HPCN TTN  CAPRICE

Public Final Report of

ESPRIT HPCN PST

REDISE

Remote and **Di**stributed **S**oftware **E**ngineering

October 31, 1999

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Acronyms

ARINC	Aeronautical Radio Inc. (standard serial data bus used in aircrafts)
CASE	Computer Aided Software Engineering
CSCW	Computer Supported Collaborative Working
CPU	Central Processing Unit
DLR	Deutsches Zentrum für Luft- und Raumfahrt e.V.
EFIS	Electronic Flight Instrument System
GPS	Global Positioning System
HPN	High Performance Networking
IRQ	Interrupt ReQuest
MBONE	Multicast Backbone (a collection of tools for tele communication)
MS	Microsoft
PC	Personal Computer
REDISE	Remote and Distributed Software Engineering
RUS	Rechenzentrum der Universität Stuttgart
SME	Small or Medium sized Enterprise

REDISE - Esprit 25992

Remote and **Di**stributed **S**oftware **E**ngineering

Abstract

Keywords:
software engineering, CSCW, computer supported collaborative working, net conferencing, CASE, computer aided software engineering

The development and maintenance of large software systems is increasingly performed by distributed teams. These software development and maintenance activities require the utilisation of an integrated common software development environment based on different software engineering tools and methods. This distributed software engineering approach has to cope with two main problems, the availability of the software engineering environment in each work group involved and high travel expenses and effort.

In this context, the demonstration action on remote and distributed software engineering has proved, that the integration of high performance networking technology into the software development process compared with the effort for a locally distributed software development not only significantly reduces the amount of travel but also allows sharing of resources and expertise.

Project Partners

1 Synopsis

In all industrial domains software and software applications play an important role. The demand for software development will increase tremendously. For software applications in industry, the main focus will be set on safety and quality aspects as well as on real time applications.

Most of the software is nowadays produced in small or medium sized enterprises (SME). New development of complex software requires the usage of expensive computer aided software engineering (CASE) tools, e.g. static and dynamic source code analysis tools and well-trained experts for using the tools. To stay competitive SMEs have to invest into tools and training for experts. Co-operation and remote and distributed engineering, are means for SME to survive in the fast evolving market of global competition. Partners for co-operation are for example research centres with their infrastructure and their experts. However, for efficient work traditional methods like exchanging papers or storage media will not meet the demands of today. Communication over high performance networks (HPN) is an adequate mean to handle big amounts of data and to solve problems without unacceptable duration for data transfer or response of launched processes.

The application of HPN enables the software developer to dispose of the computer aided software engineering tools and infrastructure of research centres and also to communicate and co-operate with their experts. The objective of REDISE is to demonstrate that the utilisation of high performance networking (HPN) infrastructure and technology

- provides the required quality of service to enable and speedup the collaborative engineering of complex software systems in distributed teams,
- allows to share expensive software engineering tools and corresponding expertise based on a distributed software engineering infrastructure,
- allows to exchange and share expertise and
- significantly reduces the needs for travel the effort in time and budget,

thus improving the software quality.

In REDISE the collaborative software engineering is realised by using a net conferencing system. The net conferencing system allows the communication by video, audio, shared whiteboard and shared text editor as well as the usage of shared applications. Using HPN infrastructure together with the communication and collaboration middleware, 50 % savings in software engineering infrastructure investments, 60 % savings in travel time and budget and 30 % savings in consulting and training are envisaged as being realistic.

The project involved a technology provider, DLR, an HPN expert, RUS and an end-user, Aerodata.
The project has been supervised by the Co-ordinating organisation:

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2 Executive Summary

2.1 Overview

For SMEs specialised in system and software developments, the importance of computer aided software engineering (CASE) tools will increase considerably in the future. The main focus will be set to quality aspects especially in real time applications. The quality aspects are in general reliability, maintainability, safety and portability. To meet the required quality level software is developed according to international standards or standards given by the customer.

In the software development process it is mandatory to use CASE tools to assure the quality level and work cost-effective. Depending on the current project phase of the software development, the correction of errors may effort a lot of time and money. Figure 2.1 shows the project phases and relations between them.

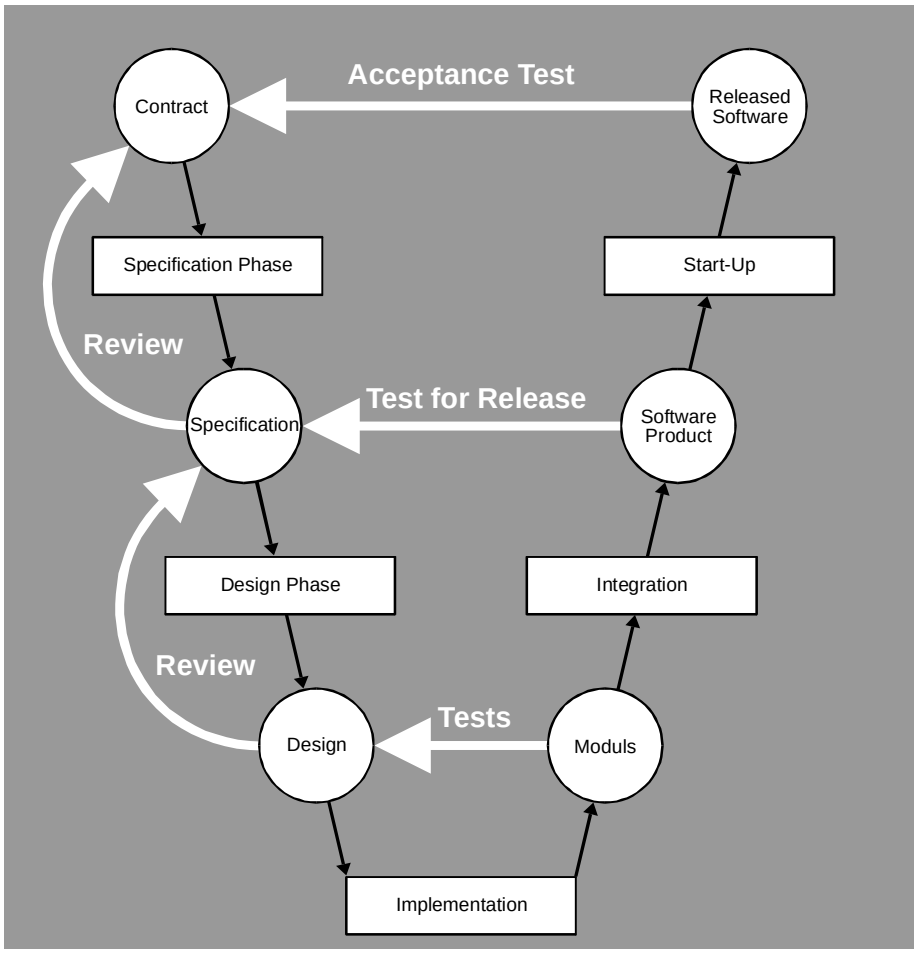


Figure 2.1: Phase Model of Software Development

In early phases like specification and design only paper work will be done and thus the costs of corrections are moderate. Errors made during the implementation phase may cause higher costs, depending from the phase in which they will be detected. If an error is detected in the fully integrated system after delivering to the customer, then costs for repairs of the system (including costs for travel) increase considerably.

Figure 2.2 shows the exponential increase of error correction measurements according to the development phase.

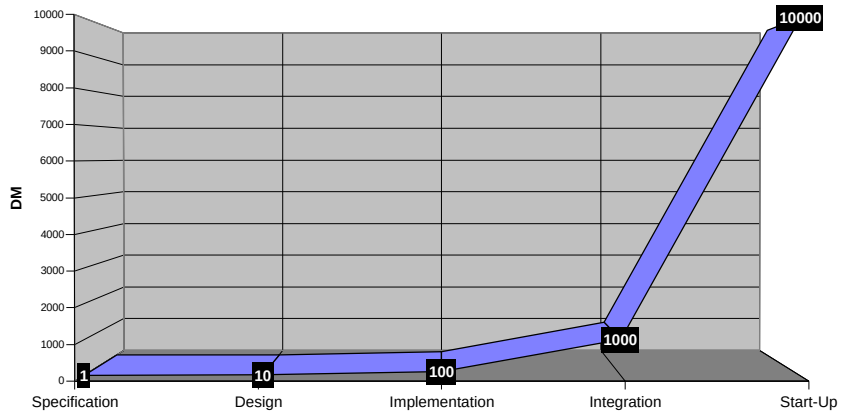


Figure 2.2: Costs of Correction Measurements

The development of software according to high quality standards requires the usage of expensive computer aided software engineering tools, e.g. static and dynamic source code analysis tools. The application of these highly specialised tools requires support from and co-operation with experienced software engineering and quality assurance experts.

It shall be underlined that in the REDISE project two aspects are of importance:

- the computer supported collaborative working via a high speed network and
- the application of computer aided software engineering.

2.2 Approach

To demonstrate the feasibility of remote and distributed software engineering the AeroNav software system from Aerodata was selected and a high speed network between Aerodata and DLR was used.

AeroNav is an Integrated GPS Navigation System which provides the user with functions tailored to the requirements of special mission operators like police forces, aero-medical services and offshore operators. By means of interfacing additional mission equipment such as FLIR (Forward Looking Infrared), Direction Finders, Moving Map Systems or Communication Systems, AeroNav fulfils the role of a Central Mission Computer which supports the aircrew in accomplishing its tactical mission. Figure 2.3 shows the Navigation and Communication Unit (NCU) and the Control and Display Unit (CDU).

Figure 2.3: AeroNav NCU and CDU

Special emphasis during the development of AeroNav was given to reliable and precise navigation during tactical mission profiles at low altitude, within obstacle environments and for areas with poor ground based navigation infrastructure. Therefore, AeroNav uses GPS as well as data from internal and external inertial sensors. In combination with these sensors, AeroNav provides a flight management software which supports the crew in flight planning and navigation. Figure 2.4 gives an overview of the basic installation of AeroNav.

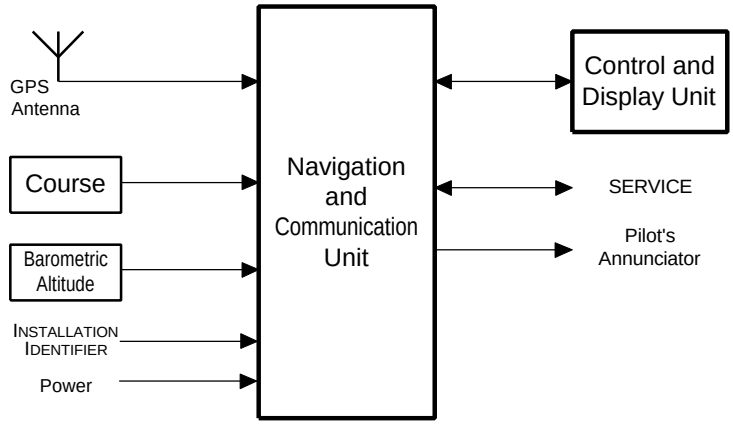


Figure 2.4: Block Diagram AeroNav (Basic Installation)

For the approval by the German Civil Aviation Authority (LBA) the software development has to be performed according to the international standard RTCA/DO-178B.

This requires the usage of expensive computer aided software engineering tools, for instance static and dynamic source code analysis tools. The application of these highly specialised tools requires support from and co-operation with experienced software engineering and quality assurance experts.

To realise the distributed software development a high speed networking connection between Aerodata and the DLR was established.

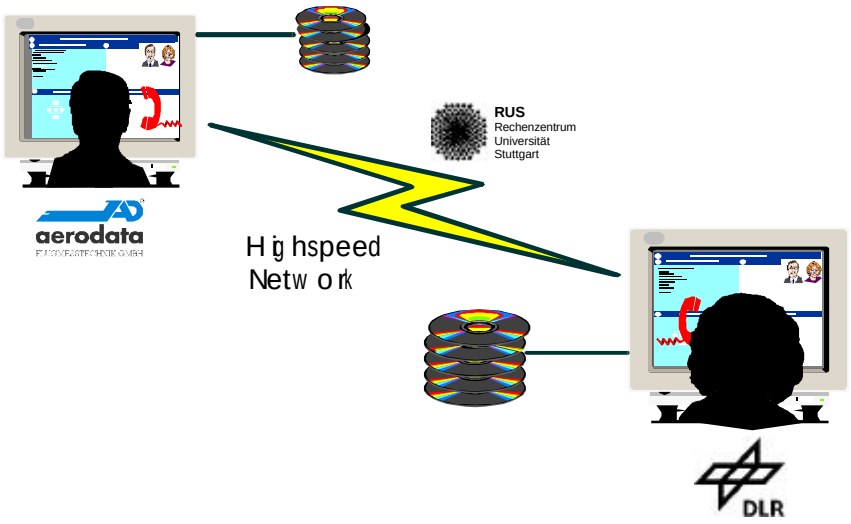


Figure 2.5: Collaborative Environment

2.3 Major Achievements

The focus in the concept phase was the integration of all tools which are needed to perform the REDISE activities within the so called PC-based office environment. The experiences with the office environment have generally shown that there are many problems when using a personal computer for network applications. The main aspects for this project are (first with higher priority):

- Shared Application,
- Audio,
- Whiteboard / Text Editor and
- Video.

Especially the audio and video components in junction with a second network component are not easy to install and some time of investigation is necessary for the realisation of a REDISE like environment.

After solving the above mentioned problems the following advantages of using the REDISE environment in junction with High Performance Networking were achieved:

- it is easier to get know-how from experts,
- the effort in time to co-ordinate things with customers and partners is lower,
- code analyses made outside the company are more objective,
- the quality of software is increasing,
- less effort for training of experts in CASE tools,
- less investments for CASE tools and
- less effort in time and money for travels.

With these achievements the major objectives for the REDISE project are reached.

2.4 Business Benefits

The business benefits depend on the degree of using distributed environment for software development, the safety level for the industrial application of the software and of the amount of partners and the distances between them. Under the parameters of the relationship between DLR and Aerodata the following qualitative evaluation could be met regarding to the major aspects of the REDISE project:

Effort in budget	reduced, if fee for data link and tool utilisation is not to expensive
Needs for travel	reduced only, if tool is not installed in company
Effort in time	reduced significantly, because no installation and training periods are necessary

The quantitative evaluation is also based on experiences with other CASE Tools, e.g. design tools for specification and design phases.

Efficiency improvement	less errors
Infrastructure investments	5.000 ... 50.000 DM per Tool
Installation and training period	25.000 DM per tool (for 15 employees)
Travel time and budget	nearly equal
Time-to-Market improvement	nearly equal

So the expected objective mentioned in chapter 1 ‘Synopsis’ could not be reached. This project has shown the problems in the installation phase of the REDISE environment and the use phase for the various analyses of safety critical avionics software. The benefits are shown in an appropriate combination of financial and safety aspects for the parameters of the tool environment and relationship to partners of the company.

3 Full Technical Text

3.1 State of the Art

3.1.1 Introduction of the Project

For small and medium sized enterprises (SME), remote and distributed engineering is becoming increasingly important in the future world of global competition and co-operation.

For future software developments, the main focus will be set to safety and quality aspects as well as to real time applications. New inventions based on complex software development and implementation require the usage of expensive computer aided software engineering (CASE) tools, e.g. static and dynamic source code analysis tools. Additionally, support from and co-operation with experienced software engineering and quality assurance experts will be required.

3.1.2 Motivation for the Project

Among other things Aerodata develops software for a special-mission navigation system. Aerodata's AeroNav is an Integrated GPS Navigation System for aircraft which provides the user with additional functions tailored to the requirements of special mission operators like police forces, aeromedical services and offshore operators. Special emphasis during the development of AeroNav is given to reliable and precise navigation during tactical mission profiles at low altitude, within obstacle environments and for areas with poor ground based navigation infrastructure.

For that reason the software is safety critical, real time critical and has to be on a high quality level. It has to be developed according to the international standard RTCA/DO-178B Level C, to state-of-the-art software engineering methods and tools. Thus CASE tools as well as external expertise have to be utilised for the AeroNav software development process.

To support these goals the REDISE project was established, do demonstrate that the utilisation of high performance networking (HPN) infrastructure and technology

provides the required quality of service to enable and speedup the collaborative engineering of complex software systems in distributed teams,

allows to share expensive software engineering tools and corresponding expertise based on a distributed software engineering infrastructure and

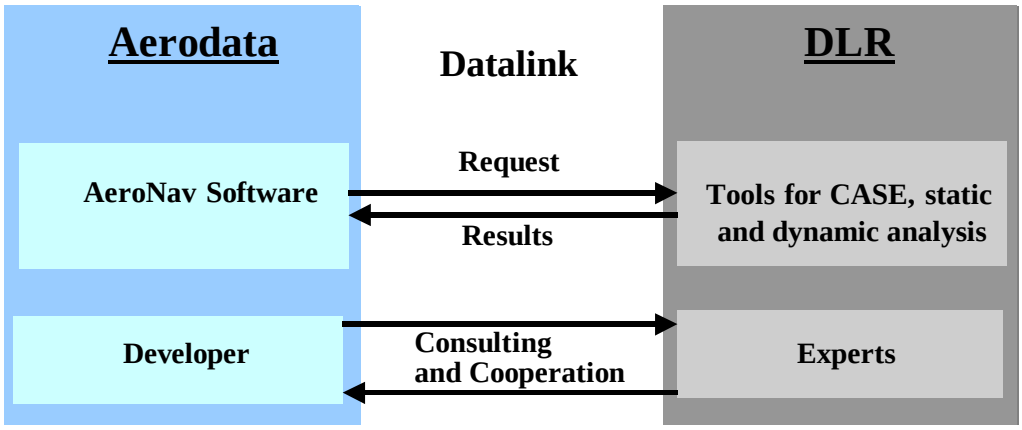
significantly reduces the needs for travel and thus the effort in time and budget,

thus improving the software quality as well as the Time-to-Market.

The collaborative software engineering is realised by using a net conferencing system, permitting the access and use for each team member independent of the

location and infrastructure. The net conferencing system allows the communication by video, audio, shared whiteboard and shared text editor as well as the usage of shared applications.

Figure 3.1: Collaborative work within the REDISE project.



3.1.3 Roles of Project Partners

To realise REDISE, three participants, Aerodata, the Computing Centre of the University of Stuttgart (RUS) and the German Aerospace Centre (DLR) took part in the project. The major users of the REDISE Environment were Aerodata and DLR while RUS acted as an advisor for hardware and net conferencing software aspects.

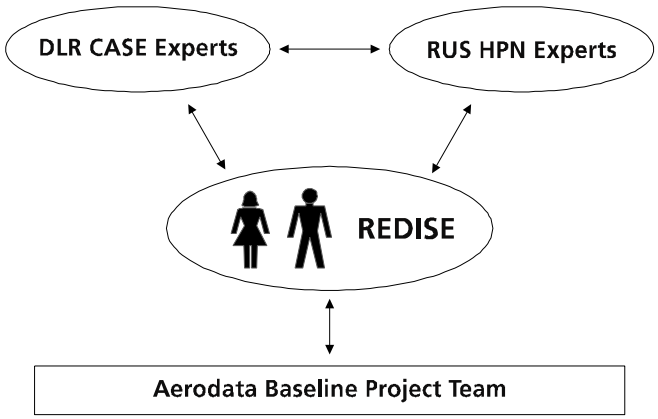


Figure 3.2: Role of the project participants.

In the DLR there are certain software engineering tools and the know-how how to develop software using state-of-the-art software engineering methods and tools. With help of DLR experts and the REDISE project the software development process of AeroNav was improved by sharing CASE tools as well as support from and co-operation with experienced software engineering and quality assurance experts.

3.1.4 Business Objectives

According to the project partners, their technical and specialised knowledge a successful project cycle is expected. Using the underlying high performance networking infrastructure together with the communication and collaboration middleware

- 50 % savings in software engineering infrastructure investments,
- 60 % savings in travel time and budget and
- 30 % savings in consulting and training

are envisaged as being realistic, thus improving the software quality as well as the Time-to-Market.

3.2 Approach

The problem has been approached by first looking for an adequate task which is also representative and typical for such applications and which can additionally produce some benefits for a current project. We selected the project „AeroNav“ from Aerodata and decided to check the current software quality. AeroNav is an integrated GPS navigation system with special mission equipment used by the aircrew. Two work packets have been defined to demonstrate distributed software development:

- using a static analyses tool should point out our current software quality and
- development of a small new software part should depict problems during distributed software development.

For the first point the „AeroNav Navigation Library“ should be examined. For the second point the throughput of an ARINC 429 interface line with very limited band width should be increased by optimising an algorithm that manages the output of ARINC data via this line to a connected EFIS display so that more information for the pilot can be provided. This software development should be done via telecommunication using the CASE tools at the DLR.

3.2.1 Hardware and Topology Selection

Next the new hardware components required for telecommunication had to be found and a network topology had to be defined. The PC, were software development occurs, was fully integrated into the internal Aerodata-network which is already connected to the internet via proxy server and firewall.

The new telecommunication features should not influence the common network activities and in addition it should not be possible to gain control over the internal network or computers via the telecommunication line. Therefore the PC had to be supplied with a secondary networking interface board which is exclusive connected

via multicast router to the CASE-Tool centre in the DLR. This was very important because it's very easy to infiltrate a network with multi-cast packets as they are used with MBONE tools.

Additionally a sound card with headset/speaker connected and a frame grabbing (TV) card with camera connected had to be inserted into the PC.

3.2.2 Software Selection

The software needed for this project is divided into two parts:
- the telecommunication software and
- CASE tools.

For the **tele communication tools** we followed the recommendations of RUS. The following tools were available for free:
- MBONE Tools (a collection of tools for video and audio transmission, whiteboard, editor, ...),
- NetMeeting from Microsoft and
- VNC (Virtual Network Computing from Olivetti & Oracle Research Laboratory).

Each packet has some advantages but also some restrictions concerning quality, speed, portability, robustness and easy operation. For example, NetMeeting has shown to be very robust but it only offers point to point connections. The MBONE utility „rat" (robust audio tool) offered the most best audio quality but there is no possibility for application sharing and at last VNC is very portable and easy to use but it is very slow and offers no audio transmission.

Remark: This only reflects the current state. At least CPU speed will increase and the MBONE tools will grow up a little.

The session announcement was done by telephone. NetMeeting was used for application sharing, rat for audio transmission and „vic" (MBONEs Video Conferencing) or NetMeeting for video transmission.

Searching for **CASE tools** was much more complicated because the currently used software development environment is very specialised according to the programming language Modula-2 and the operating system OS-9. But at least one company which offers four products was found. This is the Russian company XDS (Cross Development Software) with the following products:

- XDS-M2: native Oberon/Modula-2 integrated development environment for X86
- XDS-OSA: Oberon/Modula-2 static analysis,
- XDS-OCT: Oberon/Modula-2 coverage tool,
- XDS-MERINS: metrics for Oberon/Modula-2

3.2.3 Hardware Installation

As mentioned above the new required hardware must be installed in a standard PC under WIN9X/NT. This looks rather simple but indeed there are some restrictions that must be considered. For example the slots for the frame grabbing card and

standard graphic card were dependent on each other. Also care must be taken choosing the IRQ vectors of all boards. Finally it is much easier to install only one board at a time than all new boards together (under WIN9X/NT).

3.2.4 Software Installation

If the PC is already booting with all new boards the according software must be installed. This is normally no problem in standard configurations. But again there were some problems with two network devices. Additionally there were large problems to install the software for the sound card under NT. Installation of net-conferencing tools and CASE tools did not cause any trouble.

3.2.5 A Tele CASE conference

Normally a session will be arranged using the MBONE tool „sdr“ (session directory). But this tool did not work correctly on our network topology. So we used the telephone for that purpose.
Furthermore it turned out that video transmission is of minor importance for our purposes. It only consumes a lot of band width and in case of low cost video cameras also a lot of processing time.

After start of „rat“ and „NetMeeting“ we shared the static analysis tool. Due to differences in the Modula-2 dialects, we had to make some changes in the sources of our Navigation library. But at least we got a result (in fact we got two results):

- the static analysis uncovered only two faults but with no effect for the current AeroNav because the faults were found in an unused branch and
- the usability of static analysis via tele conferencing is practicable. This result can also be passed on the metrics tool.

The second task delivered another result. Basic software development and testing including usage of the coverage tool requires detail knowledge and high frequently changes of source code or test inputs which is normally only available at the original developer himself. Therefore the tele communication leads in more overhead and hinders normal development process. But nevertheless usage of the coverage tool results in very well tested source code and should be highly recommended for safety critical software development.

3.3 Results, Achievements and Benefits

In the following the experiences during the software engineering with the REDISE tool environment will be given. By use of REDISE the medium enterprise Aerodata could take advantage for the development of their aircraft navigation system AeroNav which is controlled by safety critical real time software.

3.3.1 Tools and Performance

For the improvement of the implementation phase a tool for static code analysis was tested. Since Modula-2 is not a main stream programming language, it was more difficult to obtain such a tool as expected. For this project the Oberon-2/Modula-2 Static Analyser (OSA) from the Russian enterprise XDS was chosen who has direct contact to N. Wirth.

The OSA tool detects at minimum 22 error classes, verified with various test programs. The tool is made by a radically new approach to the implementation of static analysers of semantic run-time errors. An efficient algorithm of the powerful context sensitive data flow analysis is developed. For this reason many warnings and error messages are avoided and only the ‘real’ errors are announced.

The first larger application with OSA was the analysis of the FGPS software library. FGPS (computation of the ‘Global Positioning Data’ is a large part of AeroNav ’s total navigation and communication software. The software library comprises 190 files by 52.266 lines of code.

The first results still dispose of a considerable number of warnings and messages. First analyses of the AeroNav library ‘FGPS’ still indicated approx. 30.000 warnings. Analyses realised at a later stage (after improvement of the OSA tool) only indicated the reduced number of approx. 1300 warnings (e.g. unused variables, procedures, parameters and code).

After significant improvement of the OSA tool the accuracy according to ‘real’ errors has been increased considerably. Only one error was detected in the already tested and released software library.

3.3.2 Consequences

The behaviour of the analysis tool was not as expected as some incompatibilities between the characteristics of the tool and the used dialect of the programming language were shown. These experiences have led to the following consequences:

- ? The analyses has to emphasise the ‘real’ errors (difficulties to identify real error among 30.000 error messages).
- ? The conversion to popular languages (e.g. in C to use C-analysis tools) is not efficient because of the additional errors of the converting process.
- ? The context sensitive analyses are only with current version practicable; therefore the code has to be changed.
- ? The 'dialect' of the programming language has to fit exactly the analysis tool (ANSI-, ISO-Modula-2).

For the in chapter 3.1 ‘Approach’ mentioned used tools from XDS the following recommendation could be given:

IDE for Modula-2: - interactive development	not recommended
Static Code Analysis: - no executable programm	recommended
Coverage Analysis: - interactive adaptations - hardware-specific	not recommended
Software Metrics: - no executable progam	recommended

3.3.3 Evaluation of the Tool Environment

For high performance networking equipment with 2 Mbit per second can already be used, anyhow equipment with transfer rates of 10 Mbit is more comfortable. The table shows the priorities of the shared engineering tools and the performance of installation and utilisation.

	Installation	**Utilisation**
1. Shared Application	simple	normal
2. Audio	difficult	simple
3. Whiteboard/Text Editor	simple	simple
4. Video	simple	difficult

3.3.4 Evaluation of the REDISE Environment

The evaluation were performed by means of the FGPS’ software library and especially prepared test programmes.

3.3.5 Qualitative Evaluation

Subjects of this evaluation are the major aspects of chapter 1 ‘Synopsis’.

Effort in budget	reduced if fee for data link and tool utilisation is not to expensive
Needs for travel	reduced only if tool is not installed in company
Effort in time	reduced significantly because no installation and training periods are necessary

3.3.6 Quantitative Evaluation

The quantitative evaluation is also based on experiences with other CASE Tools, e.g. design tools for specification and design phases.

Efficiency improvement	less errors
Infrastructure investments	2.500 ... 25.000 Euro per tool
Installation and training period	12.500 Euro per tool (for 15 employees)
Travel time and budget	nearly equal
Time-to-Market improvement	nearly equal

3.3.7 Example Project

To demonstrate the quantitative results, the example project profile shown in the following table will be the basis of further calculations:

Parameter	**Data**	**Costs in Euro**
Duration	1 year	
Employees	10 à partner	
Partners	2	4.000.000
Meetings	12 à 5 persons	144.000
Tools	2 for 10 persons	275.000
Remote	1 link for 1 tool	107.500
Office PCs	20 à 1/4 depreciation per year	10.000

With these parameters the following benefits could be achieved according to the main objectives mentioned in chapter 1 Synopsis:

Effort in budget	envisaged:	50 % savings in infrastructure investments
	realistic:	50 % without utilisation fee for HPN
		11 % (30.000 Euro) with utilisation fee
Needs for travel	envisaged:	60 % savings in time and budget
	realistic:	max. 50 % (72.000 Euro), depending on the acceptance by the affected persons
Effort in time	envisaged:	30 % savings in time
	realistic:	0,4 % (16.700 Euro = 21 person days), (by using simple tools)

The results shows that the advantages in budget and time are not so significant as envisaged. In the case of using more expensive and more complex tools it is possible to save more time, but the envisaged 30 % savings in time may not be reached. The advantage of using HPN within the REDISE environment is the combination of saving budget and getting a higher quality and a higher degree of safety of the developed software.

3.4 Dissemination

At the beginning of the project companies showed rather high interest in computer supported collaborative working and in software engineering, but were reluctant to introduce these new style of working into real application. One of the greatest hurdles was the availability of high speed connections for an affordable price.

In the last months of the project it the attitude of companies changed. Co-operation, also via networks, seems to be a means to use efficiently resources in joint projects. Further software engineering becomes more and more important to guarantee or improve quality of software. This may result in the lack of qualified programmers and informatic engineers on the labour market. Whether the market is mature to adopt now the techniques demonstrated in the REDISE project will be an outcome of the workshop foreseen in beginning of 2000.

3.4.1 Target Audience

Target audience are

- All companies which develop software in distributed teams;
- Companies who develop software which can categorised as follows:
  - Large software systems,
  - Software which must undergo certification,
  - Safety critical software ,
  - Software for real time application;
- All companies which need specialised knowledge from outside to enter the market in the early stage before building up own expertise;
- Companies which intend to involve the customer already in early stages of the development phase for quality assurance (check of specifications against requirements, check prototypes against specifications, tests of functionality of prototypes, final tests, etc.).

3.4.2 List of External Events

- **International Workshop of Flight Inspection Systems on 23.9.98**
  Experts on flight testing, flight inspection systems, flight software
  PowerPoint presentation

- **Forschungsflughafen Braunschweig e.V. 28.9.98**

  The “Forschungsflughafen Braunschweig e.V.” is a group of 16 institutions and SME’s located at the airport of Braunschweig. The participants showed strong interest in HPCN technologies especially in distributed working.

  "This technology shall be considered in future projects performed jointly by members of the group."

  PowerPoint presentation

- **“Gesprächskreis Technologie-Transfer”. 6.10.98**

  The “Gesprächskreis Technologie-Transfer” is a workgroup consisting of the responsible persons for technology transfer in 25 research, scientific and other public institutions in the region of Braunschweig.

  PowerPoint presentation

- **TeleCASE User Training on 27.10.98 at Aerodata.**

  Participants: DLR, Aerodata, Aerodata group
  TeleCASE Environment Handbook

- **Mailing action (IHK data base) and invitation to workshop in October/November 98**

  4454 addressees companies which develop software

  1720 selected

  additionally 50 selected with special Real-time applications

- **REDISE-Workshop on 16.12.98 at Aerodata**

  Four speakers (Prof. Dr. M. Zitterbart, K. Jopke, A, Rozek, M. Lother)

  12 participants

  Demonstration, PowerPoint presentations, TeleCASE Environment Handbook, hand-outs

- **Mailing action Dec.98/Jan.99**

  Handouts and documentation to companies, which requested information from the mailing action or which confirmed participation but did finally not attend.

  Copies of PowerPoint presentations, TeleCASE Environment Handbook, hand-outs

- **Presentation at GZVB (Gesamtzentrum für Verkehr Braunschweig), invited, 11.02.99**

  GZVB represents about 35 companies involved in transport and traffic systems. The participants showed strong interest in HPCN technologies especially in distributed working.

  The members stated that this is a important technology for the future co-operation, but it is still to early to foster a greater uptake by those companies.

  PowerPoint presentation, hand-outs

- **Presentation at "Les Enjeux De La Simulation Numerique" in Toulouse 17.03.99**

  Short presentation, hand-outs, poster, individual consulting

- **EuroCargo 13.4.99 - 15.4.99**

  Presentation during individual consulting to interested companies

  Technical information sheet

- **Aero99 in Friedrichshafen 21.4.99 - 25.4.99**

  Demonstration at CAPRICE booth
  Visit of companies in their booth and individual presentation

  Hand-outs, poster, technical information sheets

- **EKA '99, Entwicklung und Betrieb komplexer Automatisierungssysteme, 25.5.99 - 28.5.99 Braunschweig,**

  Lecture (70 participants)

  Conference paper, demonstration, demonstration booth, poster, hand-outs

- **DLR, Tag der offenen Tür (public presentation day), 4.9.99**
  (7000 visitors)

  Demonstration to about 10 qualified visitors from companies/research organisations

  Demonstration, poster, hand-outs

- **Aerodata disseminates information on REDISE to its customers.**

- **Use of REDISE as demonstration tool for DLR customers and co-operation partners.**

- **October 99 Telephone survey with limited number of companies**

  Based on the result of this survey it was decided to start a second mailing action with a questionnaire to prepare a workshop. This workshop will take place beginning of 2000, although the REDISE project is terminated. It is not decided as to whether it will be an alone standing event or it will performed together with another workshop, e.g. CAPRICE workshop.

- **Second mailing action November 99**

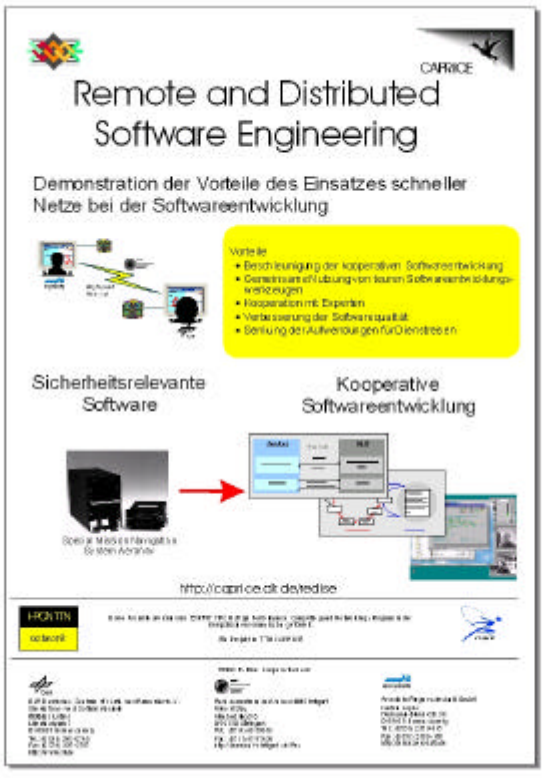
  Undated data base of the first mailing action with 1660 companies including 50 companies with real time application in software.

  Action still running (30. Nov.99), about 30 feedback's with interest for workshop, some for direct consulting and demonstration, more expected, significant increase in web traffic about 50 requests.

3.4.3 Dissemination Material

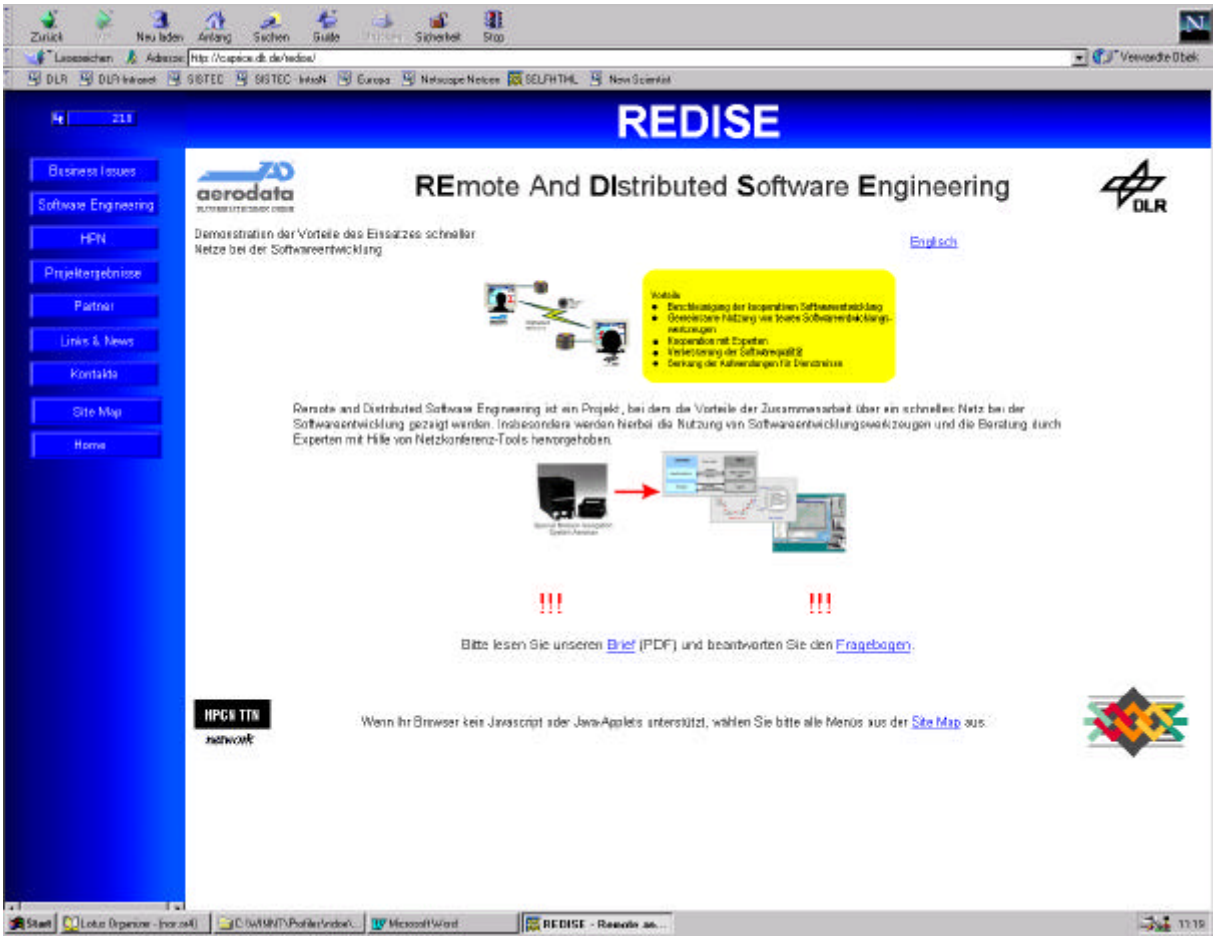
Hand-out

Poster



Web http://caprice.dlr.de/redise

Snapshot of the home page of REDISE in the WWW.



PowerPoint Presentations from workshop
Available for download from the REDISE web-site

TeleCASE Environment Handbook
Available for download from the REDISE web-site

Flyer (available beginning 2000)

3.4.4 Publications

K. Jopke, M.Lother, REDISE Remote and Distributed Software Engineering, in E. Schnieder (Hrsg.) Entwicklung und Betrieb komplexer Automatisierungssysteme, Technische Universität Braunschweig, 1999

Abstract

For small and medium sized enterprises (SME), remote and distributed engineering is becoming increasingly important in the future world of global competition and co-operation.

For future software developments, the main focus will be set to safety and quality aspects as well as to real time applications. New inventions based on complex software development and implementation require the usage of expensive computer aided software engineering (CASE) tools and static and dynamic source code analysis tools. Additionally, support from and co-operation with experienced software engineering and quality assurance experts will be required.

The collaborative software engineering is realised by using a net conferencing system, permitting the access and use for each team member independent of the location and infrastructure. The net conferencing system allows the communication by video, audio, shared whiteboard and shared text editor as well as the usage of shared applications.

Using the underlying high performance networking infrastructure together with the communication and collaboration middleware, 50 % savings in software engineering infrastructure investments, 60 % savings in travel time and budget and 30 % savings in consulting and training are envisaged as being realistic, thus improving the software quality as well as the Time-to-Market.

3.5 Conclusions

The advantages in budget and time by using HPN within the REDISE environment are not so significant as envisaged. The general and very important advantage is the combination of saving budget and getting a higher quality and a higher degree of safety of the developed software.

3.5.1 Lessons Learned

During performing the REDISE project some experiences on various aspects of software development could be made. The lessons learned show the aspects which are relevant for practical use of remote and distributed software engineering and the experiences which were made by using the static code analyses.

Data Security	actual private link; problematical by using the internet
Language	coding rules and analysis tool have to harmonise
Tools	the ‘house’ compiler has to harmonise with the analysis tool
Experts	only meaningful for introduction, training and special problems; the tool has to be used easily 'remote' and with short response time to obtain acceptance by software developers
Acceptance	It must be possible to use the tool remotely and it must have short response times

Especially the data security and the acceptance by the involved employees are very critical and business relevant for companies. After elimination of these commercial risks the implementation of an HPN environment is useful. In the case of Aerodata the data security was given by an DLR-owned glass fibre net. The acceptance was good because of the highly skilled software developer and the required analyses for the development of safety critical avionics software. In other cases respectively companies an evaluation of these critical project parameters have to be done carefully to get the advantages of a HPN environment.

3.5.2 Future Aspects

For future safety-related software engineering in aviation industries, e.g. Level B of the RTCA/DO-178B, the time for performing tests is expected to be 50% of the entire development time. This emphasises the net conferencing environment for collaborative software engineering evaluated in the REDISE project.

The experiences with remote and distributed software engineering made in the field of aeronautics can be transferred to other fields, where software with high requirements with respect to reliability and safety is developed.

3.5.3 Future Trends and Remaining Advantage

In the current time video conferencing is an upcoming method to avoid expensive meetings with global partners. In some years the corresponding tools will be more perfect and cheaper than today. The tools may include file server, integrated version control systems and backup systems, connection to project planning tools and other tools for the whole software development environment. If the tools will be significantly cheaper, the need for video conferencing according to the use of CASE tools will not be so necessary as it seems to be today.

The remaining advantage by using HPN in the REDISE environment will be the easy access to know-how of experts for analyses and the objective evaluation from outside the company (independent from the developing persons as required for high safety critical software, e.g. in RTCA/DO-178B for avionics software. Video

conferencing based tools would allow an easy and fast access to facilities which provide such services.

3.5.4 Business Benefits

The results shows that the advantages in budget and time are not so significant as envisaged. In using more expensive and more complex tools it is possible to save more time, but the envisaged 30 % savings in time may not be reached. The advantage of using HPN within the REDISE environment is the combination of saving budget and getting a higher quality and a higher degree of safety of the developed software.

Effort in budget	envisaged:	50 % savings in infrastructure investments
	realistic:	50 % without utilisation fee for HPN
		11 % (30.000 Euro) with utilisation fee
Needs for travel	envisaged:	60 % savings in time and budget
	realistic:	max. 50 % (72.000 Euro), depending on the acceptance by the affected persons
Effort in time	envisaged:	30 % savings in time
	realistic:	0,4 % (16.700 Euro = 21 person days), (by using simple tools)

3.5.5 Exploitation

In the REDISE project the feasibility in combing

- Computer Supported Collaborative Working and
- Software Engineering

was demonstrated. The objective of the project was neither a product nor a service which can provided to customers.

With the experiences gained in the REDISE project the DLR division "Simulation and Software Technology" - SISTEC - will use the communication and collaborative tools. SISTEC is responsible for software quality assurance in DLR. These tools will improve the day-to-day communication in software projects where SISTEC is involved.

3.6 Contact Details

The following table summarises the contact persons of the REDISE project:

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TTN-CAPRICE http://caprice.dlr.de	TTN CAPRICE c/o DLR Lilienthalplatz 7 38108 Braunschweig email: etc.caprice@dlr.de

Web Site

Information about the project can be found on the following URL:

http://caprice.dlr.de/redise

Project Duration

Start: 01 November 1997
End: 31 October 1999

Budget

The global cost of the project was 414.500 ECU, the EC has funded 285.750 ECU. The remaining resources have been funded by the project partners.