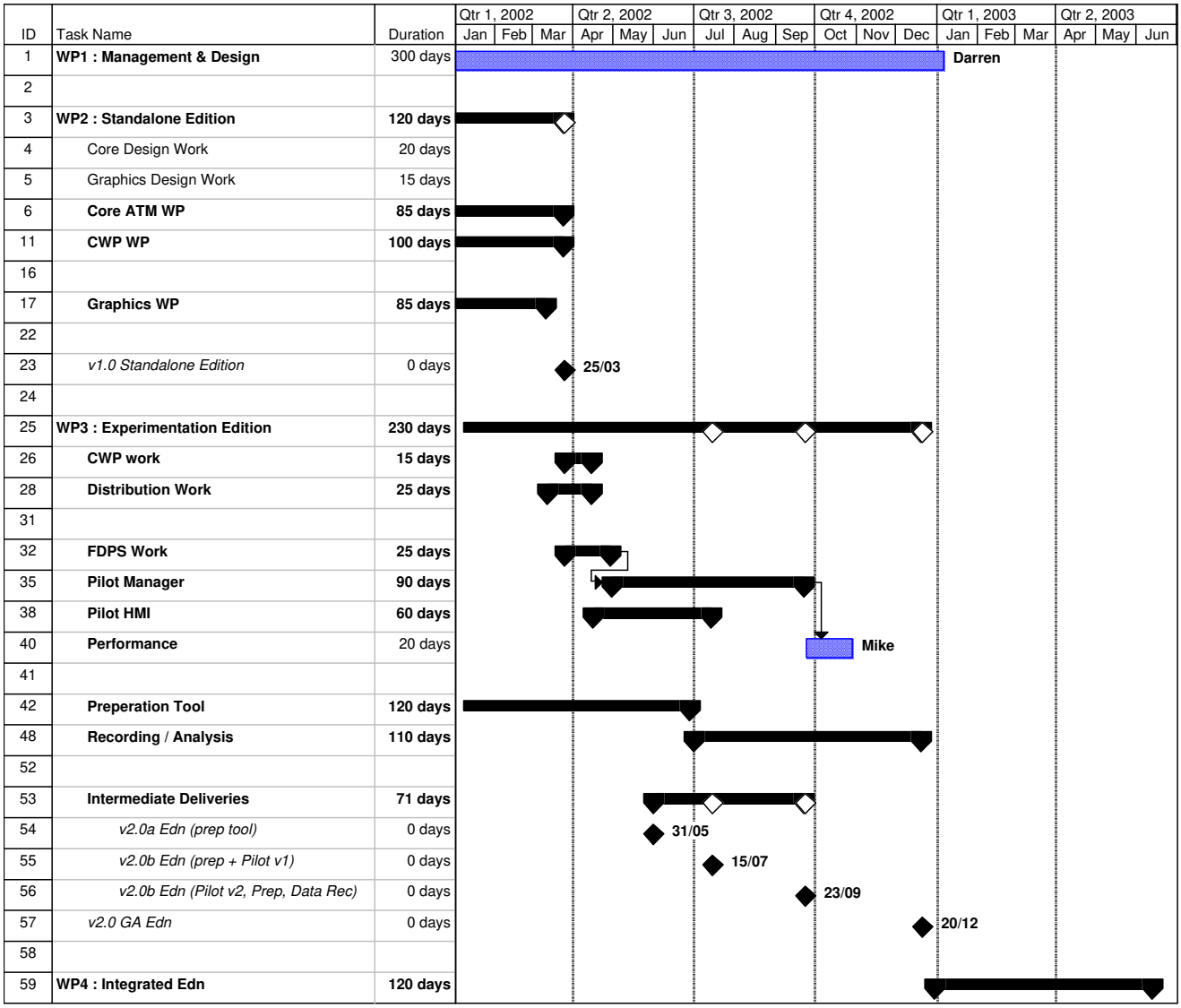
[8] This needs further evaluation – MASS is moving to GAME in Q3-Q4 2002

The EEC shall lead this work package with support effort supplied by Graffica.

Note : there is the potential in late 2002, early 2003 to incorporate the UML process work done by Patrice Boulle and Michel Geissel (CORE). This work uses XML/UML to provide tracability from user requirements, software requirements through to software packages. This type of work is of interest to prototyping – i.e. the ability to clearly define what the prototype does and why. This type of information is needed if prototypes are then carried over into real-time simulations.

5.6 Schedule

The summary schedule is as follows,



6. REFERENCES

Document Name	Reference
Decision Register	
Risk Management Plan	
Detailed Project Plan	(Start Typing Here.)
EATMP Generic HMI Specification (Version 1.0 – 10/03/2000)	
EATMP OLDI Specification v2.3 http://www.eurocontrol.int/projects/eatchip/odt/documents/standards/oldi_e23.zip	
MASS v9.0 HMI Specification	
ESCAPE FM SRD EAT2002A (30 Aug 2001)	