

COST

Domain Committee “Transport and Urban Development”

COST Action TU0904

Start Date 29th March 2010

Integrated Fire Engineering and Response (IFER)

MONITORING PROGRESS REPORT

Reporting Period: from 27th May 2011
to 25th May 2012

This Report is presented to the relevant Domain Committee.
It contains three parts:

- I. Management Report** prepared by the COST Office/Grant Holder
- II. Scientific Report** prepared by the Chair of the Management Committee of the Action
- III. Previous versions of the Scientific Report;** i.e., part II of past reporting periods

The report is a “cumulative” report, i.e. it is updated annually and covers the entire period of the Action.

Confidentiality: the documents will be made available to the public via the COST Action web page except for chapter *II.D. Self evaluation*.

Based on the monitoring results, the COST Office will decide on the following year’s budget allocation.

Executive summary (max.250 words):

Fire safety is nationally managed in the EU, and practice is determined by specific national experiences. This can lead to similar processes being re-researched and re-invented country by country. With the introduction of common standards in areas related to fire safety, COST TU0904 is intended to share experience and research across the whole field. Fire engineering researchers tend to specialise in fire dynamics, structural fire engineering, environmental protection or human response, and these disciplines scarcely interact. Practitioners, including fire engineers, building/fire control authorities and fire-fighters, take a holistic view of fire safety but, being outside academic networks, lack in-depth awareness of research. Through encouraging interaction between different aspects of fire safety across these key players in different countries, the network intends to propagate the necessary awareness of the current state of the art and best practice, and to avoid repetition of research.

After two years the Action has 22 signatories. Its second “deliverable”, reporting on advanced performance-based fire engineering design, conducted in the context of recent practical construction projects, is a 374-page compendium of Case Studies. The main interactive event of the second year has been a very successful 3½-day Training Course attended by 25 young researchers. The budget for the year has enabled a more extensive programme of Short-term Scientific Missions for young researchers than in Year 1. The third “deliverable”, on Fire and Rescue Service reports, is currently being developed, and a Core Group meeting will be held shortly to make decisions on its format and content.

I. Management Report



I.A. COST Action Fact Sheet

- **COST Action TU0904 – Integrated Fire Engineering and Response (IFER)**
- **Domain Transport and Urban Development**

- **Action details:**

CSO Approval: 2/12/2009

End date: 28/03/2014

Entry into force: 20/01/2010

Extension:

- **Objectives** *The main objective of this Action is to break down the barrier preventing the exchange of information and experience between researchers from different disciplines on the one hand and between academia and practitioners (including fire-fighters) on the other hand. Thanks to the exchange of international experience, ideas and state-of-the-art on fire risk concepts and assessment methods, the Action aims at providing concrete applications of the performance-based fire safety design methods to practitioners and at introducing the latest research into standards for fire design. Fire engineering researchers are specialists working in specific areas, such as fire dynamics, structural fire engineering, active/passive fire protection, environmental protection and human response. Since the background sciences of these disciplines are different at present there is little interaction between researchers. Practitioners, including fire engineers and building/fire control authorities, tend to consider fire safety as a whole, but lack in-depth awareness of recent advances in research. Through encouraging integration of different aspects of fire engineering and response, the Action will enable researchers with different fields of expertise and coming from different countries to understand better the recent advances in research in parallel fields, as well as their limitations, so that they see their own research in context, and identify opportunities in involvement of early-stage researchers and application of the results in national standards. Practitioners, fire fighting authorities and building control authorities will benefit from exposure to advanced research findings, discussion with the research community, and the sharing of best practice and others’ experiences. On the other side their input will make researchers aware of real-world constraints, as well as current requirements for new research and for the development of European standards.*

- **Parties:**

Austria 03/02/2010	Greece 10/03/2010	Romania 03/02/2010
Belgium 03/02/2010	Hungary 12/07/2010	Slovakia 10/05/2010
Czech Rep. 12/07/2010	Iceland 05/07/2010	Spain 20/01/2010
Finland 20/01/2010	Italy 03/02/2010	Sweden 10/05/2010
FYR of Macedonia 03/02/2010	Malta 23/02/2011	Switzerland 12/07/2010
France 10/02/2010	Poland 20/01/2010	United Kingdom 20/01/2010
Germany 20/01/2010	Portugal 26/01/2010	

- **Intentions to accept:** Croatia, Slovenia

- **Other participants:** HERA House, New Zealand

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• **Action Web site:** <http://fire.fsv.cvut.cz/ifer>

• **Grant Holder Representative:** Prof. Ing. Vaclav Havlicek, Rector, havlicek@fel.cvut.cz

• **Working Groups**

WG1: Fire Behaviour and Fire Safety

WG2: Structural Safety

WG3: Integrated design

Prof. Gintaris Kaklauskas, LT	DC
Dr Ana Maria Lacasta, ES	WG1
Dr Bart Sette, BE	WG1
Dr Bin Zhao, FR	WG1
Dr Dan Pinteau, RO	WG1
Dr Dimitrios Tsatsoulas, EL	WG1
Dr Florian Block, UK	WG1
Dr Guillermo Rein, UK	WG1
Dr Jean-François Cadorin, BE	WG1
Dr Lajos Gábor Takács, HU	WG1
Dr Mariusz Maslak, PL	WG1
Dr Miodrag Drakulic, HR	WG1
Dr Ulf Goransson, SE	WG1
Dr Zenon Drabowicz, PL	WG1
Mr Antalné Lörík, HU	WG1
Mr Bodvar Tomasson, IS	WG1
Mr Carlos Couto, PT	WG1
Mr Christoph Klinzmann, DE	WG1
Mr Krzysztof Biskup, PL	WG1
Mr Zdeněk Sokol, CZ	WG1
Ms Kamila Horova, CZ	WG1
Prof. Emidio Nigro, IT	WG1
Prof. Fabio Casciati, IT	WG1
Prof. Gianfranco De Matteis, IT	WG1
Prof. Goran Turk, SI	WG1
Prof. Jean-Marc Franssen, BE	WG1
Prof. Joao Paulo Rodrigues, PT	WG1

Prof. Markku Heinisuo, FI	WG1
Dr Buick Davison, UK	WG2
Dr Frederic Marimon, ES	WG2
Dr Gaetano Della Corte, IT	WG2
Dr Giuseppe Cefarelli, IT	WG2
Dr Jochen Köhler, CH	WG2
Dr Jochen Zehfuss, DE	WG2
Dr Leslaw Kwasniewski, PL	WG2
Dr Markus Knobloch, CH	WG2
Dr Martin Gillie, UK	WG2
Dr Miquel Ferrer, ES	WG2
Dr Mónika Hajpál, HU	WG2
Dr Pawel Krol, PL	WG2
Dr Raul Zaharia, RO	WG2
Dr Stephen Hicks, NZ	WG2
Dr Tomaz Hozjan, SI	WG2
Mr Albert Jimenéz, ES	WG2
Mr Christos Tsalikis, EL	WG2
Mr Jan Bednar, CZ	WG2
Mr Kamil Vargovský, SK	WG2
Mr Koce Todorov, MK	WG2
Mr Thomas Kirsch, DE	WG2
Mr Tomas Jana, CZ	WG2
Ms Cécile Haremza, PT	WG2
Ms Cvetanka Filipova-Chifliganec, MK	WG2
Ms Dafni Pantousa, EL	WG2
Ms Maria Jelcic Rukavina, HR	WG2

<i>Ms Milica Jovanoska, MK</i>	<i>WG2</i>
<i>Ms Monika Oswald, AT</i>	<i>WG2</i>
<i>Prof. Abdelhamid Bouchair, FR</i>	<i>WG2</i>
<i>Prof. Aldina Santiago, PT</i>	<i>WG2</i>
<i>Prof. Andrea Frangi, CH</i>	<i>WG2</i>
<i>Prof. Bernardin Peroš, HR</i>	<i>WG2</i>
<i>Prof. Dan Dumitrescu, RO</i>	<i>WG2</i>
<i>Prof. Dubravka Bjegovic, HR</i>	<i>WG2</i>
<i>Prof. Ezio Cadoni, CH</i>	<i>WG2</i>
<i>Prof. Frantisek Wald, CZ</i>	<i>WG2</i>
<i>Prof. Ljupcho Lazarov, MK</i>	<i>WG2</i>
<i>Prof. Magdalena Stujberova, SK</i>	<i>WG2</i>
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<i>Prof. Meri Cvetkovska, MK</i>	<i>WG2</i>
<i>Prof. Milan Veljkovic, SE</i>	<i>WG2</i>
<i>Prof. Peter Schaumann, DE</i>	<i>WG2</i>
<i>Prof. Raffaele Landolfo, IT</i>	<i>WG2</i>
<i>Prof. Venkatesh Kumar Kodur, US</i>	<i>expert</i>
<i>Prof. Yong Wang, UK</i>	<i>WG2</i>
<i>Dr Beatrice Faggiano, IT</i>	<i>WG3</i>
<i>Dr Dhionis Dhima, FR</i>	<i>WG3</i>
<i>Dr Ionel - Puiu Golgojan, RO</i>	<i>WG3</i>
<i>Dr Jens Upmeyer, DE</i>	<i>WG3</i>

<i>Dr Jyri Outinen, FI</i>	<i>WG3</i>
<i>Dr Michal Jandera, CZ</i>	<i>WG3</i>
<i>Dr Nuno Lopes, PT</i>	<i>WG3</i>
<i>Dr Robert Kowalski, PL</i>	<i>WG3</i>
<i>Mr Antonio Bilotta, IT</i>	<i>WG3</i>
<i>Mr Carlos Souto, PT</i>	<i>WG3</i>
<i>Mr Csaba Szilagyi, HU</i>	<i>WG3</i>
<i>Mr Jim Marsden, UK</i>	<i>WG3</i>
<i>Mr Niels Peter Hoj, CH</i>	<i>WG3</i>
<i>Mr Paul Jenkins, UK</i>	<i>WG3</i>
<i>Mr Petr Kučera, CZ</i>	<i>WG3</i>
<i>Mr Ruben Paul Borg, MT</i>	<i>WG3</i>
<i>Mr Rudolf Kaiser, CZ</i>	<i>WG3</i>
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<i>Prof. Ian Burgess, UK</i>	<i>WG3</i>
<i>Prof. Paulo Vila Real, PT</i>	<i>WG3</i>

I.B. Management Committee member list

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I.C. Overview activities and expenditure

2.nd year Budget

Total Action Budget:
120.750,00

Remaining Action Commitment: *accrued expenses are marked with **

Meetings

Meeting Type	Date	Place	Nb of participants	Nb of reimbursed P.	Cost	Total
<i>MC and WG Meeting</i>	<i>14-15/10/2011</i>	<i>Chania (EL)</i>	<i>37</i>	<i>36</i>		29.580,34
<i>MC and WG Meeting</i>	<i>10-11/04/2012</i>	<i>Sliema (MT)</i>	<i>29</i>	<i>28</i>		21.914,80
<i>Core group Meeting</i>	<i>15-16/06/2012</i>	<i>Naples (IT)</i>	<i>11</i>	<i>9</i>		7.920,00 estim.

STSM

Beneficiary	Date	Place	Host	Topic	Cost	Total
<i>Eki Lehtimäki</i>	<i>05-18/12/2011</i>	<i>Sheffield (UK)</i>	<i>Ian Burgess</i>	<i>Integration of structural analysis in fire with building information model</i>		1.200,00
<i>Marcin Balcerzak</i>	<i>10-20/03/2012</i>	<i>Leeds (UK)</i>	<i>Florian Block</i>	<i>Computer simulation of structures in fire</i>		1.200,00
<i>Antonio Bilotta</i>	<i>08-17/05/2012</i>	<i>Edinburgh (UK)</i>	<i>Guillermo Rein</i>	<i>Fire behaviour of FRP-RC members: experimental results and numerical simulations</i>		1.200,00*
<i>Jiri Jirku</i>	<i>17-26/05/2012</i>	<i>Manchester (UK)</i>	<i>Yong Wang</i>	<i>Heat Transfer in Fire</i>		1.200,00*
<i>Eva Dvorakova</i>	<i>03 - 13/06/2012</i>	<i>Zurich (CH)</i>	<i>Andrea Frangi</i>	<i>Numerical modelling of timber-concrete composite floor</i>		1.200,00*
<i>Joao Ribeiro</i>	<i>10-15/06/2012</i>	<i>Lulea (SE)</i>	<i>Milan Veljkovic</i>	<i>Impact FIRE</i>		1.640,00*
<i>Daphne Pantousa</i>	<i>18-25/06/2012</i>	<i>Sheffield (UK)</i>	<i>Ian Burgess</i>	<i>Numerical analysis of steel structures under fire conditions</i>		1.300,00*

<i>Josef Sura</i>	<i>05-15/06/2012</i>	<i>Bratislava (SK)</i>	<i>Ludovít Fillo</i>	<i>Fire Design of Concrete Columns</i>		1.000,00*
<i>Naveed Iqbal</i>	<i>03-09/06/2012</i>	<i>Coimbra (PT)</i>	<i>Aldina Santiago</i>	<i>Compfire</i>		962,00*

Workshops

Title	Date	Place	Cost	Total
				0

General Support Grants

Beneficiary	Date	Cost	Total
			0

Schools

Title	Date	Place	Details	Cost	Total
<i>Training School</i>	<i>11-14/04/2012</i>	<i>Sliema (MT)</i>	<i>"Fire Engineering Research - Key Issues for the Future", 25 trainees, 9 scholars</i>		27.595,22

Dissemination

Title	Date	Place	Details	Cost	Total
<i>Action Website</i>	<i>10/02/2012</i>	<i>Prague (CZ)</i>	<i>Preparing and service from 6/2011 to 6/2012</i>		2.000,00
<i>Integrated Fire Engineering and Response, Case Studies</i>	<i>03/04/2012</i>	<i>Prague (CZ)</i>	<i>Print release, 374 pages, 200 copies</i>		1.467,91
<i>Fire Engineering Research - Key Issues for the Future, Materials of Training School</i>	<i>05/2012</i>	<i>Prague (CZ)</i>	<i>Print release, 170 pages, 200 copies</i>		850,00*

Others

<i>Distribution of Materials of Training School</i>	1.000,00*
<i>Distribution of Case Studies</i>	1.000,00*
<i>Financial and Scientific Administration and Coordination</i>	15.750,00

Action Total: 119.980,27

II. Scientific Report

II.A. Networking during the Action Year 2011 – 2012

Having struggled in the previous year with a budget which did not allow all of the originally planned activities to take place, given the eventual number of signatory countries, it was fortunate that the 2011-12 budget had increased substantially. Although 22 countries have now signed-up to the Action it proved possible not only to fulfil the original intentions for the year, but to include a successful Training Course for young researchers.

Working Group Meetings at Chania, Greece on 14-15 October 2011

The Working Group and Management Committee meetings at Chania were interspersed so that Working Group presentations, which were held in plenary session, took place between the opening and closing sessions of the MC meeting. Presentations were given at the meeting in two sessions (16:00-19:00 on 14 October, and 09:30-14.00 on 15 October). The 35 presentations represented final drafts of the design case studies which have subsequently been published in hard-copy as a compendium providing a guide to the practice of performance-based design. A template for the final format of these had been prepared by the Action Chairman, and a check-list of information to be covered had been prepared by Dr Florian Block. The case studies contain a considerable amount of integration between structural fire engineering, fire behaviour and provision for response, and therefore their associations with the themes of Working Groups were; 15 WG1, 18 WG2 and 11 WG3. The common factor in all of the case studies was their association with real construction or refurbishment projects for which fire safety issues had been dealt with as part of the building design, usually on a performance basis.

The Chania MC meeting received the feedback from the 2011 DC meeting, that progress was “In Line” with the MoU, with advice; 1. to develop promotion activities in non-specialist publications, in order to advertise itself more effectively; 2. to emphasize inputs to standardisation. Arrangements were made to finalise and publish the compendium of Case Studies. The MC noted the greatly improved budget, but the desire to run a worthy Training Course for young researchers (postponed from 2010-11) suggested that the planned meetings at Luleå would prove too expensive. An offer to conduct the MC and Training course in sequence in Malta in April 2012 provided a potential solution to this problem. The vice-Chairman outlined a tentative scheme for the Training Course, which would be entitled “Fire Engineering Research - Key Issues for the Future”, and would run for 3½ days. The proposal was accepted.

MC Meeting and Training Course at Sliema, Malta 10-14 April 2012

The Sliema MC meeting was partly devoted to preliminary discussions for future Work Packages (benchmark studies, the Prague ASFE conference in 2013, Eurocode recommendations, educational dimension), and partly to the intermediate (draft) stage of the next deliverable, Fire Brigade Reports. This will probably be the most challenging of the deliverables, since it is outside the research scope of the majority of national delegates to the Action, who are mainly academic researchers. A total of 27 draft presentations were given, generally falling into three categories: organisation of national fire and rescue arrangements, contributions from available statistical data and lessons from disaster. In all of these categories there seemed to be a clear need for recommendations and templates to achieve standardization in both the approach and presentational format. It was therefore decided that a special two-day Core Group meeting should be held during June 2012 to decide these issues.

The Training Course for Young Researchers was conducted from the afternoon of 11 April to the evening of 14 April 2012. The first 1½ days was devoted to presentations from some of the most active research leaders in fire engineering in Europe, together with the industrial design and the fire and rescue service viewpoints. The objective was to give thought-provoking presentations which encouraged wide-ranging discussion and inspiration of new ideas to the potential next generation of research leaders of the field. The next two days were filled with “brainstorming” sessions in which each researcher introduced his/her own work and an open discussion was held to attempt to help with any perceived problems. Clearly a major advantage of the event was the opportunity for these young researchers to make valuable contacts and discuss their work informally.

II.B. Inter-disciplinary networking

The work of the Action is inherently inter-disciplinary, since it brings together researchers from different disciplines (structural fire engineering and fire science), and also includes interaction with the key players in design of buildings for fire resistance and in response to fire emergencies. The viewpoint of responders is fundamental to the Work Package which is currently in progress, and it was considered essential that this viewpoint be emphasized to young researchers in the Malta Training Course.

II.C. New networking

- Additional members joining the Action during 2011- 2012
Croatia: Prof. Dubravka Bjegovic, Prof. Bernardin Peros, Dr. Miodrag Drakulic, Ms. Marija Jelcic Rukavina.
Slovenia: Prof. Goran Turk, Dr. Tomaz Hozjan.
- Total number of individual participants involved in the Action's work
At present 118 individuals have participated in the Action, of which 16,95% have been female and 40,67% Early-stage Researchers. The latter number has increased particularly because of the Training School.
- Involvement of early-stage researchers in the Action
STSMs
6 STSMs had been planned for grant year 2011-12, but the budget was modified after the second meeting to allow more STSMs. The STSMs approved under the 2011-12 budget are:
 1. Eki Lehtimäki, 05/12/2011 – 18/12/2011, from Tampere (Finland) to Sheffield (UK), host Ian Burgess, theme Integration of structural analysis in fire with building information model.
 2. Marcin Balcerzak, 10/03/2012 – 20/03/2012 from Warsaw (Poland) to Leeds (UK), host Florian Block, theme Computer simulation of structures in fire.
 3. Antonio Bilotta, 08/05/2012 - 17/5/2012 from Naples (Italy) to Edinburgh (UK), host Guillermo Rein, theme Fire behaviour of FRP-RC members: experimental results and numerical simulations.
 4. Jiri Jirku, 17/5/2012 – 26/05/2012 from Prague (Czech Republic) to Manchester (UK), host Yong Wang, theme Heat Transfer in Fire.
 5. Eva Dvorakova, 03/06/2012 – 13/06/2012 from Prague (Czech Republic) to Zurich (Switzerland), host Andrea Frangi, theme Numerical modelling of timber-concrete composite floors.
 6. João Ribeiro, 10/06/2012 – 15/06/2012 from Aveiro (Portugal) to Lulea (Sweden), host Milan Veljkovic, theme Impact Fire.
 7. Daphne Pantousa, 18/06/2012 – 25/06/2012 from Volos (Greece) to Sheffield (UK), host Ian Burgess, theme Numerical analysis of steel structures under fire conditions.
 8. Josef Sura, 05/06/2012 – 15/06/2012 from Prague (Czech Republic) to Bratislava (Slovakia), host Ludovít Fillo, theme Fire Design of Concrete Columns.
 9. Naveed Iqbal, 03/06/2012 – 09/06/2012 from Luleå (Sweden) to Coimbra (Portugal), host Aldina Santiago, theme COMPFIRE modelling.

Conference funding for young researchers

Two requests were made for Conference Grants for Early-stage Researchers: Antonio Bilotta and Giuseppe Cefarelli (both from Naples) for the Structures in Fire conference 2012, Zurich. The response is awaited at present.

Training School for young researchers

This ran from 11 - 14 April, 2012 in Sliema, Malta. A total of 25 young researchers participated in the 3½-day intensive event "Fire Engineering Research - Key Issues for the Future":

• Guillermo Abril	Spain	• Kamila Horova	Czech Republic
• Alexandru Botici	Romania	• Tomaz Hozjan	Slovenia
• Giuseppe Cefarelli	Italy	• Naveed Iqbal	Sweden
• Carlos Couto	Portugal	• Jiri Jirku	Czech Republic
• Josep Culí	Spain	• Pawel Krol	Poland
• Aleksandra Cvetanovska	FYR Macedonia	• Daphne Pantousa	Greece
• Gianluca De Sanctis	Switzerland	• Robert Pecenko	Slovenia
• Diana Duma	Romania	• Mikko Salminen	Finland
• Roberta Fonti	Italy	• Ruirui Sun	United Kingdom
• John Gales	United Kingdom	• Csaba Szilagyi	Hungary
• Monika Hajpal	Hungary	• Teemu Tiainen	Finland
• Cecile Haremza	Portugal	• Neno Toric	Croatia
• Tim Heisterman	Sweden		

Networking activities

Early-stage researchers are involved in the work of the Action's work packages. During the Chania Meeting 16 contributions to WP2 were prepared in cooperation with young researchers. In the Malta Meeting 11 contributions to WP3 were based on the work of young researchers. In the published Case Studies 19 of the papers were prepared by young researchers.

- Involvement of researchers from outside the COST Countries
 In TU0904 6 researchers (5,08%) are from countries outside the COST Action. One external participant, Dr Stephen Hicks of HERA, New Zealand, participated in the Chania meeting, delivering a presentation "Fire performance of an office building with long-span cellular floor beams – Britomart East, Auckland", which is now published in the Case Studies document. From countries with a newly declared intention to participate in the Action, Prof. Dubravka Bjegovic, Prof. Bernardin Peros and Dr. Miodrag Drakulic joined the Chania and Malta Meetings. With their young researchers they published the paper "Reliability of steel roof structures of The Spaladium sports hall in case of fire" in the Case Studies.

At the Training School early-stage researchers from countries outside the Action participated. Neno Toric from Croatia presented "New numerical models for behaviour of steel and concrete structures exposed to fire", Dr. Tomaz Hozjan from Slovenia presented "Analysis of steel-concrete composite beam with interlayer slip in fire conditions" and Robert Pecenko, also from Slovenia, presented "Fire analysis of prestressed hollow-core slabs".
- Promotion of scientific knowledge through publications and other outreach activities
 All documentation concerning the progress of the work of the Action are available for download at the Action's website <http://fire.fsv.cvut.cz/ifer>. This includes all presentations from meetings, papers and full versions of printed publications.

The main deliverable output of the year 2011-12 is a volume "Integrated Fire Engineering and Response: Case Studies" describing practical fire engineering design applied to real projects in recent years. The final printed version contains 33 contributions from across the participant nations, in a volume of 374 pages. A total of 200 copies have been printed and are being distributed by the participants within individual countries.

The Training School conducted in Malta has given rise to the publication "Fire Engineering Research - Key Issues for the Future". The printed volume includes the presentations of 8 scholars and the abstracts of the work of the 24 participating young researchers. The presentations of the trainees are available from the project website.

Promotional text on the Action has been translated into local languages, to be published in different countries. This year an article has been published in the Finnish national journal of the Fire and Rescue Service. Two other articles, in Portuguese and German, are awaiting publication. An article about COST TU0904 was published in Newsletter 32 of the International Association of Fire Safety Science. This can be downloaded from the Action website.

During the Chania Meetings information about the Action was published on the Greek web news. The article is available from the Action website.

A local seminar was organized in the Czech Republic during February 2012 on the theme of the integration of performance-based calculation methods into fire safety solutions for structures. The COST action is promoted in the printed publication connected to this seminar. Other local seminars are under preparation for Spain (Ana Lacasta) and Greece (Daphne Pantousa).
- Activities and projects with COST network colleagues
 Prof. Dubravka Bjegovic is currently preparing a WP7 Educational Dimension proposal; at the Malta Meeting she proposed that an educational project related to fire safety should be prepared by the Action. She has undertaken to distribute a brief summary, to generate a discussion of the form and content of this proposed initiative, and to allow members of the Action to propose their own contributions to it.
- The capacity of the Action members to raise research funds
 The networking offered by this Action has provided opportunities, beyond those which would normally exist via the academic meetings/conferences circuit, to meet and discuss potential research proposals. Initial discussions are progressing on several themes at present.

II.D. Self evaluation

The relative margin in the second year's budget, after the need to postpone the Training Course in the first year of the Action, allowed this important aspect to be improved over what could have been achieved in the first year. It proved to be possible to invite 25 young researchers to the course, and to provide a format which was suitable for high-level researchers, enabling them to hear and discuss controversial opinion pieces from some of the key researchers of the current generation. The brainstorming sessions enabled the participants to think about each others' work and to attempt to assist in its development; this broadening of the research context should be valuable for their development as research workers. The informal networking and the new contacts made among the young researchers will also be useful to them in future.

The Case Studies compendium has provided a useful library of practical experiences which will allow fire engineers throughout Europe to view state-of-the-art advanced fire engineered construction projects and the techniques employed. These will be invaluable in propagating performance-based fire engineering, which is a prime objective of the project.

III. Previous scientific report

III.A. Networking during the Action Year 2010 – 2011

Kick-off Meeting, Brussels 29-30 March 2010

The Management Committee (MC) kick-off meeting in Brussels was attended by representatives of 13 of the 14 countries which had joined the Action at that time. The Chair and vice-Chair of the Action were elected. It was explained that new COST Actions were part of a grants framework, and that CVUT Prague would therefore be considered as the grant holder. The Action budget had been calculated on the basis of the current number of signatories, with the implication that the joining of subsequent signatories would demand careful budget management during the year; this has influenced the activities of the year considerably, as will become apparent. The role and scope of each of the Working Groups (WGs) was debated, an initial allocation of MC members among the 3 WGs was made, and Chair and vice-Chair of each were elected.

Workshop at UPC Barcelona on 5-6 July 2010

The initial Workshop included presentations by all WG members, and meetings were held of the MC and the three WGs. In order to begin the process of integration, which is the major theme of the Action, all presentations were made to the whole membership and illustrated the current themes and expertise of the presenters' research groups. There were 52 10-minute presentations, all of which are now available on the Action website. As an additional means of communicating background information among the membership, participants prepared poster displays; 55 posters were produced which are also available via the Action website. Within the 3 WGs the scope of expertise is reflected in the subjects presented:

WG1: Fire Behaviour and Fire Safety: The presentations (12) showed a balance between:

- summaries of fire science and fire safety research in various of the represented countries (Poland, Finland, Spain, Romania, Greece),*
- research problems concerned with thermal analysis of steel and aluminium structures in fire,*
- observation of thermal behaviour in real tests,*
- approaches to the behaviour of fires and heating of structure in unusual design cases.*

WG2; Structural Safety: Among the academic research participants in COST TU0904 this is the most developed area of active research, and this provided the largest single group of presentations (26) on a variety of structural fire engineering themes:

- summaries of structural fire engineering research and practice in various of the represented countries (Poland, Switzerland, Spain, Romania, Slovakia, Germany, Macedonia),*
- new design proposals for fire safety in the Nordic countries,*
- current research summaries for academic groups at ETH Zurich, TU München and CVUT Prague,*
- the structural behaviour of concrete materials and structural elements, both during and after fires,*
- observation and modelling of timber joints in fire,*
- the effect of elevated temperatures on the structural behaviour of natural stone masonry,*
- tests on loaded connections in car parks under the effect of localised fires,*
- thermal analysis of steel connections in composite structures in fire,*
- advanced numerical simulation of structural response to building fires,*
- analyses of structural fire effects on structures already damaged by earthquake actions,*
- steel beams under end moment in fire,*
- temperature-dependent properties of fire protection materials,*
- the need for design for robustness in future structural fire engineering practice.*

WG3: Integrated design: At the start of the Action it was important to update participants on the current context linking the engineering disciplines of fire safety and structural fire resistance design with national regulations and practice. There were 14 presentations from WG3 members:

- summaries of regulations and current practice in various of the represented countries (Romania, Portugal, Czech Republic, UK),*
- case studies in fire safety engineering from Portugal and Italy,*
- case studies on protection of built heritage - report on recent projects and their possible impact on integrated design (Belgium),*
- current research on fire safety at Warsaw University of Technology,*
- analytical design studies of buildings for the case of fire after being damaged by earthquakes,*
- mathematical and stochastic modelling in fire safety and design against extreme loadings in general.*

Working Group meetings before and after these presentation sessions concentrated on planning for the State-of-the-Art Report (WP1). The discussions produced different formats from the WGs, reflecting the different contexts, and the intensity of current research activity, of each of the subject areas:

WG1: Fire Behaviour and Fire Safety: a subject-based subdivision;

WG2; Structural Safety: summaries of research expertise in the participants and the countries of the Action;

WG3: Integrated design: a contextual summary for each country, based on a common questionnaire.

The Barcelona MC meeting was forced to take immediate account of a serious shortfall in the annual budget which, in conjunction with a post-budget increase in signatories from 14 to 20, made it necessary to abandon the objective of holding an Autumn MC meeting in Luleå. It was fortunate that the final conference of COST C26 in Naples was to be attended by all countries of TU0904; this enabled the Autumn 2010 MC meeting to be reorganised at no cost to the Action.

MC Meeting, Naples 17 – 18 September 2010

The main discussion of this MC meeting concerned the feasibility of proceeding with the remaining planned events for 2010-11, given the budgetary shortfall in this year. It was decided to defer the Prague Conference from 29-30 February 2011 to 29 April 2011, and to run it in a one-day format in order to minimise expenses. Reimbursement to COST TU0904 members would be limited to whatever the budget available at the time could afford; the conference would go ahead regardless of external support.

Conference on Applications of Structural Fire Engineering, Prague 29 April 2011

The Conference was held as planned, in a one-day format. In order to maximise value for the participants it was decided to limit oral presentation time to 6-7 minutes per paper, while still keeping to a single session, but to encourage discussion by placing emphasis on poster presentation, including open voting for the best poster overall. The Conference Proceedings, including all 72 papers, 62 slide presentations and 55 posters, all in PDF form, are available for download from the Action's website, and so the subject areas covered need not be detailed here. In order to encourage young researchers to develop their presentation and dissemination skills an award was made for "Best Young Researcher", judged on the basis of their oral and visual presentations and their posters. Although the one-day format was intense, the conference was undoubtedly successful. Future events, whether one- or two-day, would clearly be enhanced by running a full 2-hour poster session at which voting and discussions could take place.

MC Meeting, Prague 30 April 2011

Once again the need to work meaningfully within a very tight 2010-11 budget was a major influence on the discussion. The decision to postpone the Training School for young researchers was inevitable, since this could have been very expensive if places were taken up by all the partner countries. The State-of-the-Art Report had been published before the Prague meeting, and was distributed to members. Meetings of WGs, and a full session of all three, focused on the next deliverable, a collection of practical design Case Studies. As a first step, it was decided to issue a check-list as an aid to the groups developing the Case Studies; Dr Florian Block (UK) agreed to produce this check-list. The Chair of the Action will prepare a template to standardise the structure and presentation of the Case Studies.

III.B. Inter-disciplinary networking

Inter-disciplinarity is at the heart of this Action, and the nature of the State-of-the-Art reports, as well as two open events held without specialist sessions, is to disseminate knowledge from within the 3 WGs across the entire group of disparate specialists. This spreads awareness of research, issues and practice in the complementary disciplines. For researchers in WGs 1 and 2 the Barcelona presentations from fire responders on national attitudes and policies concerning performance-based design provided invaluable information about the context in which their results will be practised, and the key drivers for building control authorities. A similar but wider benefit was gained from the WG3 State-of-the-Art questionnaire responses on the national controls and processes in different countries; this will be useful even across European control authorities. Clearly there is benefit for researchers in both the "fire science" and "structural fire" communities in making associations between progress in their complementary fields.

It is perhaps too early to state categorically whether socio-economic impacts will be observed within the period of the action. However, if the two research-based WGs can influence control authorities on policy, and designers on the practice of performance-based methods, there is a very clear route to socio-economic impacts. In most countries only prescriptive fire resistance methods are commonly used or permitted at present. Although lip-service is paid to the need to move to performance- and risk-based methods, regulators need more knowledge of these methods, and the ways in which colleagues in the leading countries are taking them into account.

III.C. New networking

- Additional members joining the Action during 2010-11: Czech Republic, Hungary, Iceland, Slovakia, Sweden, Switzerland
- Total number of individual participants involved in the Action work: At present there are 91 individual participants, of which 14,3% are female, and 16,5% are Early-stage Researchers.
- STSMs: Because of the restricted budget available in the year 2010-11 only two STSMs have been granted, although 2 more are expected before June 2011. Current approved STSMs are:

1. Kamila Horová, 21/2/2011 – 7/3/2011 from Prague to Tampere (M. Heinisuo), (Design fires),
 2. Gang Dong, 19/6/2011 – 25/6/2011 from Sheffield to Coimbra (L. Simoes da Silva), (Reverse channel components in fire).
- Conference funding for young researchers: Requests were made at the Prague MC meeting for conference attendance grants for Petra Kallerová (CVUT Prague); Guillermo Rein (Edinburgh); Antonio Bilotta (Naples). They were asked to submit the forms as soon as possible. Members have been asked to submit applications for the 2011-12 Action year.
 - Training Schools: It has been necessary to postpone the Training School scheduled for June-July 2011 because of insufficient funding. It is very much hoped that it will be possible to reschedule this for later in the action.
 - Involvement of researchers from outside the COST Countries: At this stage one external participant (Dr Stephen Hicks, HERA, New Zealand) has joined the Action. In 2010-11 his active participation was curtailed by the NZ earthquake, but he will be invited to participate in subsequent phases. One international expert (Prof Venkatesh Kodur, Michigan State University, USA) participated in the Prague conference.
 - Publications and other outreach activities: Apart from the State-of-the-Art Report and the Proceedings of the International Conference, which represent the main outputs of the Action so far, some local articles have been published in national journals. Two articles are already in print (Konstrukce 4/2010, Czech Republic; Inzynieria i Budownictwo 11/2010, Poland), and others are in the pipeline.

III.D. Self evaluation

In difficult budgetary circumstances the first year of TU0904 has succeeded in running the Action much as originally envisaged. Two major scientific events have been staged, in Barcelona and Prague, producing documents (72 research papers, 110 posters and 114 slide presentations) which provide an excellent picture, freely available, of current performance-based fire engineering research, particularly in Europe which is the principal centre of this research worldwide. In addition, the 238-page State-of-the-Art Report gives an overview of the background knowledge relevant to performance-based fire engineering, in fire science and safety, structural behaviour, and the regulatory context within which it must be practised, in a wide range of countries. This last is vital for the growth of performance-based practice in the design of buildings to resist fire; regulators need to be persuaded that their national building construction and maintenance regimes and objectives do not differ fundamentally from those of other countries, and that it is possible to adapt practices which have proved successful elsewhere.

The relative failures of the year have been caused by financial constraints. It is a matter of particular regret that it was not possible to stage the planned Training Course for young researchers in this year, because a key objective is to accelerate and enhance the training of the next generation of world-class researchers in the fire engineering field by bringing them together with established experts, so that their future research will complement that in other parts of Europe rather than duplicating it. It is very much hoped that a future year's budget will allow this course to be run.

The fact that the Action Conference became a single-day, rather than a two-day, event had both positive and negative aspects. The printed papers published as Proceedings allowed a relatively detailed document of record for fellow workers in their fields, while short oral presentations maintained interest for participants in cognate fields. The requirement for posters was a stimulus for detailed discussions with their authors; the only problem was the lack of time for a further 2-hour session which could have been devoted to these discussions. This lesson will influence the organisation of the future public events of the Action.