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EURNEX

EUropean **R**ail research
Network of **EX**cellence

SIXTH FRAMEWORK PROGRAMME

PRIORITY 1.6.2: SUSTAINABLE SURFACE TRANSPORT

Pole Action Plan

**Pole 2: Operation and System
Performance**

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1 Objectives of the Pole

The description of the Pole reported on Deliverable 20 was assumed by the partners as starting points for the work.

Possible amendments or refinements of these points suggested by the development of the Pole activity itself will be discussed at a later stage.

Therefore the general objective of Pole 2 is confirmed as “to understand and to evaluate the complex nature of the railway system and to assist its operational management”, with specific contents, in accordance with the Strategic Rail Research Agenda 2020 formulated by ERRAC, on:

- stakeholders' requirements;
- interoperability;
- functional analysis and designing of system architecture and components relationships;
- modelling and simulation;
- operation planning and management;
- capacity management and optimisation.

2 Pole structure and organisation

Activities organisation

The activities of the Pole have been organised in the following four groups corresponding to aggregation of the so called "Pole Survival actions".

Namely they are:

- A) review of Pole internal ongoing research activities and planning of new collaboration activities;
- B) identification and full development of customer-oriented research projects proposals in selected Thematic Areas;
- C) pole self promotion actions;
- D) planning of internal training and identification of common education and training activities.

Thematic Areas

The scientific debate during the Berlin workshop (March 2005) was mainly dedicated to the identification of the extensive thematic subjects on which the Pole research activities and particularly the research projects proposals (group of activities B), will be mainly oriented.

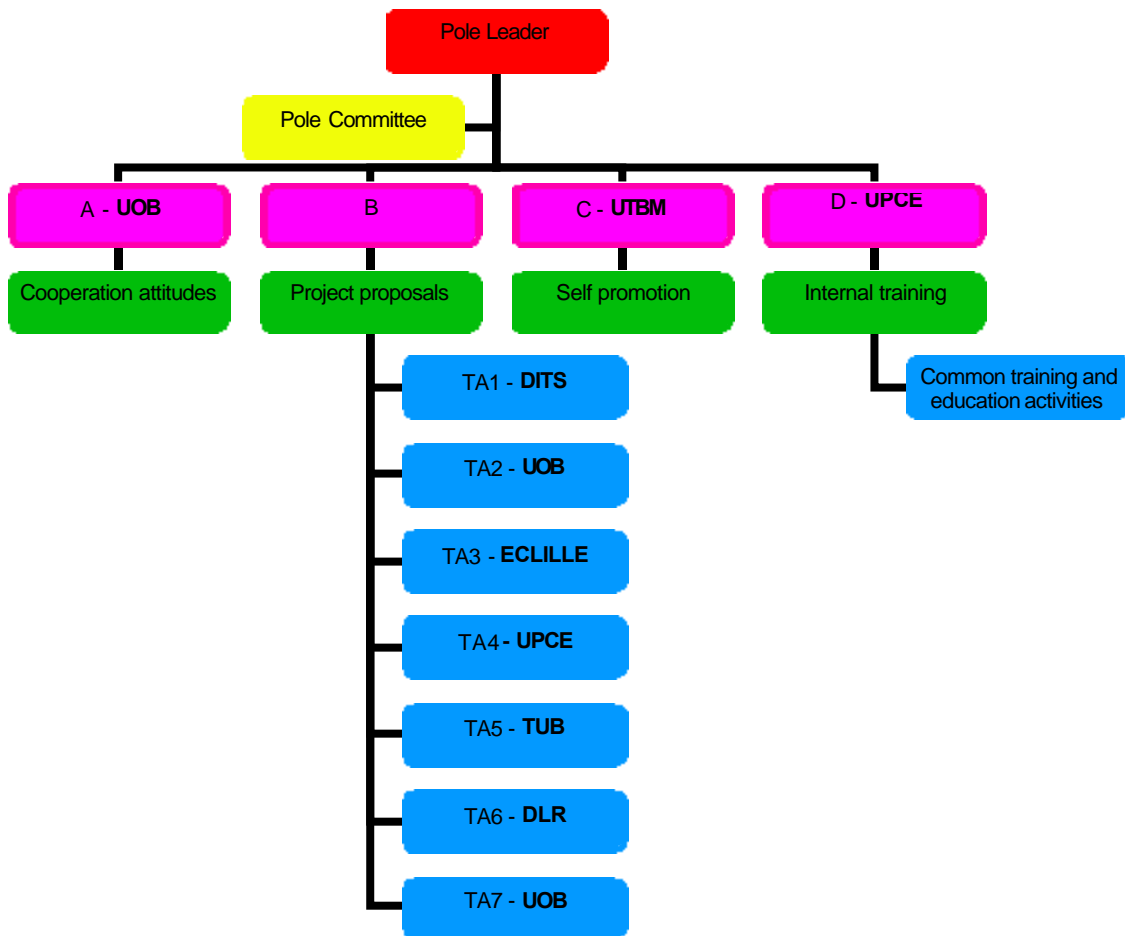
The process was developed on the basis of a bottom up approach, starting from the competencies of the partners and the research challenges suggested by them in the framework established by the general objectives.

The discussion allowed to identify the seven main Thematic Areas (TA) described below.

- 1) Inter-modal freight operation as a part of the global logistic chain;
- 2) Causes / effects links between maintenance and operation;
- 3) Driver and onboard staff and related rules / regulations interoperability.
- 4) Lines / stations performances evaluation methods and models;
- 5) Railway traffic regularity monitoring;
- 6) Integrated communication framework for human / systems dispatching interfaces;
- 7) Co-ordination in passenger inter-modality.

The Pole organisation is summarised in the flow chart below including for the following contents:

- coordination structure (red and yellow boxes);
- group of planned activities and responsible partners (violet boxes);
- products of planned activities in terms of research, education and training excellence building up and dissemination (green boxes);
- research (with partner responsible of various Thematic Areas), education and training business products (blueboxes).



Membership

All institutions member of EURNEX at present and in the future may in principle participate to Pole 2.

The updated structure of participations to Pole is and will be reported in the Pole Action Plan.

Admission of new Pole members is subject to the acceptance by the majority of Pole members and by the EURNEX Coordinator.

Institutions outside EURNEX may not be members of the Pole but they may participate into the research activities organised by the Pole itself.

Each member institution will appoint a representative to the Pole.

Pole Team

Appointed representatives of member institutions constitute the Pole Team and participate to the decisions concerning Pole activities on the basis of the principle of one vote per institution.

Pole Team meetings take place at least every six months.

Agreement of Pole Team members is required for:

- Pole Action Plan revisions;
- Pole budget revision;
- research project proposals and their supporting procedure;
- acceptance of new Pole members.

Pole Committee

The Pole Committee consists of selected members of the Pole Team appointed of specific responsibilities within the Pole organisation.

According to the present Pole organisation the Pole Committee includes representatives of members responsible for:

- group of activities A (Collaboration), C (Self promotion) and D (Education and Training);
- development of research projects (group of activities B) in the Thematic Areas 1 to 7.

The Pole Committee assists the Pole Leader with the implementation and the supervision of the Pole Action Plan.

The members of the Pole Committee are responsible to:

- coordinate the tasks defined in the Pole Action Plan, with particular, but not exclusive, regard to activities related to their specific responsibilities;
- support the Pole Leader in the overall follow-up of execution, schedule and budget of activities performed within the Pole;
- assist the Pole Leader in preparation and approval of reports on Pole activities to EURNEX Coordinator and Executive Committee;
- implement decision and recommendations of EURNEX Coordinator and Executive Committee by submitting to Pole Team required amendments to Pole Action Plan.

The composition of the Pole Committee may be modified according to the variations in Pole organisation and related Pole Action Plan approved by the majority of the Pole Team.

Pole Leader

The Pole Leader chairs the Pole Committee and represents the Pole in the EURNEX Executive Committee.

All members of the Pole Committee may in principle, on request, act as deputy Pole Leaders.

The Pole Leader is in charge of coordinating all Pole activities with the assistance of Pole Committee and in particular to:

- update the Pole Action Plan, including the budget plan, to be submitted to EURNEX Coordinator and Executive Committee upon approval of Pole Team every 3 months;
- follow-up and report to EURNEX Coordinator and Executive Committee on the use of the budget;
- prepare reports and deliverables in compliance with the requirements of the Joint Program of Activities;

- decide on transfer between the Pole members of responsibilities allocated in the Pole Action Plan;
- present the request of the Pole, approved by the Pole Team, to EURNEX Coordinator and Executive Committee;
- implement decisions and recommendations of EURNEX Coordinator and Executive Committee by submitting them to Pole Team;
- disseminate any useful document and information among the Pole members;
- convene, prepare and chair the Pole Team meetings.

The Pole Leader is elected among the members of the Pole Team for a period of 12 months.

A quorum of 2/3 of the Pole Team members or their deputies is required to validate the election that is performed on the basis of the relative majority rule. The elected Pole Leader will be confirmed by the EURNEX Council.

3 Capabilities involved in the pole

Institutions and persons included

The Pole was triggered by Andreas Lischke (DLR Berlin) and Stefano Ricci (University "La Sapienza" DITS Roma) in the starting period.

During this period the Pole was established on the basis of the discussions during the Berlin workshop and the contributions to the Pole Action Plan reporting willingness / capabilities to provide useful contribution to the Pole by various institutions.

According to this situation the 13 institutions listed below, representing 7 different countries, are presently considered included in the Pole and represent the Pole Team.

<i>EURNEX Id</i>	<i>Institution</i>	<i>Acronym</i>	<i>Country</i>
2	University of Birmingham	UOB	United Kingdom
3	INRETS Villeneuve d'Ascq	INRETS	France
11	Fraunhofer Institut Dresden	FHG	Germany
13	TU Berlin	TUB	Germany
15	TU Braunschweig	TUBS	Germany
17	DLR Berlin	DLR	Germany
22	TU Wien	TUW	Austria
30	University of Pardubice	UPCE	Czech Republic
43	UT Belfort Montbeliard	UTBM	France
44	Ecole Centrale de Lille	ECLILLE	France
48	CERTH Thessaloniki	CERTH	Greece
65	University "La Sapienza" DITS Roma	DITS	Italy
70	CIRPS Roma	CIRPS	Italy

Any additional institution involvement in the Pole will be managed according to the general procedure described in section 2.

At the end of this period, during the first Pole 2 Team meeting in Rome on 20th May 2005, Stefano Ricci (University "La Sapienza" DITS Roma) was elected Pole Leader.

On the basis of the distribution of the responsibilities among the partners the Pole Committee is presently composed by the following 7 institutions: UOB, TUB, DLR, UPCE, UTBM, ECLILLE and DITS.

Main topics of research with relevance to the pole

The Pole Team institutions are involved in a wide set of research topics relevant for Pole 2.

The information provided by each institution have been extensively listed in the following table.

<i>Institution</i>	<i>Main research topics</i>
UOB	System modelling, simulation and optimisation for: <ul style="list-style-type: none"> • conflict resolution in railway operation; • predictive maintenance and condition monitoring of railway assets; • decision support for system changes; • data exchange methods; • transport interchange optimisation.
INRETS	Harmonisation of operation rules in Europe. Formal methods (Petri Nets, B method, ...). Semantic web, ontology, interoperability of heterogeneous databases. Object oriented model of railway traffic. Model based reasoning for diagnosis and constraint programming models. Railway traffic simulation. Optimisation of trains routing and scheduling.
FHG	RailML common interfaces for railway data simulation system INVIS and infrastructure tool GPSInfraDat. Simulation of different safety standards.
TUB	Optimization of railway operation. Marketing, terminal operation and technologies for railway freight traffic. Strategic analyses concerning the optimization of track systems. Testing and analysis of infrastructure.
TUBS	Analysis and application of suitable semiformal and formal description means, operational rules analysis and harmonisation. Simulation of railway traffic, harmonised infrastructure data format, optimisation methods and strategies, traffic and passenger data collection.
DLR	Design international rules for passenger and freight transport. Defining of international processes and cost-benefit analyses of new solutions. Information technologies for passengers.
TUW	Intelligent infrastructure: safety system integrated checkpoints, conflict-warning system for tunnels, fire recognition and derailment detection, geothermic-energy use of railway buildings Simulation of railway-operation.
UPCE	Infrastructure capability, specialization of railway network, operation and control of railway, scheduling, exclusion of railway operation, new technologies applications. Interface to ERTMS and infrastructure, single rules for operation, training ERTMS, safety, reliability, relations between RU and IM. Rolling stock, management of railway operation, information system.
UTBM	Operation research and discrete event system modelling. Modelling, simulation and performance evaluation.
ECLILLE	Formal methods (Petri Nets, B method, ...). Semantic web, ontology, interoperability of heterogeneous databases.
CERTH	Evaluation of new technologies implementation impact taking into account categories of inter-modal operation, size and function profile of inter-modal terminals: requirements of involved transport modes. Models exploiting open internet platforms architectures for supporting rail / inter-modal dangerous goods transportation. Design and implementation of electronic systems to evaluate passenger inter-modality services: definition of relevant indicators.
DITS	Evaluation on infrastructure and operational measures concerning line / station operation, timetable structure and freight terminals. Evaluation of operational performance of:

	<ul style="list-style-type: none"> • signalling systems and operational rules; • operational measures concerning timetable structure; • line / stations lay-outs and signalling systems. <p>Railway traffic regularity evaluation: causes/effects of perturbations. Support to operation management by IM and RU.</p>
CIRPS	Energy management and LCC for transportation systems. Innovative vehicles design and testing.

Expected contributions to the Pole

The expected contributions from each pole member are based on the knowledge about the applied research on technical solutions and operational rules in the European railway context.

Practically all of them are referred to experiences acquired concerning the research topics listed above, nevertheless the various contributions to the pole will be adjusted according to the need to put in evidence specific specialisations to be deeply applied in selected Thematic Areas and taking into account the ongoing projects results and the general EU strategies in the railway field.

In the following table is reported a synthetic overview of the possible contributions related to the various Thematic Areas, mainly based on the self commitment of the various institutions and on the availability of facilities, laboratories, tools and tested methodologies.

<i>Institution</i>	<i>Main research topics</i>
UOB	Predictive maintenance and condition monitoring (TA2). Modelling, simulation and optimisation for conflict resolution in railway operation (TA4). Transport interchanges optimisation (TA7).
INRETS	Object oriented simulation model of railway traffic (TA1). Harmonisation of operation rules in Europe, Formal methods, Semantic web, ontology, interoperability of heterogeneous databases (TA3). Application of scheduling theory to railway traffic management (TA4). Optimisation of trains routing and scheduling (TA7).
FHG	Simulation of different safety standards (TA3) RailML common interfaces for railway data simulation system INVIS (TA6).
TUB	Marketing, terminal operation and technologies for railway freight traffic (TA1) Testing of infrastructure and strategic analyses concerning the optimization of track use (TA2). Optimization of railway operation (TA5).
TUBS	Analysis and application of suitable semiformal and formal description means, operational rules analysis and harmonisation (TA3). Optimisation methods and strategies (TA4). Simulation of railway traffic and harmonised infrastructure data format (TA6). Traffic and passenger data collection (TA7).
DLR	Design international rules for passenger and freight transport (TA3). Defining of international processes and cost-benefit analyses of new solutions (TA6). Information technologies for passengers (TA7).
TUW	Development of intelligent infrastructure systems (TA2).

	Extension of capacity methods (e.g. UIC) (TA4) Extension in simulation-software (TA5)
UPCE	Infrastructure capability, specialization of railway network and scheduling (TA1) Interface to ERTMS and infrastructure, single rules for operation, training on ERTMS, safety and reliability (TA3). Infrastructure capability and relations between RU and IM (TA4). Management of railway operation and information system (TA7).
UTBM	Performance evaluation (TA1). Discrete event system modelling (TA3). Modelling and simulation (TA4). Operation research theory and applications (TA7).
ECLILLE	Formal methods (Petri Nets, B method, ...), semantic web, ontology and interoperability of heterogeneous databases (TA3).
CERTH	Evaluation of new technologies implementation impact in inter-modal operation, size and function profile of inter-modal terminals, open internet platforms architectures for supporting rail / inter-modal dangerous goods transportation (TA1). Exploiting models (TA4). Design and implementation of electronic systems for the evaluation of services offered in the domain of passenger inter-modality (TA7).
DITS	Evaluation on infrastructure and operational measures concerning freight terminals (TA1). Modelling of consequences of infrastructure / rolling stock failures based on Neural Networks (TA2). Evaluation of operational performance of operational rules (TA3). Evaluation on infrastructure and operational measures concerning line / station operation and operational performance of line / stations lay-outs and signalling systems (TA 4). Railway traffic regularity evaluation: causes/effects of perturbations (TA5). Support to operation management by IM and RU (TA6). Evaluation of operational performance of operational measures concerning timetable structure (TA7).
CIRPS	Design and testing of innovative vehicles for freight transport (TA1).

Available facilities, laboratories, simulation tools, etc.

The Pole Team will contribute to the research by making available an extended set of facilities, laboratories, tools and methodologies defined as follows.

<i>Institution</i>	<i>Main research topics</i>
UOB	Multi-train simulator. Asset monitoring rigs (point machines, train doors, level crossing). Motion base for simulator development. Discrete modelling software.
INRETS	SAMURAIL: railway traffic simulation and capacity evaluation (French signalling). RECIFE framework: Constraint programming based tools for routing and scheduling trains. ALSITRAG: Multimodal public transport traffic simulator prototype (railways, metros, buses). DOORS: Requirements management tool. ATELIER B and BRILLANT: IDEs for B formal method. CPN tools: IDE for Petri net model design.

	Rational Rose, Argo UML: UML model design tools. ELODI: non-monotonic reasoning tool for diagnosis electronic devices (TGV signalling).
FHG	FBS, Open-track, PTV -vision-tools for infrastructure management. DB-BR 445 driver's desk with original driving dynamics. CAROLA-railway simulation lab for ETCS-driving.
TUB	Simulation of railway operation. Expert systems for railway freight traffic and operation.
TUBS	Test laboratory for ETCS components. Test of human machine interfaces.
DLR	Test laboratory for ETCS components. Test of human machine interfaces.
TUW	Intelligent infrastructure systems / sensors.
UPCE	Computer laboratory for simulation tool of processes in terminals. Specialised laboratories of railway operation (simulation and dispatcher control).
UTBM	Virtual reality platform. Knowledge theory real life experiments.
ECLILLE	Petri nets based tools. Semantic web based tools.
CERTH	Modelling tools for inter-modal networks forecast and operation. Evaluation methodologies / indicators.
DITS	Generalised model for the performance evaluation of railway freight terminals. Simulation model of failures based on self-learning processes (neural networks). Methodologies: <ul style="list-style-type: none"> • to check and to design rules and regulations based on formal methods; • to assess the contribution of the various infrastructure / signalling components to the global traffic regularity; Synthetic integrated models to calculate lines and stations carrying capacity. Railway traffic simulation model based on Petri Nets.
CIRPS	Innovative vehicles design and manufacturer coordination.

Selected project references

A first selection of relevant project references was based on the database developed within WP1 and integrated on the basis of the suggestions provided by the partners (see section 4).

More extended and detailed references will be identified and checked by the responsible partners within each Thematic Area during the building up of the single research project proposals.

They will be included in an updated version of projects database, which will be managed and possibly updated within group of activities A (collaboration management).

4 Research projects towards Business Cases

Key research topics

According to the description previously reported (section 2), the so called “group of activities B” includes identification and full development of customer-oriented research projects proposals within the selected Thematic Areas.

The process of selection and prioritisation of the research projects to develop towards business cases started during the Berlin workshop on the basis of a duplicate approach:

- a bottom up approach starting from the competencies of the partners;
- an analysis of the existing chances to address available financing sources (first of all FP6 3B and 4 calls).

According to the Pole description, the selected Thematic Areas and the actual capabilities of the involved partners, the following minimum set of relevant research topics, distributed all over the various Thematic Areas, has been identified:

- system modelling:
 - for performance measurements and evaluation (e.g. identification of bottlenecks),
 - for solving capacity problems (e.g. identification of infrastructural / operational measures),
 - for railway traffic optimisation (e.g. timetabling);
- evaluation and harmonisation of operating rules considering TSI and ERTMS;
- support of freight inter-modal / combined transport (e.g. terminal operation);
- upgrade of timetable co-ordination in the passenger interchanges by means of generally accepted effective methods;
- efficient and homogeneous measurement methods to assess passenger and freight service quality;
- definition of common standard processes for international traffic and cross border communication;
- life cycle costing and operational management for rail operators.

Objectives and expected results

The objective of Pole 2 is to establish a group of researchers which have excellence / references in the field of system and operation performance. The main topic for this work is to fill the existing gaps to reach full interoperability in the European railway sector.

Members of Pole 2 are committed to work together in common projects to be funded by national and international stakeholders and / or the European

Commission and to establish a regular exchange of new researching results and ideas at European level.

In order to fulfil these objectives in a full, effective and possibly speed way within the selected Thematic Areas have been progressively identified potential research projects and, among them, priority projects (in Thematic Areas 1, 3 and 7) to be speeded up for addressing closer FP6 calls (call 3B was launched on 01.04.2005 with deadline for proposals presentation on 01.09.2005).

The work performed in the last two months made available a first set of more refined descriptions of the selected projects in Project Sketches (PS) and, for the priority projects, a first Draft of project Proposals (DP).

In the following tables a larger description of the Thematic Areas with the identification of specific objectives and the references to the attached more detailed / extended documents have summarised to give synthetic ideas at first glance of planned research activities within the Pole.

5 Actions supporting the establishment of the pole

Collaboration (group of activities A)

Responsible partner: UOB.

Objectives: facilitate integration of Pole 2 members and support cross-pole contacts to develop new project collaboration opportunities.

Sectors of activity:

1. Reviewing and reporting on existing competencies and projects of Pole 2 members;
2. Monitoring work of other poles, and identifying and reporting on potential cross-pole collaboration opportunities;
3. Making, developing and briefing Pole members about contacts with industry;
4. Making, developing and briefing Pole members about contacts with the EU;
5. Monitoring and reporting on funding opportunities;
6. Facilitating project team building;
7. Monitoring and developing project development process.

Resource needs and sources: within EURNEX (WPs contribution in support / funding, contribution in kind by partners / possible future use of Pole activity incomes, etc.) and outside EURNEX (external sponsors / supports, etc.).

Self promotion (group of activities C)

Responsible partner: UTBM.

Objectives: disseminate the excellence of the Pole and increase the visibility of the Pole itself and of its customer-oriented Scientific Services catalogue sheet

Sectors of activity:

1. Pole image improving: improvement of the impression that the Pole gives to potential stakeholders, choice of a logo and a name (e.g. EURNEX PII or EURNEX OPERAIL), updated brochure summarising all necessary information;
2. Dissemination: participation to conferences and opening special sessions (e.g. COMPRAIL 2006, IFAC Symposium INCOM 2006, etc.), publication of articles in journals and proposition of special issues;
3. Partnership reinforcement: possible introduction of new participants in research projects.

Resource needs and sources: about 1,5 person months from EURNEX WPs + EURNEX support for Website, name and logo planning and management.

Education and training (group of activities D)

Responsible partner: UPCE.

Objectives: increase the excellence of Pole education and training platforms and participate to education initiatives at EURNEX level in co-operation with WP7 and Pole 10.

Sectors of activity:

1. Organisation of common training activities: framework for Short Training Courses (STC) migration to business cases (e.g. customers, lecturers, duration, required audience background, language, venue, fees);
2. Organisation of common education activities: shared Masters and PHD courses;
3. Planning of internal training: participation to Short Training Courses.

Resource needs and sources:

Support to STC organisation (from WP7) and STC partners participation (from WP2).

6 Pole development and milestones planning

Short term actions schedule (by June 2005)

Additional short term actions will be specifically oriented to the consolidation of the Pole structure and activities.

Namely they are:

- check of structure and contents of the Thematic Areas (e.g. prioritisation of multiple projects in some areas / possible overlapping);
- prioritise contacts with other Poles and arrange meetings;
- check feasibility of videoconference for particular meetings;
- Definition of a framework for Pole 2 Short Training Courses (e.g. customers, lecturers, duration, required audience background, language, venue, fees).

Mid term actions (by December 2005)

The following actions are planned for completion by the end of year 2005:

- identification of an extended list of potential customers and selection and contacts of a pilot set of them for all the identified Thematic Areas, including meetings with EC FP6 officers to discuss proposals (by July 2005);
- full development of priority research projects proposals and submission to FP6 Call 3B (whenever applicable) (by September 2005);
- establishing contacts with potential industrial customers / partners (by October 2005);
- investigation on possible future funding sources to be activated (by October 2005):
 - by final customers (IM, RU, Industries),
 - by customers clusters (ERA, UIC, UITP, UNIFE),
 - by subjects representing collective interests (EU, National and local authorities / governments);
- full development of pilot research projects proposals in all the identified Thematic Areas on the basis of pilot customers requirements and submission to FP6 Call 4 (whenever applicable) (by December 2005);
- selection of further projects proposals to be developed within each Thematic Area (by December 2005);
- building up of a first version of a customer-oriented Scientific Services catalogue sheet (problems that the Pole 2 is able to manage within each Thematic Area) on a modular basis (by December 2005);
- full partners integration and capabilities gaps recovering fulfilment (by December 2005);
- full operation of Pole self promotion plan (by December 2005);

- identification of Short Training Courses to be organised in the framework of Pole 2 activities.

Long term actions (by June 2006)

The following actions have been provisionally identified (a larger overview and major details on the already identified actions will be included in the later versions of the Pole Action Plan):

- issue of a complete customer-oriented Scientific Services catalogue sheet (problems that the Pole 2 is able to manage within each Thematic Area) on a modular basis (by March 2006);
- dissemination to potential customers of the Scientific Services catalogue sheet (by June 2006);
- development of identified research projects within each Thematic Area on the basis of the potential funding sources to be activated (by June 2006).
- full operation and monitoring of partners' integration activities and Pole self promotion plan (along the whole period till June 2006);
- implementation of identified Short Training Courses (by June 2006).