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EC 5th Framework

PERFORMANCE BASED BUILDING THEMATIC NETWORK 2001-2005



PeBBu Final Report



Performance Based Building Thematic
Network: 2001 - 2005



2001-2005

Performance Based Building Thematic Network
PeBBu Final Report



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FINAL REPORT

Performance Based Building Thematic Network



Author, report layout / cover design

Ms. Mansi Jasuja
CIBdf, The Netherlands

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Performance Based Building Network (PeBBu) is a thematic network funded under the European Commission's (EU) 5th framework - Competitive and Sustainable Growth and has been operational from October 2001 till September 2005. This project has been managed by CIBdf, The Netherlands. The PeBBu Network has been facilitating in enhancing the existing performance based building research and activities by networking with the main European stakeholders and other international stakeholders. The network has also been producing synergistic results for dissemination and adaptation of performance based building and construction. More than 70 organisations worldwide have been participating in the PeBBu Network.



PeBBu Coordinator:
Wim BAKENS
wim.bakens@cibworld.nl



PeBBu Programme Manager:
Mansi JASUJA

CIB (PeBBu) General Secretariat

Postal Address: Postbox 1837, 3000 BV
Visitors Address: Kruisplein 25-G, 3014 DB
Rotterdam
The Netherlands
Email: secretariat@cibworld.nl
Tel: +31.10.4110240
Fax: +31.10.4334372

www.pebbu.nl

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FOREWORD

Performance Based Building! The concept has been around for a few decades, although it still implies different things to different people. The professional building world has taken a microscope and has gone about studying it in a scientific way. They have been aided in this task amongst others by the European Union who decided to fund the PeBBu network in 2001. I first came across the term Performance Based Building when I took up the position of the PeBBu programme manager in 2003 and began to unravel the mysteries of the concept for myself by reading the already published work on it. In no time, I was lost in all the words! Then I took a new approach and asked many PBB experts on what this means to them in simple terms. For, if you cannot explain the concept in a simplified manner to a novice, it's intake into the everyday practice of design, building and construction would be impossible! After all, one of the major drivers for PBB concept are clients who are more often than not lay-men in the technicalities of building and construction. Take for instance, a typical conversation when I, as the programme manager (PM) try to explain to non-building professionals (NBP) the concept of PBB:

NBP: So what do you do?

PM: I work as the programme manager of a Thematic Network funded by the EU, which basically does research and implementation of a concept called Performance Based Building - PBB.

NBP: Hmm... what does it mean? PBB?

PM: well, the PBB approach is the practice of thinking and working in terms of ends rather than means.

NBP: Huh? What does that mean?

PM: It means that the focus of building should be on what a building is supposed to do, and not on how it is to be constructed..

NBP: That sounds complicated. I don't quite understand. How do you achieve that?

PM: Our project has now come up with a consensus document called the conceptual framework on PBB. That explains the concept in a simple and easy manner, which you might like to read. PBB can be achieved by making sure the client defines the requirements of whatever the building is meant for in a detailed manner and for the suppliers that is, the architects, the contractor, the services providers etc. to ensure that they follow the requirements precisely.

NBP: But...but isn't that common sense? Why do you need to study this?

PM: oh well...it might be common sense but the practice is different from reality. The PBB approach ensures that the building process is efficient, you don't "over-design" or "under-design" the building. It is thus a more cost-efficient method too. Another major advantage is that it is innovation oriented since it gives more flexibility to the designers and the service-providers to meet a goal. The entire process becomes less prescriptive and more innovative.

NBP: And how does one put aesthetic requirements in black and white?

PM: you'll have to read the report of our Domain 3 - design of buildings to understand that!

NBP: So what about the building regulations? Do they influence the concept? Can one do away with them if the process is not prescriptive anymore?

PM: Of course not! The building regulations are a big drive and incentive for PBB. One of the domains or themes of our project is dealing solely with this theme. You should read that report too!

NBP: aha...interesting...



Mansi JASUJA
CIBdf, The Netherlands
Programme Manager, PeBBu Project

I'd like to take this opportunity to thank all the PeBBu community, all Task Leaders (in particular Christer Sjoström, Marcel Loomans, Dik Spekkink, Peter Barrett, Paolo Cardillo, Karoly Matolcsy, Greg Foliente and Fracoise Szigeti for many enriching discussions), Steering Committee and CIBdf board members who have helped to enlighten this path for me. Many thanks to the entire CIB secretariat for all the support and help especially Tom Heyblom for teaching me the financial tricks, Peggy van Asch for all the lists she had to generate, Wim Bakens for his guidance. A special thanks is due for Merss. Georgios Katalagarianakis and Christophe Lesniak, our EU scientific officers, who have supported the PeBBu network greatly.

EXECUTIVE SUMMARY

Application of the performance concept is gaining worldwide interest and acceptance. It is becoming increasingly recognised as the basis for harmonisation and globalisation of the building market. An international awareness with respect to PBB is growing and much of this credit can go to the PeBBu Network. The PeBBu Network, established in 2001, has been facilitating in enhancing the existing performance based building research and activities by networking with the main European stakeholders. It has produced synergistic results for dissemination and adaptation of performance based building and construction and has had a key role in triggering off a global interest in the principles of Performance Based Building.

The main objective of the PeBBu Network has been “**Stimulation and pro-active facilitation of international dissemination and implementation of Performance Based Building in building and construction practice**”, and in that context to maximise the contribution to this by the international R&D community. This objective is achieved through many sub objectives.

The **main initial components** of the PeBBu Network include the 9 Scientific Domains, 4 Regional European Platforms, 3 User Platforms, the Research Mapping Database and the Network Secretariat.

The main criteria of success for the PeBBu Thematic Network have been its operation and growth as a network. In both these aspects, PeBBu has been a very successful network. By the end of the second year, the PeBBu network was already **established and operational**. The enthusiasm of the partners, internal and external communication of the network and the exchange of experiences and ideas within the network have been exemplary. In addition to this excellent cooperation of the initial partners, over the 4 years, the network has expanded in many spheres.

The PeBBu **website**, www.pebbu.nl, with its state of the art design and navigation, has become the main platform for internal communication and exchange within the network. It is beginning to be acknowledged as the world's premier portal to information on PBB. All the PeBBu deliverables, reports and publications, news articles and contact database information are available and downloadable from the PeBBu website.

The PeBBu Network included from the start 33 Member organisations in EU countries plus 2 organisations in respectively Canada and the USA that provided Task Leaders. In past 4 years, the network **expanded** to include a Newly Associated States (NAS) programme, acquired 26 (including NAS: 39) **new observer-members and liaisons from across the world**. Another major triumph has been the launch of an **Australian PeBBu programme** (Aus-PeBBu) in October 2003. This requires no additional funding from the EU and has enabled Australia to participate in the global move towards the performance approach that has occurred in Australia and elsewhere through regulatory changes from a prescriptive to a performance based building code. Aus-PeBBu has been expanding to include countries from the Pacific Rim and South-East Asia. In Poland, a national level platform has been incorporated in setting up the ECTP platform in which PBB is also an issue although of a minor significance. A South African national platform is currently under consideration.

Apart from this, several other **aligned activities** to promote PBB principles have also taken place such as the development and launch of 2 PeBBu Compendia and the involvement with and support of several CIB commissions. Another major **plan for dissemination** of PBB principles was achieved by being part of a major international conference that was held in June 2005 in Helsinki at which the main outcomes of the PeBBu network were presented.

Other main achievements of the network include:

- Production of **22 State of the Art Reports** (See Annex 8) including 9 scientific domain reports, 4 regional platform reports in various themes of PBB.
- **Production & publication of the 1st & 2nd International State of the Art Report**, which give an overview of the status of PBB in an international context. The International SotA highlights the SotA of the PBB subject addressing the following topics: Definition/Scope of PBB, Conceptual Framework, Stakeholders, User Needs, Performance Requirements and Criteria, Fitness for Use, Assessment Methods, Regulatory Concerns, Standardization, Economic Performance, Decision-Making Tools, Performance Measures and Key Performance Indicators, Risk Analysis, Quality Management, Research Needs, Incentives and Barriers, Strategic and Operative Routes for Further Implementation. In addition it presents a summary of the Network's main outcome, the proposed PBB Research Agenda. The contents of the report are based on the vast PBB-relevant existing literature as well as on the outcomes of the Thematic Network PeBBu. The 1st International SotA has been published as a CIB publication and the 2nd one as a PeBBu publication. These are excellent tools to disseminate vital information on PBB.
- **Production of a final East European SotA Report** (NAS SotA).
- **Production of a high level, global synthesis of RTD agenda for PBB.**
- **Setting up of a prototype of interactive website for educational purposes** in 2 PBB themes of Indoor environment and design of buildings.
- **Establishment of many strategic relationships** with both European and international organisations.

In conclusion, the PeBBu Network is well under operation and has accomplished much. All the domains and regional platforms are functioning well and so are the technical and steering committees. As can be viewed in Chapter 2, a lot of scientific research and results have been achieved in various fields of Performance Based Building and these are starting to have an impact on the international stakeholder community. With the ending of the EU funding in 2005, it will be hard to keep up the network's momentum in promoting PBB principles. However, it is hoped that under EU Framework 7, a continuation of the PeBBu project in some form would be possible. A few current PeBBu task leaders have taken the lead in this aspect.

The first part of this report compiles of the main objectives of the PeBBu project (Chapter 1). A detailed scientific and technical assessment of each task within the PeBBu framework (Chapter 2), a complete list of deliverables Chapter 3, comparison of planned activities and actual deliverables (Chapter 4) and a plan for use and dissemination of each result (Chapter 5) is given in the main body of this report. Chapter 6 provides the main management and coordination issues which have been faced by the project since it's inception. Chapter 7 gives the main conclusions and summary of the report. Complete individual Task Reports, Mid-Term interventions, brief summaries of RTD synthesis, prototype website for educational purposes, lists of all PeBBu task leaders, contacts, meetings etc. are provided in the Annexes. A Technological Implementation Plan is provided as a separate document. An e-TIP has been submitted to the EU via the Cordis website.

CONTENTS

	Foreword	3
	Executive Summary	5
	Contents	9
1	OBJECTIVES OF THE PROJECT	19
1.1	OBJECTIVES	19
1.2	ORGANISATIONAL STRUCTURE	20
1.3	STRATEGIC ASPECTS	21
1.3.1	<i>EU Membership and Expansion</i>	21
1.3.2	<i>Alignment of International R&D</i>	21
1.3.3	<i>Enhanced International Alignment of Sector Interests</i>	21
1.3.4	<i>Review and Interventions</i>	21
1.3.5	<i>Economic gains forecast (suppliers – manufacturers – users)</i>	22
2	SCIENTIFIC & TECHNICAL DESCRIPTION OF THE RESULTS	27
2.1	OVERALL SCIENTIFIC & TECHNICAL ASSESSMENT OF PeBBU	27
2.2	PeBBU NETWORK: OVERVIEW OF MAIN ACHIEVEMENTS	28
2.2.1	<i>Operability of the Network</i>	28
2.2.2	<i>Spread of the Network</i>	28
2.2.3	<i>Aligned Activities</i>	29
2.3	OTHER ACHIEVEMENTS	31
2.4	ACCOMPLISHED WORKPLAN AND DELIVERABLES	31
2.5	MEMBERS	33
2.6	DETAILS OF THE NETWORK TASKS & DELIVERABLES	34
2.6.1	<i>Nine Scientific Domains</i>	35
2.6.2	<i>Three User Platforms</i>	37
2.6.3	<i>Four Regional Platforms</i>	39
2.6.4	<i>Mapping of Research Activities</i>	42
2.6.5	<i>Three New Generic Tasks</i>	43
2.6.6	<i>Aligned Tasks</i>	44
2.6.7	<i>PeBBu Prototype Interactive Website for Educational Purposes</i>	45
2.6.8	<i>Regional / National Platforms</i>	45
2.6.9	<i>Assigned Task Leaders</i>	45
2.6.10	<i>Network management</i>	47
2.6.11	<i>Individual Task Reports</i>	49
2.7	OVERVIEW OF SCIENTIFIC & TECHNICAL PROGRESS PER TASK	50
2.7.1	<i>Scientific Domains</i>	50
2.7.2	<i>User Platforms</i>	63
2.7.3	<i>Regional Platforms</i>	67
2.7.4	<i>International Research Mapping</i>	70
2.7.5	<i>NAS SotA Report</i>	71
2.7.6	<i>Generic Tasks</i>	72
2.7.7	<i>Compendia</i>	74
2.7.8	<i>2nd International SotA Report on PBB</i>	76
2.7.9	<i>Research Agenda</i>	77
2.7.10	<i>PeBBu Prototype Interactive Website for Educational Purposes – a guide to PBB</i>	77

3	LIST OF DELIVERABLES	81
3.1	COMPARISON OF PLANNED AND ACTUAL PEBBU TASKS & DELIVERABLES DURING THE ENTIRE PROJECT	81
4	COMPARISON OF INITIALLY PLANNED ACTIVITIES & ACTUAL WORK ACCOMPLISHED	85
4.1	OVERALL ACTIVITIES	85
4.2	INDIVIDUAL TASKS	85
4.2.1	<i>Scientific Domains</i>	85
4.2.2	<i>User Platforms</i>	93
4.2.3	<i>Regional Platforms</i>	93
4.2.4	<i>International Research Mapping</i>	95
4.2.5	<i>Steering Committee</i>	95
4.2.6	<i>Technical Committee</i>	95
4.2.7	<i>Network Secretariat</i>	96
4.2.8	<i>NAS SotA</i>	96
4.2.9	<i>Generic Tasks</i>	97
4.2.10	<i>Compendia</i>	97
5	PLANS FOR USE & DISSEMINATION.....	101
5.1	PEBBU OVERALL DELIVERABLES: PLANS FOR USE AND DISSEMINATION	101
5.2	USE & DISSEMINATION STRATEGIES FOR PEBBU TASKS RESULTS	105
5.3	TECHNOLOGICAL IMPLEMENTATION PLAN (E-TIP)	105
6	MANAGEMENT & COORDINATION ASPECTS.....	109
6.1	OVERALL PERFORMANCE OF TASK LEADERS / MEMBERS	109
6.2	NETWORK MANAGEMENT	110
6.2.1	<i>Steering Committee</i>	110
6.2.2	<i>Technical Committee</i>	110
6.2.3	<i>Network Secretariat</i>	111
6.2.4	<i>Internal and external communication</i>	111
6.2.5	<i>Publications</i>	112
6.2.6	<i>Financial Management</i>	112
6.3	NETWORK COMPOSITION / MEMBERSHIP	113
6.3.1	<i>NAS Extension</i>	113
6.3.2	<i>Observer members and Liaison Organisations</i>	113
6.4	EXTERNAL COOPERATION	114
6.4.1	<i>Other EU programmes and networks</i>	114
6.4.2	<i>Aligned CIB projects</i>	114
6.4.3	<i>Non-EU Co-operation</i>	114
6.5	DOMAINS AND PLATFORMS	115
6.5.1	<i>Coordination of domain activities</i>	115
6.5.2	<i>User Platform activities</i>	116
6.5.3	<i>Regional Platforms activities</i>	116
7	CONCLUSIONS.....	121
	ANNEXES	127
	ANNEX 1: PEBBU TASK REPORTS	127
	ANNEX 1.1: TASK REPORT FOR DOMAIN 1: LIFE PERFORMANCE OF CONSTRUCTION MATERIALS AND COMPONENTS	127
	1. <i>Executive summary</i>	127
	2. <i>Objectives of the task</i>	128
	3. <i>Scientific and Technical assessment</i>	128
	4. <i>Deliverables</i>	133
	5. <i>Plans for Use and Dissemination</i>	135
	6. <i>Management and co-ordination aspects</i>	138
	7. <i>Results & Conclusions</i>	138
	8. <i>Acknowledgements</i>	141

ANNEX 1.2: TASK REPORT FOR DOMAIN 2: INDOOR ENVIRONMENT	142
1. Executive summary	142
2. Objectives of the task	143
3. Scientific and Technical assessment	143
4. List of deliverables	147
5. Plans for Use and Dissemination.....	148
6. Management and co-ordination aspects.....	151
7. Results & Conclusions	151
8. Acknowledgements	152
ANNEX 1.3: TASK REPORT FOR DOMAIN 3: DESIGN OF BUILDINGS	153
1. Executive summary	153
2. Objectives of the task	154
3. Scientific and Technical assessment	154
4. List of deliverables	159
5. Plans for Use and Dissemination.....	160
6. Management and co-ordination aspects.....	161
7. Results & Conclusions	162
ANNEX 1.4: TASK REPORT FOR DOMAIN 4: BUILT ENVIRONMENT	163
1. Executive Summary	163
2. Scope and Objectives	164
3. Scientific & Technical Assessment.....	164
4. List of Deliverables:	166
5. Plans for Use & Dissemination.....	166
6. Management & Coordination Aspects.....	167
7. Results & Conclusions	167
8. Acknowledgements	167
ANNEX 1.5: TASK REPORT FOR DOMAIN 5: ORGANISATION & MANAGEMENT.....	168
1. Executive summary	168
2. Objectives of the task	169
3. Scientific and Technical assessment	169
3. List of deliverables	170
4. Plans for Use and Dissemination.....	170
5. Management and co-ordination aspects.....	171
6. Results & Conclusions	171
ANNEX 1.6: TASK REPORT FOR DOMAIN 6: LEGAL & PROCUREMENT PRACTICES	172
1. Executive Summary	172
2. Objectives of the Task	173
3. Scientific and Technical Assessment.....	173
4. List of deliverables	175
5. Plans for Use and Dissemination.....	176
6. Management and co-ordination aspects.....	177
7. Conclusions	177
8. Acknowledgements	177
ANNEX 1.7: TASK REPORT FOR DOMAIN 7: BUILDING REGULATIONS	178
1. Executive summary	178
2. Objectives of the task	179
3. Scientific and Technical assessment	179
4. List of deliverables	184
5. Plans for Use and Dissemination.....	185
6. Management and co-ordination aspects.....	185
7. Results & Conclusions	186
8. Acknowledgements	186
ANNEX 1.8: TASK REPORT FOR DOMAIN 8: BUILDING INNOVATION	187
1. Executive summary	187
2. Objectives of the task	187
3. Scientific and Technical assessment	188
4. List of deliverables	191
5. Plans for Use and Dissemination.....	191

6. Management and co-ordination aspects.....	192
7. Results & Conclusions.....	192
8. Acknowledgements.....	193
ANNEX 1.9: TASK REPORT FOR DOMAIN 9: INFORMATION & DOCUMENTATION.....	194
1. Overview.....	194
2. Scope and Objectives:.....	194
3. Conceptual Framework:.....	195
4. Methodology and Process:.....	195
5. State of the Art:.....	196
6. Dissemination and Implementation:.....	197
7. Conclusions:.....	198
ANNEX 1.10: TASK REPORT FOR USER PLATFORM 1: OWNERS / USERS / MANAGERS USER PLATFORM.....	199
1. Executive summary.....	199
2. Objectives of the task.....	200
3. Scientific and Technical assessment.....	200
4. List of deliverables.....	202
5. Plans for Use and Dissemination.....	202
6. Management and co-ordination aspects.....	203
7. Results & Conclusions.....	203
8. Acknowledgements.....	203
ANNEX 1.11: TASK REPORT FOR USER PLATFORM 2: BUILDING & CONSTRUCTION INDUSTRY.....	204
1. Executive summary.....	204
2. Objectives of the task.....	204
3. Scientific and Technical assessment.....	205
4. List of deliverables.....	206
5. Plans for Use and Dissemination.....	206
6. Management and co-ordination aspects.....	206
7. Results & Conclusions.....	206
ANNEX 1.12: TASK REPORT FOR USER PLATFORM 3: INTERNATIONAL STANDARDISATION & CONFORMITY.....	207
1. Executive summary.....	207
2. Objectives of the task.....	208
3. Scientific and Technical assessment.....	208
4. List of deliverables.....	209
5. Plans for Use and Dissemination.....	210
6. Management and co-ordination aspects.....	210
7. Results & Conclusions.....	210
8. Acknowledgements.....	210
ANNEX 1.13: TASK REPORT FOR REGIONAL PLATFORM 1: NORTH EUROPEAN REGIONAL PLATFORM.....	211
1. Executive summary.....	211
2. Objectives of the task.....	212
3. Scientific and Technical assessment.....	212
4. List of deliverables.....	217
5. Plans for Use and Dissemination.....	218
6. Management and co-ordination aspects.....	218
7. Results & Conclusions.....	219
8. Acknowledgements.....	219
ANNEX 1.14: TASK REPORT FOR REGIONAL PLATFORM 2: WEST/CENTRAL EUROPEAN REGIONAL PLATFORM.....	220
1. Executive summary.....	220
2. Objectives of the task.....	220
3. Scientific and Technical assessment.....	221
4. List of deliverables.....	222
5. Plans for Use and Dissemination.....	222
6. Management and co-ordination aspects.....	223
7. Results & Conclusions.....	224
ANNEX 1.15: TASK REPORT FOR REGIONAL PLATFORM 3: EAST EUROPEAN REGIONAL PLATFORM.....	225
1. Executive summary.....	225
2. Objectives of the task.....	226
3. Scientific and Technical assessment.....	226

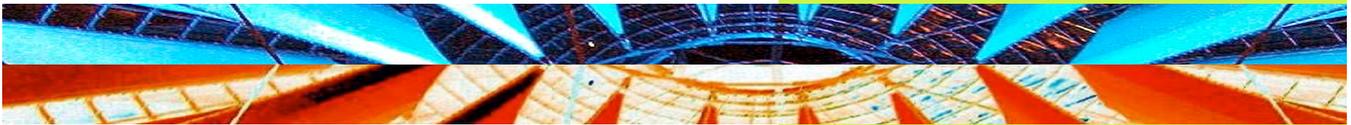
4. List of deliverables	234
5. Plans for Use and Dissemination.....	234
6. Management and co-ordination aspects.....	235
7. Results & Conclusions	236
8. Acknowledgements	237
ANNEX 1.16: TASK REPORT FOR REGIONAL PLATFORM 4: MEDITERRANEAN EUROPEAN REGIONAL PLATFORM	238
1. Executive summary	238
2. Objectives of the task	238
3. Scientific and Technical assessment	239
4. List of deliverables	241
5. Plans for Use and Dissemination.....	241
6. Management and co-ordination aspects.....	242
7. Results & Conclusions	242
8. Acknowledgements	242
ANNEX 1.17: TASK REPORT FOR INTERNATIONAL RESEARCH MAPPING	243
1. Executive summary	243
2. Objectives of the task	243
3. Scientific and Technical assessment	244
4. List of deliverables	245
5. Plans for Use and Dissemination.....	245
6. Management and co-ordination aspects.....	245
7. Results & Conclusions	246
8. Acknowledgements	246
ANNEX 1.18: TASK REPORT FOR STEERING & TECHNICAL COMMITTEE'S	247
1. Objectives of the task	247
2. Scientific and Technical assessment	248
3. List of deliverables	249
4. Plans for Use and Dissemination.....	249
5. Management and co-ordination aspects.....	249
6. Results & Conclusions	250
ANNEX 1.19: TASK REPORT FOR NETWORK SECRETARIAT / NETWORK MANAGEMENT.....	251
1. Objectives of the task	251
2. Scientific and Technical assessment	252
3. List of deliverables	253
4. Plans for Use and Dissemination.....	254
5. Management and co-ordination aspects.....	255
6. Results & Conclusions	255
ANNEX 1.20: TASK REPORT FOR FINANCIAL MANAGEMENT	256
1. Objectives of the task	256
2. Management and co-ordination aspects.....	256
3. Results & Conclusions	257
ANNEX 1.21: TASK REPORT FOR NAS SOTA	258
1. Executive summary	258
2. Objectives of the task	259
3. Scientific and Technical assessment	259
4. List of deliverables	264
5. Plans for Use and Dissemination.....	264
6. Management and co-ordination aspects.....	265
7. Results & Conclusions	265
8. Acknowledgements	266
ANNEX 1.22: TASK REPORT FOR GENERIC TASK 1: CPD	267
1. Executive summary	267
2. Objectives of the task	268
3. Scientific and Technical assessment	269
4. List of deliverables	269
5. Plans for Use and Dissemination.....	269
6. Management and co-ordination aspects.....	270
7. Results & Conclusions	270

ANNEX 1.23: TASK REPORT FOR GENERIC TASK 2: CRISP	271
1. <i>Executive summary</i>	271
2. <i>Objectives of the task</i>	271
3. <i>Scientific and Technical assessment</i>	271
4. <i>List of deliverables</i>	272
5. <i>Plans for Use and Dissemination</i>	272
6. <i>Management and co-ordination aspects</i>	273
7. <i>Results & Conclusions</i>	273
ANNEX 1.24: TASK REPORT FOR GENERIC TASK 3: DST	274
1. <i>Executive summary</i>	274
2. <i>Objectives of the task</i>	275
3. <i>Scientific and Technical assessment</i>	275
4. <i>List of deliverables</i>	275
5. <i>Plans for Use and Dissemination</i>	275
6. <i>Management and co-ordination aspects</i>	276
7. <i>Results & Conclusions</i>	277
8. <i>Acknowledgements</i>	277
ANNEX 1.25: TASK REPORT FOR COMPENDIUM 1: BUILDING PERFORMANCE MODELS	278
1. <i>Overview</i>	278
2. <i>Building Performance Models</i>	278
3. <i>Structure of the Compendium</i>	279
4. <i>Compendium Entries</i>	280
5. <i>Classification of Models</i>	280
6. <i>Contributing to the Compendium</i>	281
7. <i>Guide to Environmental Design and Assessment Tools</i>	281
ANNEX 1.26: TASK REPORT FOR COMPENDIUM 2: STATEMENT OF REQUIREMENTS	283
1. <i>Executive summary</i>	283
2. <i>Objectives of the task</i>	284
3. <i>Scientific and Technical assessment</i>	284
4. <i>List of deliverables</i>	285
5. <i>Plans for Use and Dissemination</i>	285
6. <i>Management and co-ordination aspects</i>	286
7. <i>Results & Conclusions</i>	287
8. <i>Acknowledgements</i>	287
ANNEX 2: MID-TERM INTERVENTIONS	288
ANNEX 2.1 STEERING COMMITTEE INTERVENTIONS	288
ANNEX 2.2: BUDGET IMPLICATIONS PER MEMBER FROM THE SC INTERVENTION DECISIONS	290
2.2.1 - PeBBu NAS	295
ANNEX 3: CIB COMMISSION PROJECTS	296
ANNEX 4: LIST OF NEW MEMBERS FROM NAS EXTENSION	298
ANNEX 5: INFORMATION ON 3 NATIONAL PLATFORMS	299
ANNEX 5.1: SWEDEN	299
1. <i>Everybody is supportive – few can make it happen!</i>	299
2. <i>Who has the key?</i>	299
3. <i>Performance approach instrumental for innovation climate</i>	300
4. <i>BIC - Swedish Construction Sector Innovation Centre</i>	300
5. <i>A Swedish National Platform</i>	300
6. <i>International dimension</i>	301
ANNEX 5.2: AUSTRALIA – AUS-PEBBU PROGRAMME	302
1. <i>Listing of Aus-PeBBu Task Members</i>	302
2. <i>Overview</i>	302
3. <i>Network Structure and Technical Domains</i>	302
4. <i>Industry Participation</i>	304
5. <i>Participation in EU PeBBu Domain Meetings</i>	305
6. <i>Aus-PeBBu Web-site and Communication with Australian Industry</i>	305

7. Aus-PeBBu Seminars	305
8. Asia Pacific Network.....	307
9. Key Reports and Publications	307
ANNEX 5.3: ISRAEL – ISR-PEBBU	308
1. Scope and Objectives:	308
2. Deliverables.....	308
ANNEX 6: SUMMARY OF SYNTHESIS OF PBB R&D AGENDA.....	310
ANNEX 7: SUMMARY OF PEBBU PROTOTYPE INTERACTIVE WEBSITE TASK	311
1. Introduction	311
2. Framework.....	311
3. Result.....	312
4. Conclusion.....	314
ANNEX 8: LIST OF ALL PEBBU FINAL PUBLICATIONS	315
ANNEX 9: LIST OF CURRENT TASK LEADERS & SUPPORT TO TASK LEADERS	316
ANNEX 10: LIST OF ALL PEBBU CONTACTS.....	318
ANNEX 11: LIST OF ALL PEBBU OBSERVER-MEMBERS / LIAISONS	330
ANNEX 12: LIST OF ALL PEBBU MEETINGS.....	332
ANNEX 13: ATTENDANCE ANALYSIS FROM PEBBU MEETINGS	334
ANNEX 13.1: DOMAIN MEETINGS	334
ANNEX 13.2: REGIONAL PLATFORM MEETINGS	337
ANNEX 13.3: STEERING / TECHNICAL COMMITTEE MEETINGS.....	338
ANNEX 14: LIST OF ALL PEBBU NEWS-ARTICLES	339
ANNEX 15: FINANCIAL TABLES – YEAR 4	ERROR! BOOKMARK NOT DEFINED.
<u>FIGURE 1. INITIAL PEBBU STRUCTURE</u>	<u>20</u>
<u>FIGURE 2. INITIAL NETWORK PLANNING & DELIVERABLES</u>	<u>27</u>
<u>FIGURE 3.: SCHEMATIC OF THE PEBBU NETWORK COMPONENTS</u>	<u>32</u>
<u>FIGURE 4.. CONCEPTUAL FRAMEWORK AS APPLIED FOR THE RESEARCH AGENDA.....</u>	<u>53</u>
<u>FIGURE 5.: ‘PERFORMANCE’ AS THE RESULT OF DIFFERENT SOLUTIONS FOR DIFFERENT SUBSYSTEMS.....</u>	<u>54</u>
<u>FIGURE 6. PBD CALLS FOR INTEGRAL DESIGN</u>	<u>55</u>
<u>FIGURE 7.: FRAMEWORK DEVELOPED FOR ORGANISATION AND MANAGEMENT OF PBB</u>	<u>58</u>
<u>FIGURE 8.: OVERVIEW OF THE CONTEXT.</u>	<u>59</u>
<u>FIGURE 9.: AN EVOLUTIONARY MODEL OF PERFORMANCE BASED BUILDING</u>	<u>61</u>
<u>FIGURE 10. CONCEPTUAL FRAMEWORK AS APPLIED FOR THE RESEARCH AGENDA.....</u>	<u>144</u>



Objectives of the project



CHAPTER 1



1 OBJECTIVES OF THE PROJECT

1.1 Objectives

Performance Based Building (PBB) & PeBBu

Prescriptive building specifications, building codes and standards currently enforced in most countries inhibit both organisational and technological innovation in the building and construction industry. Performance Based Building strives to overcome this problem by using performance requirements to define a building product's fitness for purpose. Performance Based Building addresses the ends rather than means. This is a strong stimulus for product and process innovation and enhances consumer-orientation. When applied, PBB results in very different relationships between the building and construction industry and its clients, and provides a new language for communication between the various practitioners in this industry.

The PeBBu Network, established in 2001, facilitates in boosting the existing performance based building research and activities by networking with the main European stakeholders. It produces synergistic results for dissemination and adaptation of performance based building and construction.

The main objective of the PeBBu Network was “Stimulation and pro-active facilitation of international dissemination and implementation of Performance Based Building in building and construction practice”, and in that context to maximise the contribution to this by the international R&D community, through:

- Stimulation and facilitation of the international programming and coordination of research and implementation projects as concerns Performance Based Building as effectively as possible in order to make optimal use of limited available resources and to prevent unnecessary recurrences.
- Stimulation of actual investments in such research and implementation projects.
- Providing EU Network Members with an optimal access to knowledge and experience as available in non-EU countries in which respective developments have progressed further than in the EU.
- Co-ordinated dissemination and implementation of results of international research in the area of Performance Based Building.

The Network aimed at combining fragmented knowledge in the area of Performance Based Building in order to build a systematic approach towards innovation of the building industry and applying user requirements throughout the building process. From this, white spots and a coherent future research agenda could be derived. End-users, policy makers, building industry and regulatory communities would be closely involved in this development in order to facilitate dissemination and implementation of research results. The Network would especially stimulate investments in research that may be expected to produce practical recommendations for the adoption and application of Performance Based Building throughout the building industry and in all phases of the building process.

The main components of the PeBBu Network, at the start of the project, included 9 scientific Domains, 4 Regional European Platforms, 3 User Platforms, the Research Mapping Database and the Network Secretariat. These components have been detailed out later in Section 2.4.

1.2 Organisational Structure

The structure of PeBBu involved a diverse range of components. These ranged from an established network of research community, undertaking of scientific research, dialogue between users and stakeholders of the building and construction sector, mapping and databases on performance based building, regional interpretations of PBB implementation etc.

The main components of PeBBu at the start of the project were:

- International programming and co-ordination of research and dissemination projects in nine **Scientific Domains** (see below);
- Involvement of target groups / stakeholders from the start of the programme through **three User Platforms** for respectively i) Buildings Owners, Users and Managers, ii) Building and Construction Industry and iii) the International Standardisation & Conformity Community;
- **Mapping of national and international research** related to aspects of Performance Based Building;
- **Four Regional Platforms** in Europe to act as the bridge to and the initiator of aligned national activities (Northern, West/Central, East and Mediterranean);
- **Network Management**, including the establishment of a Network Steering Committee, a Technical Committee and a Network Secretariat that among others are to be responsible for: i) annual technical and financial reporting to the EU, ii) final report, iii) designated website including among others a newsletter, and iv) overall project management.

The following diagram gives the initial components of PeBBu. The components in the shaded boxes in the diagram are funded through the PeBBu Network, while those in the non-shaded boxed are initially envisioned aligned activities that were not funded through PeBBu.

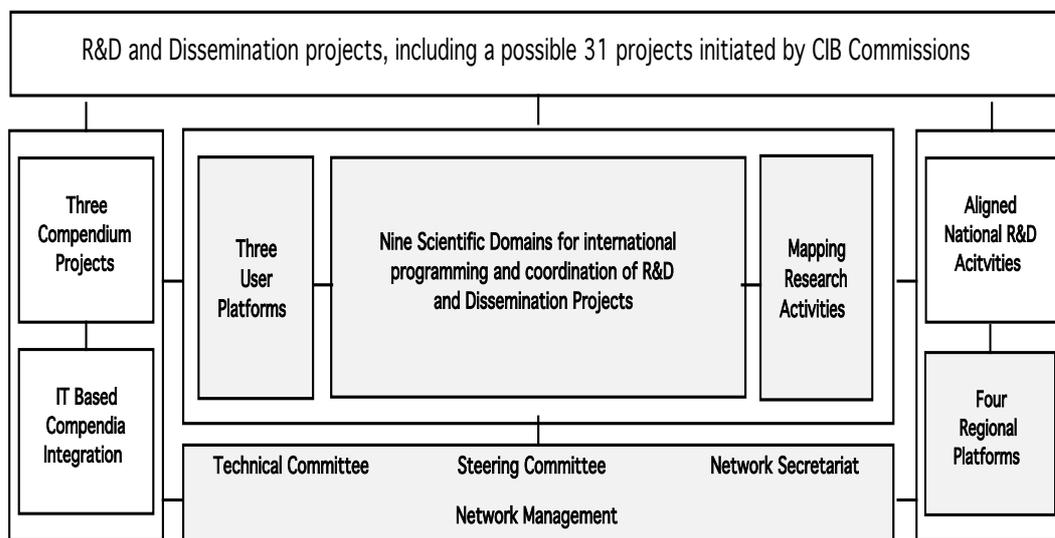


Figure 1. Initial PeBBu Structure

In Year 1 PeBBu expanded to include a Newly Associated States (NAS) programme. The EU NAS countries include 13 new member organisations. One of the objectives of this activity was to produce an East European State of the Art Report (NAS SotA).

An updated version of the PeBBu Organisational Structure diagram that incorporates various new aligned activities is provided in Section 2.4.

1.3 Strategic Aspects

This section provides some information about new developments since the commencement of the PeBBu Network that have had a major strategic impact on the success of the PeBBu Network.

1.3.1 EU Membership and Expansion

At the beginning of the programme, the PeBBu network comprised of 33 members, including 3 non-EU members / observer-members. In the first 2 years of existence, the PeBBu programme has expanded to include countries from NAS, several new observer-members and liaisons have joined the network and an Australian Platform has been launched called Aus-PeBBu. Details of this expansion are given in Section 2.2.2.

1.3.2 Alignment of International R&D

Already by the mid-term of the project, PeBBu has begun to have an impact on the programme of activities of various organisations in the international R&D community in general and in particular via the programme of activities of CIB (International Council for Research and Innovation in Building and Construction). Various projects as initiated by CIB Task Groups and Working Commissions were explicitly aligned with the coordinating work as performed by the operating PeBBu Scientific Domains. Initial results from this alignment are indicated in Section 2.2.3.2. The establishment of Aus-PeBBu and the funding through CIB Members of the production of PBB Compendia are examples of such an impact.

1.3.3 Enhanced International Alignment of Sector Interests

In various domains of interest in the building and construction sector, including the domains of fire engineering, structural engineering and environmental impacts from building and construction, stakeholders are becoming aware that some strategic and typical problems in their domain need to be addressed through the application of different types of regulatory approaches, design tools and construction methods, and that applying the principles of Performance Based Building in this context may be the adequate basis for actually solving such problems.

Most of the decisive stakeholders in those domains are aware of the PeBBu project. To a large extent, the PeBBu project has developed into a platform for achieving international alignment between development activities in several domains. Some alliances have been established especially in the domain of fire engineering through CIB Commission W014 – Fire - and in the domain of structural engineering through the Liaison Committee of International Associations of Structural Engineering (including as members: CIB, ECCS, FIB, IABSE, IASSE and RILEM).

1.3.4 Review and Interventions

The PeBBu project has been regularly reviewed, assessed and steered by the Technical and Steering Committees in the past 4 years.

During a review of the 1st two years of the operation and main results of the PeBBu Network in a Steering Committee meeting held in August 2003, many factors of operation came into light that needed to be addressed. At that moment, some of the main results from the PeBBu Programme were the outcomes from the 9 scientific domains on various aspects of Performance Based Building. It was decided to terminate 3 out of these 9 domains (Domain 4, 5 and 9) due to reasons such as an overlap of this

information in other domains, insufficient past or ongoing international research on the interface between domain themes and PBB. These terminated domains were then required to finalise their Domain Reports and produce an international R&D Agenda by 2004.

The other main intervention was regarding holding of a series of Domain Meetings instead of individual meetings in the coming time. A similar policy was planned for the User Platform Meetings. Some budget interventions were also discussed; this included the recommendation to re-allocate parts of the PeBBu budget in support of initiating defined new activities (all PeBBu member organisations influenced by such recommended budget re-allocations have contacted and have communicated their support to this). All these are detailed out in Annex 2.

In the fourth year, again, several new tasks were introduced since need of these tasks were felt to properly synthesise the results of PeBBu. This included producing a synthesis of the all the R&D agenda's produced by the PeBBu domains and regional platforms. Another task was to produce a PeBBu Prototype Interactive Website for Educational Purposes. Details can be found in Annexes 6 & 7.

1.3.5 Economic gains forecast (suppliers - manufacturers - users)

The following text is an elaboration on forecasted economic gains from an international and integral application of the principles of Performance Based Building in building and construction practice. This text is based on the information presented in the initial PeBBu Workplan. Under each point, the results from PeBBu network are given briefly.

- ❖ *Although prescriptive criteria are uncomplicated and relatively easy to apply and monitor for architects and contractors and third parties involved, they also prove to be a significant barrier for innovation, cost optimisation and international trade:*
- ❖ *Prescriptive regulations are a main barrier for the application of new, improved or altered products. Those products often do not comply with the solution-based prescription indicating materials, form, size and composition to be used. Performance Based Building would overcome this problem and stimulate innovation, leading to enhanced building quality.*

The work of the PeBBu Domain 8 as well as other domain work, has through several case studies presented during domain meetings, proved this to be true. A performance based requirements brief more often than not leads to innovative solutions in design, use of innovative products and thus enhancement of functionality and quality.

- ❖ *The same prescription of solutions hampers the introduction of cheaper products or efficiency measures as the stipulated design also fixes the manufacturing and production process. This blocks, for instance, long-term investments in technological specialisation by construction companies. Performance Based Building would enable optimisation of the production process. This may among other effects, lead to specialisation among the parties involved in the building process: it will become worthwhile to invest in the efficiency of a specific production method. This will lead to further industrialisation of the building industry. For example, performance based tenders for construction will enable construction contractors to immediately realise a substantial optimisation of their traditional work processes.*

PeBBu Domain 6 on Legal and Procurement Practices is the domain primarily working on the above stated issue and has again through case studies and national state of the art concluded the point that performance based building leads to an optimisation of the production process.

- ❖ *National prescriptive regulations obstruct international trade: two countries with differing regulations cannot readily exchange products. Proving the compliance with performance criteria is difficult. Explicit performance based regulations would assist with overcoming this difficulty and increase possibilities for international trade in the building sector.*

The Construction Products Directive (CPD) has a key role to play in facilitating international trade of construction products and components within the EU. PeBBu has introduced CPD and PBB as a new task a year ago, to enable a better understanding of CPD in the PeBBu domains as well as to be able to provide a feedback on the CPD from a performance based perspective.

- ❖ *Performance Based Building will also lead to a reduction of miscommunication throughout the building process, as the required output will be expressed in terms of building performance. This required building performance will serve as a beacon throughout the building process: all agents within the building process will use the same “language” to express the added value of their activities to this required performance.*
- ❖
- ❖ *Performance Based Building enables and enforces clients to explicitly define required performances and enables them to measure whether design and construction activities fit with those requirements. This stimulates both a clearer role for the client during all phases of the project and a better alignment of design and construction with the actual needs of the client.*

Almost all the PeBBu domains are dealing with the aspects of client role and the need for a clear involvement and clarification of requirements by the client in the project. Several case studies have been presented from different countries wherein the clear definition of the performance of a building required has resulted in all building and construction stakeholders to work together in a cohesive manner to fulfil those requirements and thus achieve the desired result by a constant collaboration and feedback mechanism.

In brief the benefits of a sector wide application of Performance Based Building will result in:

- ❖ *Per project enhanced focus on well defined client requirements, consequent client satisfaction and cost reduction*
- ❖ *For the sector as a whole in a building and construction industry that is more client orientated, innovative, and competitive and therefore in the long term more sustainable.*

The expected magnitude of cost saving per project from the integral application of Performance Based Building on both the short and long term are indicated to be about 25%.

It must be realised that this data is in fact not based upon real scientific evidence. It is an indication of a possible magnitude and cannot be more than that as long as international and consensus based methods to measure economic benefits do not exist.



Scientific & Technical Description of the results



CHAPTER 2



2 SCIENTIFIC & TECHNICAL DESCRIPTION OF THE RESULTS

2.1 Overall Scientific & Technical Assessment of PeBBu

The table below gives the time planning and status of all activities to be implemented and outcomes to be delivered in Years 1 to 4, as agreed in the PeBBu work plan at the start of the network (not including the NAS extension of the network in year 1, new activities introduced at mid-term and 4th year of the project, and also not including the aligned PBB activities that are not funded through PeBBu). In the section that follows, the main achievements of the PeBBu Network so far are highlighted followed by a comparison between the original descriptions of work against the work achieved. A detailed scientific and technical assessment has also been made of each task individually.

PeBBu Tasks and Deliverables		Activity	Deliverables		Year					
			Internal	External	1	2	3	4		
Nine Scientific Domains	Contribution to first State-of-the-art Report									
	Two Domain Workshops	Workshop Preparation Report								
		Workshop								
		Workshop Minutes								
	Two Domain Reports									
	Input into PeBBu Website									
	Communication with PeBBu Compendia									
	Assessment of Project Proposals									
	Contribution to Final PeBBu Report									
Domain Support	Input into Workshop Preparation Reports									
	Workshop Participation									
	Distribution Domain Reports									
Three User Platforms	Two Platform Workshops	Workshop Preparation Report								
		Workshop								
		Workshop Report								
Platform Support	Contribution to Final PeBBu Report									
	Input into Workshop Preparation Reports									
	Workshop Participation									
Four Regional Platforms	Contribution to first State-of-the-art Report									
	Three Platform Workshops	Workshop Preparation Report								
		Workshop								
		Workshop Report								
	Initiation National PeBBu Activities									
	Contribution to Final PeBBu Report									
	Platform Support	Input into Workshop Preparation Reports								
Mapping EU Research Activities	Framework and Infrastructure									
	Inventory / Valisation									
	First Inventory Report									
Steering Committee	Four Annual Meetings	Meeting Preparation Report								
		Meeting								
		Meeting Report								
Technical Committee	Two Bi-annual Meetings	Meeting Preparation Report								
		Meeting								
		Meeting Report								
Network Secretariat	Annual Technical and Financial Report									
	First PeBBu State-of-the-art report									
	Final PeBBu Report									
	Website	Development Infrastructure								
		General PeBBu Information								
		Relational Database								
		PeBBu Newsletter								
	Technical Support Unit	Electronic Publications								
		Support Project Elaboration								
	Project Management	Project Assessment Reports								
Attracting new Members										
Coordination other Programmes										
Financial Network Coordination	EU Contacts									
	Supervision Secretary									

Figure 2. Initial Network Planning & Deliverables

2.2 PeBBu Network: Overview of Main Achievements

The following section runs the reader through some of the overall progress of the PeBBu Network and in the course of this highlights the main achievements accomplished in the four years of existence.

2.2.1 Operability of the Network

The PeBBu Network was established 4 years ago. Being primarily a Thematic Network with an aim to stimulate and facilitate the international dissemination and implementation of Performance Based Building, the initial months (for some of the planned activities up to almost a full year) of this project were focused on establishing the network and finding appropriate members to join each domain. By the middle of the second year, the **network was truly established and operational**. Currently, almost 250 members representing different organisations and different countries across the world are a part of the PeBBu network.

Another key successfully operational area of work within the PeBBu Network is the PeBBu **website** www.pebbu.nl, which holds an extensive amount of relevant and varied information on PBB and helps in spreading the network. The news-articles and newsletters, which are a key means of spreading the knowledge on PBB and PeBBu, are also found online on this website and accessible to all. The PeBBu website by now has developed into the main platform for internal communication and exchange within the network and is beginning to be acknowledged as the world's main portal to information on PBB in general.

2.2.2 Spread of the Network

2.2.2.1 PeBBu NAS Expansion

In the course of 2001, it became obvious that in the coming years the EU would be expanded to include the EU-NAS – Newly Associate States. In this case, soon after the construction markets in those countries would be open for construction firms from the current EU countries (and vice-versa). It would be of strategic importance for the building and construction sectors in the current EU countries as well as in the NAS countries that building operational frameworks in all countries should be maximally compatible.

In response, the PeBBu Network submitted a proposal to the EU for expansion to include stakeholders in the development and implementation of Performance Based Building in those NAS countries with available financial EU support. The EU financial support to the - PeBBu NAS expansion was formalised through a PeBBu contract amendment in the beginning of 2003. The respective amendment to the initial PeBBu contract has enabled representatives from the NAS countries to participate in the defined PeBBu Scientific Domains, Regional Platforms and in the Research Mapping Activity.

In the second year, the network spread beyond its initial conception to include the NAS (Newly Associate States). This ensures a complete European perspective for the stimulation and establishment of Performance Based Building practices. 13 new organisations from the NAS countries are now members of the PeBBu Network (these new NAS members are listed in annex 4).

2.2.2.2 Launch of Aus-PeBBu

An Australian version of the PeBBu Network has been launched in October 2003 in Australia. The Australian programme, referred to as Aus-PeBBu, is similar in structure to (EU) PeBBu. (More information in Annex 5.2) With the launch of Aus-PeBBu, Australia is now participating in the global move towards the performance approach, which has occurred in Australia and elsewhere through regulatory changes from a

prescriptive to a performance based building code. This network acknowledges that performance based codes open the door to the use of new materials and practices in building and construction, such as composite products and innovative processes. Aus-PeBBu, like (EU) PeBBu, provides an opportunity to extend the practical application of the performance approach, beyond the mandatory requirements (i.e. specified by the building code) to voluntary user requirements, as part of client brief, and towards best practice and in this context it commits to:

- More user-oriented and cost-effective buildings.
- Promotion of technological innovation.
- Enhanced international trade.

During 2004-2005, Aus-PeBBu has been expanding to include countries in the Pacific Rim and South East Asia with which Australia had cooperation agreements in place (such as New Zealand, China, Malaysia, Vietnam, Hong Kong, Singapore, Indonesia and India).

2.2.2.3 Observer-Members & Liaisons

Several new observer-members and liaisons have joined the PeBBu Network since its inception. The main role of an observer-member has been primarily to participate in one or more scientific domains / tasks. This participation involves discussing ideas, areas of interest within the domain with other members of that domain. The targeted goal of obtaining 20 observer-members by the 2nd year was reached. In addition to the 3 observer-members from the USA and Canada, who participated from the start of the network, 13 new members were added through the NAS expansion of the network. Apart from this, 26 observer members and registered liaison organisations from various countries joined the PeBBu network (listed in Annex 11).

2.2.3 Aligned Activities

Apart from the tasks and objectives defined in the work plan of PeBBu, several aligned activities were initiated in the first 2 years. These activities do not rely on the funding by the European Union but are in explicit support of achieving the defined PeBBu objectives. Some of these aligned activities, which were under successful operation are:

2.2.3.1 PeBBu Compendia

Work was carried to establish two PeBBu related Compendia: one on PBB – Performance Based Building related Models (as to be applied for defining and measuring performances in IT based environments, and the other on PBB Statements of Requirements (to replace the traditional project programmes or briefs that are not performance based).

Compendium of PBB Models

Commissioned by CIB, CSIRO, Australia (with inputs especially by NIST, USA and Technion, Israel) developed a database that includes 30 such PBB models, with each model a description of the following aspects: Name of model, Keywords, Relevant compendium and section, Classification, Certification status, Model description, Examples, Developer, Publisher/Supplier, Availability and Contributor details. Continued expansion and maintenance of this database has been guaranteed by CSIRO and will be resourced from the Aus-PeBBu programme.

Compendium of PBB Statements of Requirements

CIB commissioned ICF, Canada to do a first phase of a preparatory study, in preparation of such compendium. In December 2002, the second phase of this preparatory study was commissioned by CIB, to which RGD, Netherlands and GSA, USA provide substantial financial support. The actual compendium, which included both the inventory and presentation of such Statements of Requirements and various case studies in building and construction practice, has now been finalised.

A separate part of the above mentioned, second preparatory phase towards such PBB Compendium of Statements of Requirements aims for the development of a consensus based PBB conceptual framework and key-terminology. Amongst others, the PeBBu Domain Leaders contributed to such framework and terminology.

Information on the PBB Compendia can be viewed at www.pebbu.nl/alignedcomponents/compendia/.

2.2.3.2 Involvement with/ Support of CIB commissions

Annex 3 provides detailed information on CIB (Task Groups and Working) Commissions that have been established to facilitate international exchange and co-operation in areas that cover aspects of PBB on a voluntary basis. As an average, each such commission incorporates 50 appointed representatives of organisations worldwide who meet on a regular basis and aim for joint, voluntary, international R&D projects in their area. In addition this annex provides information on such international projects of special relevance to PBB as have been initiated by commission with a more general scope, who have decided to focus part of their work on aspects of PBB.

A few examples of such commissions and projects that on a voluntary basis contribute to achieving the defined PeBBu objectives are:

- Performance Definition for Façade Systems
- Development of Quality Management Systems in Construction based on the Performance Approach
- Analysis of Case Studies on Quantitative versus Qualitative Aspects of Performance Based Regulation
- Performance Evaluation of Buildings with Response Control Devices
- Collection of Recent Research on Indoor Air and Performance Based Building

2.2.3.3 Two aligned proposals for EU IP's where PBB was a major issue (Cityhome2010 / Ecospace)

In March 2003, two proposals were submitted for IP's – Integrated Projects – for EU funding in the 6FP, in which major PBB related components were incorporated with the full support of the respective industrial partners:

- CityHome2010, that aims for developing a new European industry for the industrial production and delivery of affordable housing
- EcoSpace, that focuses on the development and application of new technologies for the monitoring and control of indoor environments in spaces, including spaces in buildings.

The PeBBu Secretariat was involved in a co-leading role in the production and submission of these proposals and was able to convince the involved industrial partners to embrace the principles of PBB as a necessary way forward towards required technological and organisational change. However, both submitted proposals were declined for EU support in 2003 and were re-submitted later in 2003. EcoSpace was rejected again. CityHome was accepted in the form of a new project called ManuBuild, but then the PeBBu Secretariat was no longer involved in the respective consortium.

2.2.3.4 PeBBu Conference: 2005, Helsinki

In the conference: “Combining Forces - 11th joint CIB International symposium” held in Helsinki, Finland in 13-16 June 2005, the almost final results of the PeBBu network and from aligned activities were presented. It was a well-attended session and the key-note speech on PBB generated a lot of interest in the network as well as principles of PBB.

2.3 Other achievements

As partly presented above, it can be clearly stated that the PeBBu Network made considerable progress in its 4 years. Some of the main achievements in these 4 years of the existence of the network apart from the ones mentioned above (expansion of the network through NAS and observer-members, launch of Aus-PeBBu and other aligned activities, PeBBu compendia etc.) are:

- **Production of 9 scientific domain reports** in various themes of PBB which summarise effectively the main content-based work and results emanating from the domain work and workshops.
- **Production of the 1st and 2nd International State of the Art Reports**, which give an overview of the status of PBB in an international context. The International SotA analysis the spread of PBB principles through many National SotAs from the European context and a secondary research about proliferation of PBB principles in other parts of the world. The International SotA is being published as a separate publication and this will be a good tool to disseminate vital information on PBB. This work has been detailed out in forthcoming section 2.7.8.
- **Production of final East European SotA Report**
- **Establishment of some strategic relationships.** Examples of these are:
 - Between Domain I and ISO. This relationship has influenced writing of standards related to durability of construction materials and components;
 - Co-operation with ISO TAG8 (the ISO Technical Advisory Group that is responsible for building related standards) on a multi-year programme within ISO that aims for the production of performance based standards that are to replace or to be added to the current prescriptive ones
 - Other strategic relationships including PeBBu and aligned activities have influenced new work in the Indoor Environment area;
 - Co-operation with the Liaison Committee's of International Associations of Structural Engineering aiming for the establishment of a joint committee on PBB related pre-standardisation issues in the area of structural engineering
- **Consensus on PBB language, concepts and issues.** This is mainly a result of the PBB compendium 3 on Statement of Requirements.
- **Production of a synthesis PBB R&D agenda.**

For a more detailed scientific and technical evaluation of the PeBBu project, it becomes necessary to look at individual work and achievements of all Tasks. This breakdown has been presented in the following sections.

2.4 Accomplished Workplan and deliverables

An infrastructure was established for the programming, coordination and facilitation of research and for the dissemination of research results in the area of Performance Based Building. The main components of this program are given below:

- International programming and coordination of research projects in **nine scientific Domains**. As explained later, three of the nine Domains have been terminated at the end of the first two years and **three New Tasks** have been introduced which reflect current important developments in performance based building and the need to address them.
- Involvement of target groups / stakeholders from the start of the programme through **three User Platforms** for i) buildings owners, users and managers, ii) building and construction industry, and iii) the International Standardisation and Conformity Community;
- **Mapping** of national and international research related to aspects of Performance Based Building;

- **Four Regional Platforms** in Europe to act as the bridge to and the initiator of aligned national activities (Northern, West/Central, East and Mediterranean);
- **Network Management**, including the establishment of a Network Steering Committee, a Technical Committee and a Network Secretariat that among others are to be responsible for: i) annual technical and financial reporting to the EU, ii) final report, iii) designated website including among others a newsletter, and iv) overall project management.

During the course of the project, the following components were added:

- **Three Generic Tasks** that handle specific professional topics, which have been identified as significant in the framework of PBB implementation, and include i) Support on the CPD, ii) Decision making Toolkit for PBB, and iii) CRISP Indicator Analysis.
- **Two Compendium projects** that serve as a scientific basis for the research projects and establish a common framework, a shared language, and the state of the art in terms of research and best practices in the area of i) Validated Models, and iii) Statements of Requirements¹.
- Launch of the Regional **Australian PeBBu Platform** (Aus-PeBBu).
- Establishment of **National Platforms** (Sweden and Poland).
- Various **R&D projects** related to Performance Based Building, including the about 30 projects that already have been initiated by CIB Task Groups and Working Commissions. The further elaboration of those projects into proposals/request for additional funding has already commenced.

The following figure illustrates the various Network components.

The central part represents the main components as included in the PeBBu Thematic Network, while the outer circle represents the additional / aligned components, which are in operation without EU funding. The PeBBu Network was planned for and has been operational during a four-year period, from October 2001 to October 2005. The tasks and deliverables for each of the main components as included in the PeBBu Thematic Network are described in detail in section 2.6.

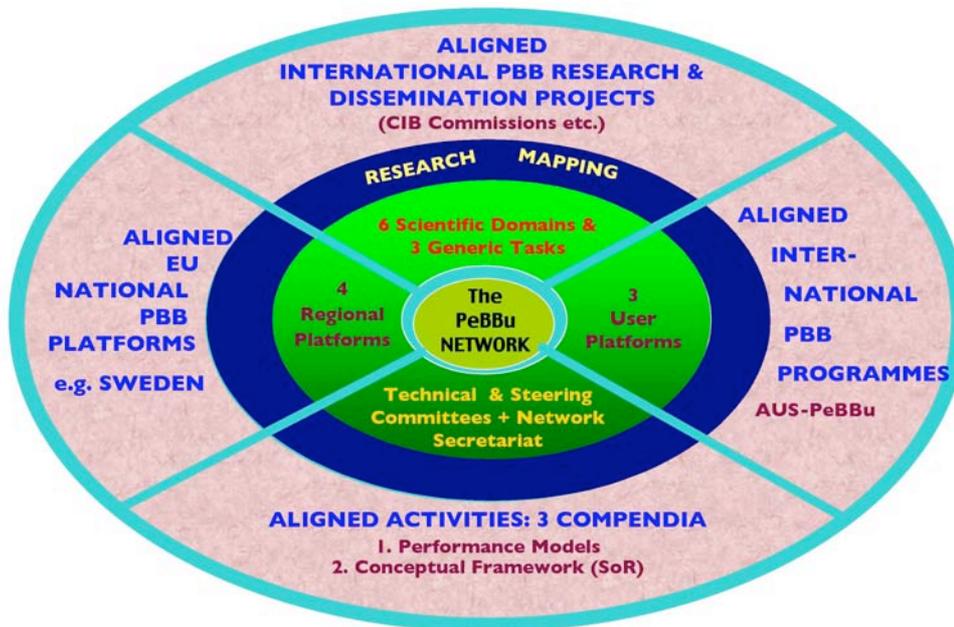


Figure 3.: Schematic of the PeBBu Network Components

¹ The development of the Compendium of Validated Building Performance Models has already been commissioned in 2000 by CIB, and CIB has also already commissioned preparatory studies for the other two Compendia

2.5 Members

The PeBBu Network, at the launch of the project, included i) 33 organisations in EU and EU Associated countries and ii) 15 organisations in other countries that committed to participation under the condition that the required funding would become available. Finally, the PeBBu network grew to include 73 organisations in all from 30 countries, out of which 56 are EU and 17 are non-EU countries. Within the EU, there are 17 organisations from the NAS countries. PeBBu Members which joined in the course of the project were all given an “Observer-member or liaison-member status”.

The final list of PeBBu Members in EU and EU Associated Countries per country is given below. This includes an indication of the organisations’ function in the Network.

Organisations involved in the PeBBu Project

	Country	Organisation	Function
1	Australia	Australian Building Codes Board	Observer
2	Australia	CSIRO	Observer
3	Belgium	Belgian Building Research Institute	Principal Contractor
4	Bulgaria	Sofia Energy Centre Ltd.	Member
5	Canada	NRC/CETC	Observer
6	Canada	ICF - International Centre for Facilities	Observer
7	Canada	University of Manitoba	Observer
8	Canada	University of Montreal	Observer
9	Croatia	University of Zagreb	Observer
10	Czech Republic	Brno University of Technology	Member
11	Czech Republic	VSB - Technical University of Ostrava	Member
12	Denmark	Danish Building Research Institute	Member
13	Estonia	TTU - Tallinn Technical University	Observer
14	Finland	Helsinki University of Technology	Member
15	Finland	RTS - Building Information Foundation	Member
16	Finland	VTT Building and Transport	Principal Contractor
17	France	CSTB - Centre Scientifique et Technique du Bâtiment	Principal Contractor
18	France	University of Rochelle	Member
19	Germany	Fraunhofer Institute for Building Physics	Member
20	Germany	University of Karlsruhe	Observer
21	Greece	Aristotle University	Member
22	Hungary	ÉMI	Member
23	Iceland	Building Research Institute of Iceland	Observer
24	India	VIA Architectural Consultants	Observer
25	Ireland	Dublin Institute of Technology	Member
26	Israel	Min. of Int. Div. of Planning and Bldg. Guidelines and Reg.	Member
27	Israel	Technion – Israel Institute of Technology	Member
28	Italy	Architettura Senza Frontiere	Observer
29	Italy	National Research Council	Member
30	Japan	National Institute of Public Health	Observer
31	Lithuania	Vilnius Gediminas Technical University	Member
32	Netherlands	BAM Advies & Engineering	Member
33	Netherlands	CIB	Liaison
34	Netherlands	CIBdf - CIB Development Foundation	Coordinating Contractor
35	Netherlands	EGM Architects - Research Department	Principal Contractor
36	Netherlands	Eindhoven University of Technology	Member

37	Netherlands	Eurocer-Building	Observer
38	Netherlands	Ministry of Housing, Spatial Planning and the Environment	Member
39	Netherlands	SBR	Member
40	Netherlands	STABU - Specification System for the Construction Industry	Member
41	Netherlands	TNO Environment and Geosciences	Principal Contractor
42	New Zealand	Department of Building and Housing	Ex Liaison
43	Norway	Norwegian Building Research Institute	Observer
44	Poland	Architect & Urban Housing Manager	Observer
45	Poland	ASM Market Research & Analysis Centre Ltd.	Member
46	Poland	The Polish National Energy Conservation Agency	Member
47	Poland	Warsaw University of Technology	Member
48	Portugal	IST - Technical University of Lisbon	Member
49	Portugal	University of Porto	Member
50	Saudi Arabia	King Fahd University of Petroleum & Minerals	Observer
51	Slovakia	Institute of Construction and Architecture	Member
52	Slovakia	Slovak University of Technology	Member
53	Slovakia	Technical University - Faculty of Civil Engineering	Member
54	Slovakia	Technical University in Zvolen	Member
55	Slovakia	VVUPS	Member
56	Slovenia	ZAG - Slovenian National Building and Civil Eng. Institute	Member
57	Spain	Instituto de Ciencias de la Construcción Eduardo Torroja	Member
58	Spain	UPC - Polytechnical University of Catalunya	Member
59	Sweden	FORMAS	Member
60	Sweden	KTH - Royal Institute of Technology	Member
61	United Kingdom	Borough Council of Wellingborough	Observer
62	United Kingdom	BRE - Building Research Establishment	Principal Contractor
63	United Kingdom	Glasgow Caledonian University	Observer
64	United Kingdom	Pinsent Masons Solicitors	Liaison
65	United Kingdom	University of Manchester	Principal Contractor
66	United Kingdom	University of Reading	Member
67	United Kingdom	University of Salford	Principal Contractor
68	United Kingdom	University of Strathclyde	Observer
69	United States	ASTM International	Liaison
70	United States	Georgia Institute of Technology	Liaison
71	United States	GSA - US General Services Administration	Liaison
72	United States	NFPA - National Fire Protection Association	EX Observer
73	United States	University of Pennsylvania	Observer

2.6 Details of the Network Tasks & Deliverables

The task reports for all defined PeBBu tasks including a summary description of the scope and objectives, accomplished work-plan and deliverables of each Task are included in Annexes I to XXIV. The following sections summarise briefly the overall framework of the project.

2.6.1 Nine Scientific Domains



For each Scientific Domain, separate international research programming and coordination took place to ensure internationally accepted prioritising of research, maximum stimulus for international collaboration and a maximum compatibility between the results from the research projects. The following nine separate Scientific Domains were distinguished in the initial planning.

In the area: Building Technique

- **Domain 1: Life Performance of Construction Materials and Components**
- **Domain 2: Indoor Environments (formerly called Building Physics)**



In the area: Buildings and the Built Environment

- **Domain 3: Design of Buildings**
- **Domain 4: Built Environment**

In the area: Building Process

- **Domain 5: Organisation and Management**
- **Domain 6: Legal and Procurement Practices**

In the area: Building Industry

- **Domain 7: Regulation**
- **Domain 8: Innovation**
- **Domain 9: Information and Documentation**

Per Domain the following tasks and deliverables were defined.

Overall Objectives for the Domains:

During the four year period

- Supply of input into the PeBBu Website (task 20), including: news articles, domain workshop reports, domain reports, information on research and contacts, etc.
- Supply of input into PeBBu Compendia (if and when in place)
- Assessment of proposals for international research and dissemination projects
- Participation (by the Domain leader) in the PeBBu Technical Committee (task 19)
- Provision of domain related input for the activities and workshops of the PeBBu User Platforms and Regional Platforms, and acting upon domain related recommendations from those workshops

Year 1 & 2

- Contribution to the first International PBB State-of-the-art Report (task 20)
- 1st Domain Workshop, including a workshop preparation report and elaborated workshop minutes
- 1st Domain Report (see under External deliverables for the report's content)

Year 3

- 2nd Domain Workshop, including a workshop preparation report and elaborated workshop minutes
- 2nd Domain Report

Year 4

- Contribution to this Final PeBBu Report (task 20)

Additional Objectives: Apart from these overall objectives, each domain had some additional specific objectives. These are detailed out further in the Task Reports of all domains annexed at the end of this document.

The initial work-plan included the flexibility to combine, split up and/or add such Domains if research developments so require. That indeed was necessary during the course of the project. At a Steering

Committee Meeting in August 2003, it was concluded that 3 domains (namely domain 4, 5 and 9) are to be terminated due to non availability of relevant research in the international community in these 3 fields and in 2 cases, overlap of work with other domains. However, these domains have produced a domain report as well as an international R & D agenda. At the same time, it was realised that certain issues, which are of importance to the work of PeBBu and had not been initially included should be added in the project as New Tasks. These are the three Generic Tasks mentioned above, and detailed out in sections 2.6.5 & 2.7.6.

2.6.1.1 Contribution to the International PeBBu State-of-the-art Report

The Domain Leaders elaborated their initial international state-of-the-art indication into a formatted contribution to the first official International PeBBu State-of-the-art Report that was published by the Network Secretariat in Year 2 of its operation.

2.6.1.2 Domain Workshops and Domain Reports

The general work-plan for each Domain was identical, but its actual details were of course an outcome of the specific combination of Domain Leader and members. In this section, the common agenda is outlined briefly. The specifics are given separately in Annexes I.1 to I.9.

In each of the nine Domains, 2 research programming and coordinating workshops, by the appointed Domain Leader, were planned to take place. The first workshop of each Domain was actually so organised and took place during the first year of the project. However, a complementary workshop, organised by the network secretariat in Budapest for all those who could not participate in the first workshop, indicated the benefits of having all members in the same place. The 2nd workshop was thus planned as a series of domain meetings held in Manchester, UK, during the same week.

A need for an additional workshop was felt in the course of the project. This additional 3rd domain workshop, was again held as a series for the continuing 6 domains, in November 2004 in Porto, Portugal.

Apart from being responsible for these Domain Workshops, the respective Domain Leaders were responsible for the production of two Domain Reports, which included:

- Conceptual framework for research programming
- Worldwide inventory and assessment of recently finalized, ongoing and planned research in the respective Domain as far as relevant to PBB
- International status and state-of-the-art report, including best practice examples
- Recommendations for international prioritising of further research
- Recommendations for international collaboration in future research projects
- Recommendations for international dissemination of research results, for example through training, summer courses, publications, etceteras.

The Domain Leaders stimulated the Domain Members to provide a maximal contribution to the production of such Domain Reports.

2.6.1.3 Input into the PeBBu Website

The Domain Leaders supplied the Network Secretariat with input to the PeBBu Website. This included:

- Workshop Reports
- Bi-annual Domain Reports, as defined above
- In-between articles to be included in the PeBBu Newsletter and in the PeBBu Website
- Information on ongoing research in the respective Domain, as far as available, including information of relevant research results

2.6.1.4 Communication with PeBBu Compendia

The Domain Leaders communicated on a regular basis with the contact persons for the PeBBu Compendia, as concerns things like: conceptual framework for and terminology related to Performance Based Building, best practices and state-of-the-art examples as concerns PeBBu applications to be included in those Compendia.

2.6.1.5 Participation in PeBBu Technical Committee

The Task Leaders have participated at the meetings of the Network Technical Committee.

2.6.1.6 Contribution to Final PeBBu Report

Each Domain Leader, including the three terminated domains, supplied the state of the art individual summary report for his or her domain, as included in the relevant Annex of this Report.

2.6.1.7 Production of an International R&D Agenda

All the domains, including the three terminated domains, produced by the end of their programme an international Research and Development agenda, as reported in their individual Domain Reports and in the relevant Annexes to this report. A synthesis report of the R&D Agenda has been prepared by a dedicated task and reported in a separate Report. Its summary is given in Annex 6.

2.6.1.8 General Support to the nine Scientific Domains

Administrative and related type of support to the nine Domain Leaders has been provided by the Network Secretariat, that was also responsible for providing input from all CIB related activities into the Domain Workshops and for distributing the reports of the Domain Workshops and the Domain Reports amongst those participants in the Thematic Network who did not participate at the respective Domain Workshops. The network secretariat had also the responsibility of organising the series of domain workshops, which took place instead of stand-alone workshops, in coordination with the Domain Leaders.

2.6.2 Three User Platforms

The actual implementation of the principles of Performance Based Building would have a major impact on both the day-to-day and strategic operations of various stakeholders.

In order to stimulate and facilitate the input of those stakeholders' opinions into the programming and execution of the respective research and dissemination projects in all stages of the program, and in order to prepare for their active support for future implementation activities, the following three User Platforms have been established:

User Platform 1:	representing Building Owners, Users and Managers
User Platform 2:	representing the Building and Construction Industry
User Platform 3:	representing the international Standardisation and Conformity Community

Per User Platform, the following tasks and deliverables have been defined.

2.6.2.1 Platform Workshops and Reports

In the initial work-plan, the Leader of a User Platform was responsible for organising bi-annual Platform Workshops. For participation at those workshops respective international representing organisations were to be invited to appoint Workshop participants. In preparation of each Workshop, the respective Platform

Leader – with support of the Network Secretariat – was to produce and provide the Workshop participants with a report, which included:

- an indication of all programming and research and dissemination activities that are ongoing within the PeBBu Programme

Each such Workshop should have resulted in a Workshop Report that includes:

- An assessment by the participants at the Workshop of presented PeBBu activities. This was to be presented such that the Leaders and Members of the PeBBu Scientific Domains, the three Generic Tasks, the four PeBBu Regional Platforms, and the persons as involved in ongoing or planned PeBBu related research and dissemination projects can use those as meaningful input to their future activities
- A “stake holders” advice as concerns the PeBBu activities in general. The objective of such an advice is to be a means for maximal alignment of PeBBu’s activities with the actual need for international R&D as perceived by the participating stake holder representatives in the respective workshops.

Overall Objectives for User Platforms

- To engage high level representatives of actual PBB stakeholders in decision making on the programme as to be performed by the PeBBu Network and in the evaluation of the results of this programme
- To stimulate and facilitate input of the PBB actual stakeholders opinions into the programming and execution of international PBB related research and dissemination projects during all stages of the PeBBu Network programme
- To prepare for the respective stakeholders support to future implementation activities.

Work-plan

Incidental responses at the request of the Network Secretariat to selected strategic network documents, for which the inclusion of the respective stakeholders' opinions is important, including in particular:

- Strategic programming documents per PeBBu Domain
- Definition of the needs for research as to be included in the structure for the PeBBu Mapping activity

Within the Work-plan of the User Platforms, two workshops were envisaged in the entire duration of the PeBBu Project.

Besides the above tasks and deliverables for the User Platforms, the Standardisation Platform had some additional objectives:

- To stimulate and facilitate the transfer of PBB research results and pre-normative knowledge into Standardisation processes
- To stimulate and facilitate the transfer of actual knowledge about the characteristics of PBB Standardisation issues into their respective research projects
- To facilitate co-ordination between International, European/regional and National Standards Bodies in Standardisation processes associated with PBB.

The Standardisation Platform report should thus include:

- International status concerning the inclusion of the principles of PBB in National, European/Regional and International Standards
- An assessment of results available from research on Performance Based Building as concerns possibilities for inclusion in Standards together with an indication of further research required in support of future standardization
- Recommendations to standards organisations.

2.6.2.2 General Support to the three User Platforms

In preparation of the User Platform Workshop, the Network Secretariat provided the respective Platform Leader with selected information on all ongoing and planned PeBBu activities that may be of relevance to the respective User Platform.

The Network Secretariat was responsible – as far as relevant – for the distribution of products of the three User Platforms to i) the Leaders and Members of the nine Scientific Domains for international programming and coordination of the PeBBu research and dissemination projects, and to ii) the Leaders and Members of the four PeBBu Regional Platforms.

2.6.2.3 Changes in Work-plan for User Platforms

There was one information workshop held in year 1 for the User Platform for Standardisation and Conformity.

In this workshop several high level representatives of EU stakeholder organisations were present e.g. representatives of European commission for CPD. In this meeting, there was an agreement to set up a User Platform for Standardisation, to coordinate activities regarding PBB and regulations. At the moment, EU did not commit to this and later it withdrew due to internal reorganisations. This led to a loss of incentive to the other organisations.

After this, another meeting for the User platform was planned to be held in October 2003. However, due to a variety of reasons, this meeting was postponed. The main reason was unexpected cancellations due to illness/holiday. The meetings planned for the other 2 user platforms namely Owners and Industry were also not successful. The main reasons for these were: not being able to attract enough high-level organisations since PeBBu is still in a more theoretical stage of research and development and it was premature to expect such high-level representatives in a meeting without any funding.

In a Technical Committee Meeting held in January 2004, it was agreed that for the Standardisation platform, the idea of a meeting of stakeholders would still be pursued. For the other two platforms, a more individual approach seemed more feasible. The idea of making a PBB-related questionnaire geared specifically to the owners or industry is being developed and then circulated by the national contacts in their network/region. A draft of such a questionnaire for the industry platform was prepared in November 2004 jointly by the task leader of the industry platform, Dr. Luk Vandaele, BBRI, Belgium and an expert commissioned from within the PeBBu network – Assoc. Prof. Rachel Becker, Technion, Israel. This questionnaire aimed in giving local or regional feedback on the main issues surrounding the application and implementation of PBB with respect to those stakeholders. The questionnaire for the User Platform on Owners was prepared by Mr. Tim Yates, BRE, UK and sent to all National contacts for distribution. Several responses were received for this questionnaire.

It was decided by the Steering and Technical Committee in a meeting held in November 2004 in Porto to wait for the results of the Domain 7 on Regulations to see how the results of this domain can help us in making any progress with the work on the User Platform on Standardisation. However, it seems that at this stage the setting up of this User Platform is too ambitious. First, more awareness on PBB principles is needed and steps have to be made to further the PBB approach from a largely theoretical concept to a more applicable concept.

2.6.2.4 Contribution to Final PeBBu Report

Each User Platform Leader supplied the state of the art individual summary report for his or her platform, as included in Annexes XIV to XVI of this Report.

2.6.3 Four Regional Platforms

In addition to the international research and dissemination projects that were a part of the PeBBu Programme, national activities were necessary in preparation of the actual implementation of the principles

of PBB. It was envisaged from the beginning that such national activities would be aligned as much as possible with the international PeBBu activities.

In order to stimulate and facilitate the programming and coordination of such national activities, to facilitate the input of typical national and regional characteristics into the international programming of projects, and to prepare for the necessary future national implementation activities, four Regional PeBBu Platforms were established in the participating EU and EU Associate countries.

The following four EU Regions were defined. Per Region, the participating countries as included in the PeBBu Network and funded by the EU, are mentioned and the country that ‘supplies’ the Leader of the respective Regional Platform is underlined. For three of those Regional Platforms, an additional objective was to attract new PeBBu Members in countries in the region to the PeBBu Network. Some changes in the composition of these Regional Platforms have taken place in the course of the project. These are included in the table below. E.g. Slovenia has moved from the East European platform to the Mediterranean platform.

National contact persons participated in the four Regional Platforms as “representatives” of stakeholders in the national communities.

Region 1 (North Europe):	<u>Sweden</u> , Finland, Denmark, Norway, Lithuania, Estonia, Iceland.
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Region 2 (West/Central Europe): ²	<u>Belgium</u> , UK, Ireland, Netherlands, France, Germany,
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Region 3 (East Europe):	<u>Hungary</u> , Poland, Czech Republic ³ , Slovakia, Bulgaria, and participation of Romania
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Region 4 (Mediterranean Europe):	<u>Italy</u> , Spain, Portugal, Greece, Israel, Slovenia, Croatia
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² TNO, Netherlands was in the initial Work-plan, a joint task leader with BBRI, Belgium of the Regional Platform in West / Central Europe. However, at the end of Year 2, the leadership was left to BBRI.

³ In Czech Republic, VSB - Technical University of Ostrava was initially the official member of the regional platform. However, another active organisation in Czech Republic, Brno University of Technology (PeBBu members of NAS SotA), had been active in the regional platform of east Europe by attending all past meetings, giving input and producing the national SotA.

Per Regional Platform, the following tasks and deliverables were accomplished:

2.6.3.1 Contribution to the first International PeBBu State-of-the-art Report

The Regional Platform Leaders in communication with the respective national Platform Members elaborated the national state-of-the-art reports into a formatted, following a structure defined by the secretariat, contribution per country, plus an additional, about 1-2 page long, regional synthesis to the 1st International SotA Report that has been published by the Network Secretariat in Year 2 of it's operation.

Overall Objectives for the Regional Platforms

- To stimulate and facilitate a maximal alignment between the international PeBBu activities and national research and dissemination activities concerning the development and implementation of PBB in the countries that participate in PeBBu, through:
 - Stimulation and facilitation of the programming of such national activities
 - Facilitation of the input of typical national and regional characteristics into the international programming of the international PeBBu activities
 - Preparation for future national PBB implementation activities, including the national dissemination of PeBBu results, and in support of achieving those objectives.
- To initiate and facilitate the establishment of National or Trans-national PeBBu Platforms in the region, which includes:
 - Support to defining the scope and objectives of such platforms
 - Support to the establishment of required financial support structures for such platforms in collaboration with the PeBBu Secretariat and aiming for international financial support from the EU and other international sources
 - Support to regional, trans-national and national PeBBu related events.

Work-plan

- To attract new PeBBu Members/Observers from both already participating and not yet participating countries in the region
- To provide input into the PeBBu website, in terms of data/information/news articles concerning national / trans national / regional PBB related activities and events.

Within the work-plan of the Regional Platforms, three sets of annual workshops took place in the entire duration of the PeBBu Project.

2.6.3.2 Three Regional Workshops and Reports

The Leader of each of the four Regional PeBBu Platforms organised three annual Regional Platform Workshops (with the exception of one workshop not held for West / Central Regional Platform). In preparation of each Regional PeBBu Workshop, the Regional Platform Leader in collaboration with the Network Secretariat produced a report on ongoing and planned international PeBBu activities as far as those might be of importance to the Platform Members.

Immediately after each regional Workshop a Regional PeBBu Report was produced that included the following:

- The status as concerned i) the envisaged future implementation of PBB in the participating countries, and ii) the national programming and execution of related research and dissemination activities.
- Comments by the Platform Members to the International PeBBu activities and an indication of national of regional requirements as regards future international PeBBu activities in the areas of the International PeBBu Scientific Domains and User Platforms.

2.6.3.3 Contribution to Final PeBBu Report

Each Regional Platform Leader supplied the state of the art individual summary report for his or her platform, as included in Annexes X to XIII of this Report.

2.6.3.4 Initiation & Alignment of and Funding for National PeBBu Activities

The Regional PeBBu Platforms were to function as initiators for aligned national activities in the area of Performance Based Building.

The Regional PeBBu Platforms in collaboration with the Network Secretariat coordinated and supported possible national programme proposals and request for possible international funding for the included “kick off” activities, as far as those aimed at establishing a more long term National PeBBu Programme that is sufficiently aligned with international activities of the PeBBu Network. The final aim in this context was to establish permanent National PeBBu Platforms.

The objectives of such National Platforms was:

- to stimulate and facilitate the programming and coordination of national projects, which are necessary in preparation of the actual implementation of the principles of PBB programmes
- to achieve a maximal alignment between those national projects and the international activities as performed in the context of the PeBBu Network.

The participants of each National Platform were typically envisaged to include representatives of building owners, design, construction and regulatory communities as well as research organisations.

At present three National/Regional platforms have been established, namely Australia, Sweden and Israel. These are reported in Annexes 5.1 to 5.3. The Australian platform is growing to have a regional focus by including south-Asian countries in its fold. In Poland, a national level platform has been incorporated in setting up the ECTP platform in which PBB is also an issue although of a minor significance. The South African national platform is still under consideration. There were some initiatives for setting up a national platform for PBB in the US but they have faded away.

In order to disseminate the international knowledge and experience in the area of PBB at a national level, an Israeli Thematic Network is being established.

2.6.3.5 General Support to the three Regional Platforms

The four Regional Platforms were supported by the Network Secretariat. This support included:

- Distribution of the results of the international programming and coordination of research and dissemination projects to the Leaders of the Regional Platforms
- Distribution of the results of the Regional Platforms, as far as relevant, to the Leaders of the nine Scientific Domains, the three Generic Tasks and to the three PeBBu User Platforms.

2.6.4 Mapping of Research Activities

A separate task of the PeBBu project was:

Mapping of Research Activities in countries that are represented in the PeBBu Network as concerns R&D related to Performance based Building

One of the defined tasks of this activity is the development of a database with information on research and development that is of special relevance to PBB. The aim of such a Mapping is to contribute to future policy making as concerns Performance Based Building. The final objective is to develop this into the

world's foremost portal to information on Performance Based Building. It is to be assumed that at that time it will be of strategic importance to various organisations working with PBB principles.

This PeBBu Mapping database contains information on ongoing Research Projects, Publications, (recently published scientific) Papers, Organisations and Contacts (with their expertise) as of special importance to the further development, implementation and application of PBB. The result contains an information system on different levels of detail for the research and for the organisations involved, including: databases in searchable formats, with adequate links to information sources and with several degrees of accessibility.

This mapping task was performed based on the following approach and organisation:

- The Network Secretariat task facilitated and coordinated the respective work
- On the international level information was collected and assessed by the Task Leaders of the nine Scientific Domains, in first instance via the Domain Members
- On the national level information was collected and assessed by the National Contacts who participate in the PeBBu Network, with support by the Regional Platforms
- As concerns the technical infrastructure for this mapping activity, and as concerns formats to be used, the respective PeBBu work was initially planned to be coordinated with the ECORE Network that has the overall coordinating responsibility for the Mapping of Research Activities in the Building and Construction Sector. However, this did not succeed, which led PeBBu to develop its own mapping infrastructure. This caused some delay in the mapping work.

The appointed PeBBu Designated Contact in each organisation is responsible in his/her organisation for incorporating as many as possible relevant Projects, Publications and Papers and stimulating other PeBBu members in the organisation to add the papers. Designated contacts can also add more contacts in this database that can further add papers.

This database can be accessed from: <http://www.pebbu.nl/maincomponents/mapping/>

2.6.5 Three New Generic Tasks

As mentioned before, three New Generic Tasks have been introduced in the PeBBu project during the 3rd year of the network activity. A brief summary of the objectives of each task is given below.

GT I - PBB & Construction Products Directive (CPD); Support on the CPD

Background (as initially provided):

The Construction Products Directive defines, through a series of interpretative documents, six essential requirements for construction works. For those essential requirements, the European Commission, after consultation of the Member States of the EEA, specifies the regulated characteristics for construction products and kits in mandates to the European Standardisation Committee (CEN) and the European Organisation for Technical Approval (EOTA) to develop harmonised technical product specifications, i.e. harmonized European standards or European Technical Approvals, for the performance assessment of the building products.

The EC New Approach directives in general and the CPD specifically introduce a mandatory system of conformity attestation throughout the construction products sector. Therefore, in this activity, the expected impact of the CPD on the market of construction products will be examined. Besides this new mandatory system, attention will be given to the European voluntary product assessment systems, which exist for many years in most European countries, and are expected to remain in place, although their scope might be very different and as far as they are not in conflict with the CPD and if there is a market driven demand.

At the moment, the CPD is at the end of its first phase, with the first generation of harmonised technical specifications becoming available and being used in the construction sector. The activity will explore domains that the CPD does not cover for the time being and where supporting Standardisation activities are on-going (e.g. dangerous substances, durability, life cycle analysis, environmental declarations, etc.).

On 1 May 2004, the CPD will be applicable in an additional 10 countries, with 28 countries requiring construction products to be CE Marked. This will certainly influence the introduction of CE Marking. Thanks to the CPD, the way technical product specifications are being written has changed. It is expected that the CPD technical specifications should be a driving tool towards performance based works specifications and regulations in a very large part of geographical Europe.

Objectives of the New Task

It has been acknowledged that the CPD should be a basic element in PeBBu work and therefore, the introduction of the CPD is considered to be a horizontal task in PeBBu. The objective of the activity was to provide basic info on the CPD to the PeBBu Domains and Tasks, and to receive and incorporate feedback in a final report that aims at linking PeBBu with the CPD.

The task report for the CPD work is given in Annex I.22.

A special emphasis in this activity's scope and objectives was on:

- Providing support regarding the Construction Products Directive (89/106/EEC)
- Analysis of the PBB regulatory systems that are already implemented on a regional, national or local basis, with an understanding as to how those systems are structured
- Analysis of how PBB regulatory systems can incorporate CPD technical specifications.

GT2 - Sustainability Indicators for PBB: CRISP Indicator Analysis

Objectives of the New Task

The objective of this activity is to report how Performance Based Building can benefit from the EC FP5 CRISP (Construction and City Related Sustainability Indicators) Thematic Network outcome. Within the CRISP project (2000-2003) 24 organisations from 14 countries collected and validated 38 relevant indicator systems using a compatible sustainability framework. This activity aimed at studying and selecting CRISP indicator systems and individual indicators that can add value to PBB.

The task report for this task is given in Annex I.23.

GT3 - Decision Support Tool-Kit for PBB

Objectives of the New Task

The objective of this activity is to give an overview on decision support tools for performance based building. The most promising ones are presented in detail and their applicability was tested in selected PeBBu Domains using simple software prototype applications. Recommendations for further development were drawn and integration of feasible tools was proposed.

The task report for this task is given in Annex I.24.

2.6.6 Aligned Tasks

Two Aligned Tasks have been introduced in the PeBBu project. The Compendium of PBB Models, and the Compendium of PBB Statements of Requirements. These tasks have been initiated by CIB prior to the establishment of the PeBBu network, and have been recognised as a supplement of significant added value to its deliverables.

The task leaders of the aligned tasks have participated in Technical Committee meetings as well as contributed to the final report.

A brief summary of the objectives of each task is given below.

AT1 - Compendium of PBB Models

will be added after Greg Foliente supplies the task Report

AT2 - Compendium of PBB Statements of Requirements

This Task was mandated to prepare a "consensus based conceptual framework" for the PeBBu project overall and to develop documents that would provide examples of how the Performance Based Building (PBB) approach is used during actual building projects.

The primary objective for this Compendium was to provide support to the PeBBu Domains and Tasks so that they would prepare their own conceptual framework within an overall understanding of the PBB approach.

The deliverables of this Task include:

1. Conceptual Framework (articles, papers, presentations, and other documents).
2. Compendium of PBB Statements of Requirements (SoR), including Case Studies.
3. Related Terminology, Bibliography, List of key words to be used for research mapping, and Glossary of related Abbreviations, Acronyms and Initialisms.

The task report for this task is given in Annex I.26.

2.6.7 PeBBu Prototype Interactive Website for Educational Purposes

It was realised that one of the key contributions of the PeBBu network can be to assist in preparation of materials for education and training related to PBB. Thus it was decided in a Steering Committee Meeting held in June 2005 in Helsinki that part of the budget can be used for preparation of a pilot interactive website or CD for educational purposes. Two domains were chosen for this pilot project namely, Domain 2 on Indoor Environment and Domain 3 on Design of Buildings. The pilot project would begin by putting all the PBB related domains and the building process as well as stakeholders in a matrix in which each intersection can be clicked and leads to a set of educational materials. This may be text, documents, images, PowerPoint presentations or a list of resources. However, at this moment only the parts related to the two identified domains will be populated.

The pilot website is ready to view by end of October 2005 and can be accessed via the PeBBu website. More details on this task can be found under Annex 7.

2.6.8 Regional / National Platforms



Two additional components, which are a direct outcome of the PeBBu project, have been added to it without any additional funding. These include the newly established National Platforms in Sweden and Israel, and a new Regional Platform in Australia, which is expanding its efforts to include the entire south-East Asian region.

More information on the national platforms can be found under Annex 5.

2.6.9 Assigned Task Leaders

The listing of the most recent assigned Task Leaders is given next.

As mentioned before, an overall scientific responsibility for achieving a maximal alignment between the activities that fall under the different tasks was given to the Network Technical Committee, in which the Tasks Leaders participated.

All main tasks were facilitated, and through this facilitation also coordinated, by the Network Secretariat, which was a responsibility of the Coordinating Contractor.

Task	Task Name	Organisation	Task Leader	Support TL	e-mail address
T01-D1	Domain 1: Life Performance of Construction Materials and Components	KTH, Sweden CSTB, France KTH, Germany	Christer Sjöström JL Chevallier	Wolfram Trinius	christer.sjostrom@hig.se jl.chevalier@cstb.fr trinius@trinius.de
T02-D2	Domain 2: Indoor Environment	TNO, Netherlands	Philomena Bluysen Marcel Loomans		p.bluysen@bouw.tno.nl marcel.loomans@tno.nl
T03-D3	Domain 3: Design of Buildings	EGM, Netherlands	Dik Spekkink		d.spekkink@spekkink.nl
T04-D4	Domain 4: Built Environment	Univ. of Reading, UK	Colin Gray		c.gray@reading.ac.uk
T05-D5	Domain 5: Organisation and Management	VTT, Finland	Pekka Huovila		pekka.huovila@vtt.fi
T06-D6	Domain 6: Legal and procurement Practices	Univ. of Manchester, UK DBRI, Denmark	Peter Fenn Kim Haugbølle		peter.fenn@umist.ac.uk khh@sbi.dk
T07-D7	Domain 7: Regulations	TECHNION, Israel	David Pilzer		davidpi@moin.gov.il
T08-D8	Domain 8: Innovation	Univ. of Salford, UK	Peter S. Barrett	Martin Sexton Angela Lee	p.s.barrett@salford.ac.uk m.g.sexton@salford.ac.uk a.lee@salford.ac.uk
T09-D9	Domain 9: Information and Documentation	Univ. of Montreal, Canada	Colin Davidson		dav0528@attglobal.net
T10-UP1	Task 10: User Platform: Building Owners, Users and Managers	BRE, UK	Tim Yates		yatest@bre.co.uk
T11-UP2	Task 11: User Platform 2: Building & Construction Industry	BBRI, Belgium	Luk Vandaele		luk.vandaele@bbri.be
T12-UP3	Task 12: User Platform 3: International Standardisation & Conformity Community	BRE, UK	Nigel Smithies		smithiesjn@bre.co.uk
T13-RP1	Task 13: Regional Platform 1 North Europe	KTH, Sweden KTH, Sweden	Christer Sjöström	Wolfram Trinius	christer.sjostrom@hig.se trinius@trinius.de
T14-RP2	Task 14: Regional Platform 2 West/Central Europe	BBRI, Belgium	Luk Vandaele	Johan Parthoens	luk.vandaele@bbri.be johan.parthoens@bbri.be
T15-RP3	Task 15: Regional Platform 3 East Europe	ÉMI, Hungary	Károly Matolcsy	Gábor Tiderenczl	mat.k@mail.emi.hu gtideren@emi.hu
T16-RP4	Task 16: Regional Platform 4 Mediterranean Europe	NRC, Italy	Paolo Cardillo	Giuseppina Varone	paolo.cardillo@itc.cnr.it giuseppina.varone@itc.cnr.it
T17-Map	Task 17: International Mapping PBB Research	CIBdf, Netherlands	Mansi Jasuja		mansijasuja@hotmail.com
T18-NM1	Task 18: Network Management – Steering Committee	CIBdf, Netherlands	Wim Bakens	Mansi Jasuja	wim.bakens@cibworld.nl mansijasuja@hotmail.com
T19-NM2	Task 19: Network Management – Technical Committee	CIBdf, Netherlands	Wim Bakens	Mansi Jasuja	wim.bakens@cibworld.nl mansijasuja@hotmail.com
T20-NM3	Task 20: Network Management – Network Secretariat	CIBdf, Netherlands	Mansi Jasuja		mansijasuja@hotmail.com
T21-NM4	Task 21: Network Management – Financial Coordination	BBRI, Belgium	Bart Michiels		bart.michiels@bbri.be
T23-NAS	Task 23: NAS SotA	EMI, Hungary ICASA, Slovakia EMI, Hungary	Károly Matolcsy Peter Matiasovsky	Gábor Tiderenczl	mat.k@mail.emi.hu usarmat@savba.sk gtideren@emi.hu
T24-GT1	Generic Task 1: PBB & Construction Products Directive	BBRI, Belgium	Winnepenninckx		eric.winnepenninckx@bbri.be
T25-GT2	Generic Task 2: CRISP Indicators	VTT, Finland CSTB, France CSIRO, Australia	Pekka Huovila JL Chevallier Greg Foliente		pekka.huovila@vtt.fi jl.chevalier@cstb.fr Greg.Foliente@csiro.au
T26-	Generic Task 3: Decision	VTT, Finland	Pekka Huovila		pekka.huovila@vtt.fi

GT3	Support Toolkit for PBB			Janne Porkka	Janne.Porkka@vtt.fi
T27-C1	Compendium 1: PBB Models	CSIRO, Australia	Greg Foliente		Greg.Foliente@csiro.au
T28-C2	Compendium 2: Statement of Requirements & PBB Conceptual Framework	ICF, Canada BRE, UK	Françoise Szigeti	Jo Prior Kathryn Bourke Tim Yates	fs-gd@icf-cebe.com PriorJ@bre.co.uk YatesT@bre.co.uk
T-29-RTD	RTD Agenda Synthesis	CIBdf, Netherlands CSIRO, Australia VTT, Finland EGM, Netherlands MinistryVROM, NL	Wim Bakens Greg Foliente	Pekka Huovila Dik Spekkink George Ang	wim.bakens@cibworld.nl Greg.Foliente@csiro.au pekka.huovila@vtt.fi d.spekkink@spekkink.nl george.ang@minvrom.nl
T-30-Pilot website	PeBBu Prototype Interactive Website for Educational Purposes	TNO, Netherlands EGM, Netherlands	Marcel Loomans Dik Spekkink		marcel.loomans@tno.nl d.spekkink@spekkink.nl

2.6.10 Network management

The Management of the Thematic Network included the following components:

- Steering Committee
- Technical Committee
- Network Secretariat
- Financial Coordination

2.6.10.1 Steering Committee

A Network Steering Committee has been set up whose task was to give overall scientific and managerial guidance on both the strategic and operational level to all activities in the Thematic Network program.

The Steering Committee had the following Members:

- Network Secretariat (that acted as the Committee's Secretariat)
- A high level representative of each of the nine Principal Contractors

The Steering Committee met once a year in the respective four year period. The Steering Committee has played a very positive 'steering' role in the project. In a meeting in August 2003, several intervention decisions were made which brought about a positive impact on the PeBBu project, including the termination of three Domains, and the launching of three new Generic Tasks.

2.6.10.2 Technical Committee



In conjunction with two of the meetings of the Network Steering Committee, the Network Secretariat organised a meeting of the Network Technical Committee. The members of this Technical Committee were initially the PeBBu Task Leaders who were then joined by the Leaders of the three Generic Tasks, two compendia projects, and the Aligned Regional Platform Aus-PeBBu.

The objectives of the Technical Committee were to achieve a maximal technical alignment between the activities as were included in the nine Scientific Domains, the three User Platforms, and the four Regional Platforms. Initially, the Technical Committee was expected to meet once every two years but a decision for the

Technical Committee to meet more regularly and to be more active in the PeBBu project's on-goings was made in the Steering Committee meeting held in August 2003, resulting in annual meetings.

2.6.10.3 Network Secretariat

Main tasks for the Network Secretariat related to:

- Annual Technical and Financial Reports
- Regular News articles
- Final report
- Website development and maintenance
- Technical Support Unit
- Project Management

- Organisation of Series of domain meetings

Annual Technical and Financial Report

The Network Secretariat was responsible for producing annual reports according to the respective EU directives on planned and actually achieved activities, deliverables and progress. Those reports were the basis for the respective EU Scientific Officer to make the annual stop/go decisions as concerns continuation of the EU funding of the PeBBu Programme. All progress reports can be downloaded from: <http://www.pebbu.nl/pebbuthematicnetwork/progressreports/>

Regular News Articles

The Network Secretariat was responsible for producing and distributing regular news articles on issues related to the progress of the PeBBu domains, regional platforms, and user platforms, as well as other publications, news, projects, conferences of interest to PBB. Most of these news articles were sent out electronically and also placed on the PeBBu website. These can be viewed at: <http://www.pebbu.nl/newsarticles/> and <http://www.pebbu.nl/newsarticles/archives/>

A list of all PeBBu news articles produced and sent out in the duration of the PeBBu project is provided in Annex I4.

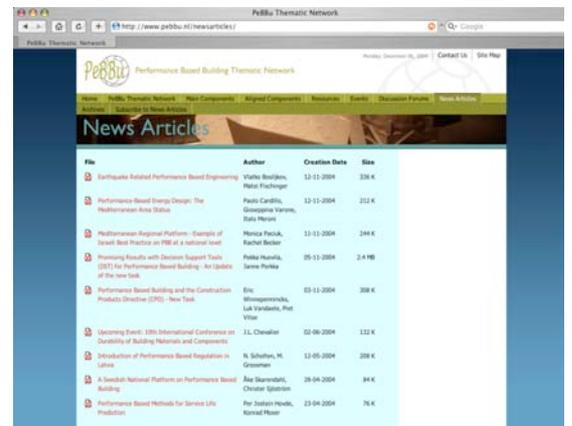
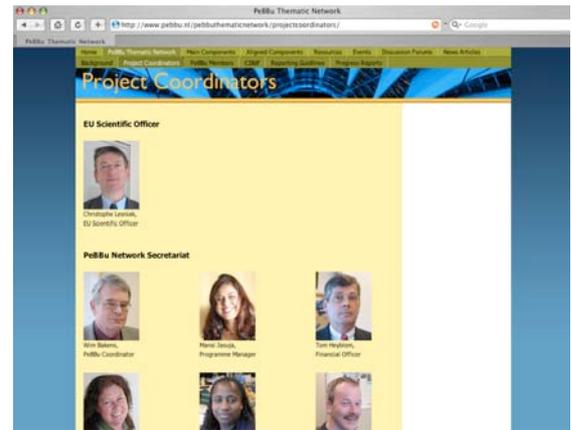
Final report

The Network Secretariat produced the required Final Report according to the respective EU directives. The report is published in both electronic and paper format.

Apart from the final report, the almost final outcomes of PeBBu were presented in an international conference in Helsinki, Finland in June 2005 [Houvila, 2005].

Website development and maintenance

The Network Secretariat has set up and was responsible for maintaining the PeBBu website (www.pebbu.nl). during the four years of the duration of the project. This website was redesigned and improved substantially in the 3rd year of the project. This not only improved the user-friendly-ness of the



website but also made it a state of the art, aesthetically appealing source of information. This website includes the following components:

- General Information about PeBBu, especially for non PeBBu Members
- Permanently updated data on Members, Scientific Domains, Regional Platforms and User Platforms and their Workshops (in the format of an relational database)
- All Workshop Reports and all State-of-the-art reports
- Electronic PeBBu Newsletter (this includes various PeBBu Newsgroups that were defined and populated based on a broad and worldwide survey of interests, to which both PeBBu Members and non Members may subscribe)
- Electronic publications from PeBBu related R&D project, as far as made available to the Network Secretariat.
- A Discussion forum possibility
- Mapping Database

The PeBBu Website has become 'the' portal to information on all PeBBu activities, members and results and was 'the' platform for information transfer between the various defined PeBBu Scientific Domains, Regional Platforms, User Platforms, Steering Committee, Technical Committee and the Network Secretariat.

All above mentioned items included in the PeBBu Website are accessible to all. In addition, the website includes sub-sections with information that is accessible to the PeBBu Members only.

Project Management

The PeBBu Project Management related to:

- Attracting additional EU (especially from within East Europe) and non-EU Members to the Network and offering support to the new Members as concerns finding funding for their activities. This concerned both new members in general and industry based new members in particular.
- Coordination with other major international Networks and R&D Programmes that are of special importance to achieving the Network's objectives
- Acting as the Network's first contact for the EU respective Scientific Officer
- Supervising the performances of the Network Secretariat

Organising Series of Domain Meetings

In a Steering Committee meeting held in August 2003, it was decided that it is beneficial to have a combined series of domain meetings instead of stand-alone domain meetings, in order to give an opportunity for domains to interact with each other and for the network to really operate as a network. The Network Secretariat was thus responsible for organising and coordinating these meetings with the help of the Domain Leaders.

The first of such meetings was held in Manchester, UK, in January 2004. The second (additional, not in the original Work-plan) series of meetings was held in Porto, Portugal, in November 2004.

2.6.11 Individual Task Reports

Annexes I.1 to I.26 include detailed summaries of the above listed tasks, including the Task Leader, brief overview, scope and objectives, state of the art summary, deliverables, comparison of achieved vs. expected workplan, conclusions etc.

2.7 Overview of scientific & technical progress per task

2.7.1 Scientific Domains

Detailed task reports of all 9 PeBBu scientific domains can be found under Annex I.1 to Annex I.9.

2.7.1.1 Domain 1: Life Performance of Construction Materials and Components



PeBBu Domain I on Life Performance of Construction Materials and Components succeeded to establish a well-functioning platform to develop and discuss topics related to the thematic domain. A core success factor was that DI operated very centrally within ongoing international standardisation work, and with pre- and co-normative research projects. With the main objectives being to work for the establishment and the anchoring of an agreed international research and development agenda in its thematic domain, to relate to the work namely of ISO/TC59/SCI4 and to develop the there-specified methodologies and to bring these to the attention and application of actors in the building and

construction sector.

In brief, DI has managed to

- contribute to international standardisation and to international research projects and networks,
- discussed the application of service life information in the context of product declarations intensely mainly involving the perspectives of provision and application of provided information
- developed education and training material
- contributed to the international research community with numerous contributions on international conferences and workshops, as well as through publications in scientific journals.

DI has strived to position itself at the gap between research and application of innovation, which has led to the conduction of interesting workshops with participants from “both sides”. Where the dialogue at times has been difficult, the discussions have been fruitful and efficient in the meaning to generate understanding for the thematic field of life performance of materials and components.

Due to these discussions and the success in establishing a dialogue, it is assumed that PeBBu DI managed to play a significant role on the route to bring performance based building, and especially the consideration of service life aspects in the planning process, into practice. This process is however, by no means completed with the end of the project, but the contacts for a continued development and a continued dialogue are in place, which is a precondition for future exploitation of the DI results as well as for the thematic field as such.

Since 1993, international standardisation in the field of service life planning is undertaken. The main purpose of standardisation efforts in ISO/TC59/SCI4 “Design Life” is to identify routines that support the design of buildings that meet identified performance requirements, throughout their design life. By directing the work to this thematic field, also demands originating e.g. from the European Construction Products Directive (CPD) are addressed. The methodology obviously is equally worthy for other regions. For Europe meanwhile, the CPD can be identified as a very significant driver for standardization and harmonization, as products fulfilling the six essential requirements of the CPD are eligible for CE marking.

One of the routes to CE marking is based on an assessment of the product, including an evaluation of its durability in order to obtain a reasonable working life, as required in the CPD. Especially for the evaluation of new and innovative products, where no experience-based information is available, the European Organisation of Technical Approvals (EOTA) has developed general guidance based on the service life prediction concepts, as expressed in ISO 15686-2.

The International Council for Research and Innovation in Building and Construction (CIB) began work on the subject of building performance in the 1970s. The “performance approach” was described as “first and foremost, the practice of thinking and working in terms of ends rather than means. It is concerned with what a building is required to do, and not with prescribing how it is to be constructed”. Over the years, CIB has started a number of working groups addressing performance based building, with the EU funded thematic network PeBBu, addressing performance based building in 6 scientific domains, 4 regional platforms and 3 user platforms, being a prime present activity.

PeBBu Domain I on life performance of construction materials, components and systems specifically relates to the ISO 15686 standards. The link between the ISO standards and Performance Based Building has long-since been understood as evident, and has been elaborated and discussed at hand of the CPD. Domain I intends to exemplify these standards with the goal to enable wider provision of information needed for the process of service life planning, as well as enabling a wider application of service life information in project planning and building design. While focussing building materials and components, the context of functional application of materials and components deserves consideration. Consequently, DI also addresses systems. The topic of sustainable construction provides the contextual frame and the philosophical reason for acting on the topic of service life. This involves the development of methodologies to identify reference service lives and estimated service lives, also in terms of service life declarations. These methodologies provide important input especially to environmental product declarations of building materials and components and equally evident, to the assessment of environmental performance of buildings. Both items are addressed in ISO/TC59/SC17 and in CEN/TC 350.

The current development of internationally harmonised standards follows to large extent a modular approach that allows the inclusion of use phase (and thereby service life) scenarios that can be adapted to better reflect the situation in which a material, component or system is to be applied. The ISO 15686 standards on service life planning can be applied in order to generate information for such adaptable modules and scenarios. With the relative ease to adapt scenarios and modules as a positive aspect, also the negative potential to include information based on scenarios that are not in line with each other, or service life information that is based on performance requirements that do not sufficiently well reflect the situation at hand, is rising.

For the process of identification and adaptation of service life information to the planning situation at hand, ISO 15686 identifies two core concepts, one being the establishment of a reference service life and the other being the identification of an estimated service life. Where the earlier must be based on testing, exposure or experience, the latter is a modification of a given reference service life that shall allow the planner to establish a reasonable estimate for a material, component or system as part of a specific building design. One route towards such adaptation is application of the “factor method”. As both, the reference service life and the process of adaptation in order to establish an estimated service life are forming the basis for the generation of information, PeBBu Domain I sets its focus onto these aspects of service life planning methodology. With this in specific focus, PeBBu DI addresses demands in co-normative research and development, where the target is to provide information that is needed in everyday application of the standards.

PeBBu strives to identify current practice in the building sector, both to identify the potential for improvement and to provide feedback of experience and practical information into the process of formulating standards. Based on the requirements posed by the standards and the experience and practice in the building sector, thematic fields for future attention and research can be identified. The derivation

and communication of performance requirements and performance information are to be named expressly. Developing standards in the field of EPD (environmental product declaration) and sustainable construction show modular structures, where scenarios for service life and life performance have significant influence on the declared information.

Innovation in the building sector may be described as either supply-driven or demand-driven. In the first case, the provider of innovative solutions will seek to convince key market actors to recognise and apply the innovative products. In the latter case, the suppliers of products are to develop solutions that meet the requirements originating from the innovation demand. In both cases, the communication of life performance or service life aspects is an essential element of information. For innovative solutions, information on long-term performance and service life will not be available. Such information hence must be estimated, e.g. in accordance to the EOTA guidelines and the ISO 15686 standards.

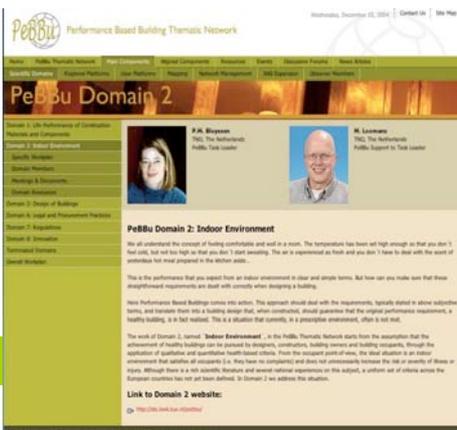
Where service life information is communicated between various stakeholders of the building sector, it has to be assured, that a common understanding, also of the underlying scenarios, for which information has been provided, as well is communicated and understood by all parties participating in the communication. A harmonised approach to service life declaration may be very helpful.

PeBBu DI investigated to what extent actors in building construction already today are informed about the ISO standards, to what extent they make use of service life information and apply the performance based building concept. A general conclusion is that the concepts appear to be well known, but there still is a significant lack of experience and feedback from examples, where the concepts have been applied systematically and successfully. The question whether performance based building in practice leads to innovative solutions, and concerning which performance aspects these innovative solutions are beneficial and in that case to whom they are beneficial, remains to be investigated and documented. Such documentation, as part of the developed training material and presented as successful examples, is supposed to take the role as a key driver to motivate for the application of the performance concept. Motivation of actors to enable and apply performance information is regarded as the main obstacle to more frequent application of the performance concept in building construction.

However, the availability of information and the number of examples of application is rising, all while the development of tools for the application of service life planning has taken up momentum. From this, in combination with the general awareness of the usefulness of the concepts of performance based building and service life planning, it can be assumed that the development of tools, and the integration into standards relating to building sustainability, will spur the application of the concepts.

The communication of service life information within the construction sector sets high requirements concerning transparency of the information. A declaration of service life can only reflect one or a few scenarios for product application. Therefore, designers for instance, may need to perform or initiate a process of modification of declared information, all in order to obtain information that is relevant to the situation in a specific building context. The primary source of information will still be the manufacturers, while recognising that information provided by them only can be based on reference scenarios. Such scenarios must be available for scrutiny by those applying the provided information.

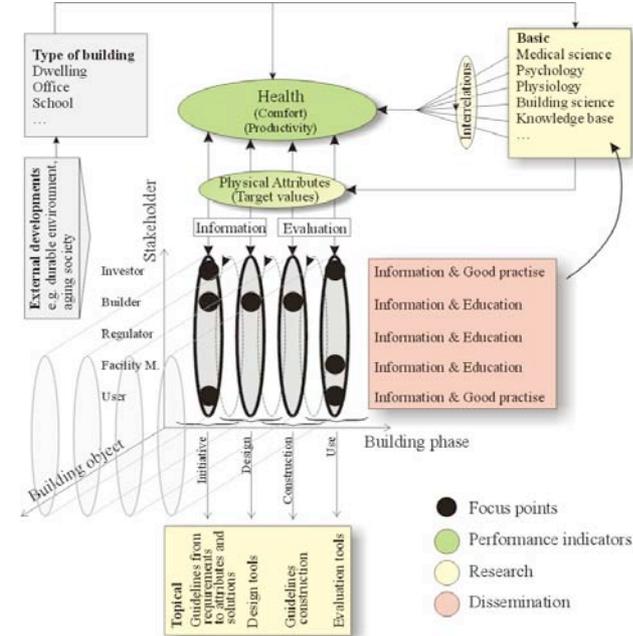
2.7.1.2 Domain 2: Indoor Environments



The work performed in Domain 2, as part of the PeBBu project, has been well in line with the general and domain specific objectives stated in the workplan. Though the work performed is based on existing literature on the topic, the gathering and combination of this literature gave new insights. The workshops, reports and website allowed for the interaction and dissemination of the results to the PeBBu Network and from there to the wider audience at (inter-

)national level. The interest on the indoor environmental topic is also shown from the list of members, guests and observers that were linked to the Domain during the project.

One of the main outcomes is the consensus on the detailed description of Performance Based Building in



relation to the indoor environment. The developed conceptual framework contributed to this. The Domain report in that respect hopefully will serve as a good reference for further developments in this direction. It also provides a lot of (also practical) information and references on how to deal with the performance based approach in relation to healthy building. The Research Agenda, that has been issued separately, indicates several developments that are foreseen and wished for to support this further. This Agenda at least should present a reference for the (national research) developments in this area. [Figure 4](#) presents the central picture for the Research Agenda.

An important result from the work done in the Domain is found in the (indoor environment specific) definition of PBB and the set-up of the Framework for the structuring of the information.

In line with the original idea, the framework also has been applied to structure the Research Agenda that has been developed in the final year. Furthermore, the information that has been gathered has been used in several ways to publish on the PBB concept and the importance of the relation with the indoor environment. Amongst others, the developed framework was introduced in the 5th FW project HOPE. The work within PeBBu has been used as one of the basis for the definition of the ECOSPACE concept.

[Figure 4.](#) Conceptual Framework as applied for the Research Agenda.

The work in PeBBu has presented its usefulness in several ways. Members of the Network (specifically from the NAS countries) have indicated that they are using the results from PeBBu (reports, workshop presentations, etc.) in their lectures to introduce/further explain the performance based approach in relation to the indoor environment. This is an important result as the PB approach is disseminated through education to the future professionals.

The line of thinking that has evolved within the PeBBu project now is also used more often in proposals for new research, internationally as well as nationally. It is noticed that the clear view on the topic as developed within PeBBu allows for a better explanation to third parties (stakeholders). The advantages are obvious, especially to owners and end-users. Contractors and suppliers, i.e. the progressive ones, see the (marketing) possibilities the approach can provide for. Nevertheless, there still are significant practical hurdles that restrict its full and direct application.

The PeBBu network presented a good platform to generate consensus on the application of the PBB-approach in relation to Healthy Building. Nevertheless, the topic remains complex and very extensive. Therefore, the main intention of the work was to further clarify the performance based approach in relation to the indoor environment and healthy building in particular. Optimally, together with the Domain 2 Research Agenda, the Domain report can serve as a reference for further developments in this area.

2.7.1.3 Domain 3: Design of Buildings



The main objective of Domain 3 “Design of Buildings” has been to investigate and clarify the concept of performance based Design (PBD) for both the European R&D community and design professionals. The main drivers for PBD are user requirements (users demand better performance of buildings-in-use) and legislation that is becoming more and more performance based (solution independent). A major part of the research in the Domain was focused on the ‘translation’ and management of user and stakeholder requirements into performance requirements and the ‘prediction’ of the building’s performance in use on the

basis of a design. This deliverables in an overview of the State of the Art of PBD, descriptions of best practices, and recommendations for the implementation of the available knowledge in education, an international RTD agenda and education and training modules for design professionals.

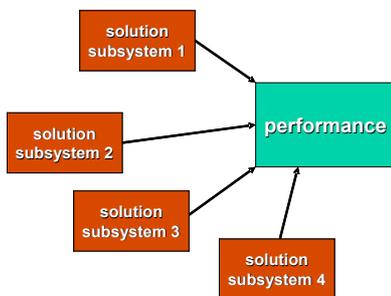
The main results of this domain work are:

- the concept of performance based Design (PBD) has been clearly defined and there is a common understanding of this concept among the Domain Members;
- insight in the consequences of the application of PBD for the organisation and management of the design process;
- a general framework for both practical knowledge dissemination to education and design professionals and for an RTD agenda.

This essential role of Domain 3 is about the integration of knowledge and systems from other PeBBu domains in the context of real building designs. The building design is where it all comes together. Designers have to deal with systematic interrelations between different performance specifications, which often relate to different fields of expertise. Thus, the performance based approach calls for integral design, with parallel, interrelated contributions from all design disciplines involved.

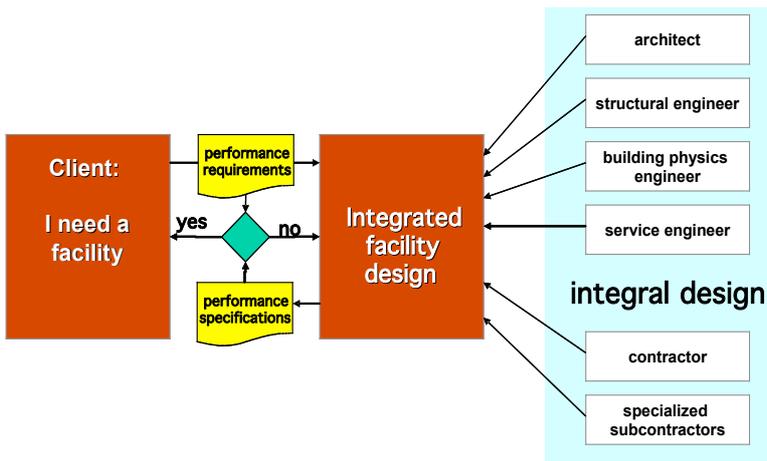
The performance of a building or a building part is always the result of the interaction between different solutions for different subsystems, like the architectural system, the structural system, the climate system and so on. This is depicted in diagram 1.

The end user is not really interested in the performances of different subsystems; he experiences the performance of a built facility as a whole. The design disciplines will have to co-operate closely to create an integrated facility design. Maybe in some aspects even the expertise of the contractor and specialized subcontractors is needed to get optimal performance. This is illustrated in Figure 5.



All over Europe design professionals seems hardly aware of the concept of PBD and also for the R&D community it is a rather new and unexplored field of work. Nevertheless, PBD is already being put to practice to some extent in most countries, consciously or unconsciously. Therefore, it seemed appropriate to aim the Domain 3 results at making researchers and design professionals aware of PBD.

Figure 5.: ‘performance’ as the result of different solutions for different subsystems



The State of the Art of PBD is described in the Domain 3 Final Report, which is mainly meant for the institutes and researchers participating in the PeBBu project. The Domain Members contributed to the inventory of the State of the Art. This contributed strongly to the awareness of the concept of PBD within the Domain. The State of the Art is also an important input for the international R&D agenda. The Final Report, that is distributed by means of the PeBBu website, also contains the recommendations for the implementation of the available knowledge in education.

FIGURE 6. PBD CALLS FOR INTEGRAL DESIGN

One of the main problems in PBD appears to be how to ‘predict’ the performance of a building in use on the basis of a design. Therefore, the Domain 3 Research Agenda is aimed at solving that problem. On the basis of a classification of performance aspects or requirements, an inventory has been made of related assessment tools. The results of this inventory are presented in a framework. This framework consists of a matrix, with a list of subjects for which performance requirements can be formulated (‘performance issues’) on the vertical axis and the most common design stages on the horizontal axis. ‘White spots’ in the matrix mark the performance aspects for which new design assessment tools need to be developed. These are mostly simulation tools, using sophisticated IT applications. The result serves two goals:

- it gives students, teachers and design professionals an overview of tools that are already available. This is an important and practical issue for knowledge dissemination to design practice;
- after further completion, it shows for which performance subjects decision support tools and/or assessment tools will have to be developed.

The education and training modules for design professionals have taken the form of:

- a report “Performance-based Design: bringing Vitruvius up to date”, explaining and defining PBD, showing where and how the concept is already being put to practice and giving best practice examples. This report will be distributed through the PeBBu website and by the Domain Members in their respective countries;
- news articles, distributed through the PeBBu website;
- a slideshow about performance based Design, that can be used by Domain Members for the education and training of students and design professionals in their countries;
- a pilot module for an electronic education system (cd-rom), disclosing relevant results for design professionals from essentially all PeBBu Domains and Tasks.

2.7.1.4 Domain 4: Built Environment



The state of the art showed that this area within the topic had not been considered previously. In order to assist future work a survey of potential subjects was undertaken. This showed that within the topic a very large number of variables needed to be considered. Integrated IT based tools will be required to access this information and enable users to make decisions. A prototype tool was developed to show how this could be achieved.

Domain 4 started by asking one significant and initial question; 'in what type of urban situation is the performance based built environment going to be designed to perform? This

question was addressed because it sets the framework for the whole of the subsequent specification. So far three concepts have been identified: the compact city (Jenks et al, 2000), the creative city (Landry, 2000) and the high-density city (DETR, 1999). The compact city debate questions the cost of urban sprawl versus the social and psychological issues of high-density living. The argument is one of conservation, reduced transportation and a general increase in well being through a reduction in the dependency on cars. The creative city case is one of releasing the potential within the citizen by providing the right leadership and facilities within the various 'rings' (hub, inner urban ring and suburbs) or areas of a city. These concepts have been used to provide an initial sort of the desirable features that a specifier may need to consider.

The three city concepts have been used to structure the review of the literature and surveys of the World Wide Web. A dedicated PeBBu website has been developed and is maintained at <http://www.rdg.ac.uk/PeBBu/>. This contains the current state of the collection and analysis of the relevant published literature and website surveys. The difficulty with the available information is that the desirable urban features and regeneration actions are implicit within the description of the urban problem. The continuing task is to review the literature and to determine action-oriented statements that can be construed as performance requirements.

In order to establish the state of the art as required in the overall PeBBu project a questionnaire was developed based on the findings of the extensive literature search described above. The development of the questionnaire was done on schedule. The questionnaire required that for each area the definition was confirmed or that suggestions were made as to amendments so that an agreed definition of the topic could be achieved. The respondents were also asked to give information on their local activity in each of the topic areas so that the draft state of the art could be obtained. By necessity the questionnaire was complex and few returns were made because the built environment had not been described in performance terms before so respondents had great difficulty in replying to the specific questions that were asked.

The primary goal of the questionnaire was to establish the scope of the domain and to obtain an agreed definition of each sub-topic. Whilst input to the PeBBu website was a goal of the project this has been developed in this Domain to be the primary method to access the knowledge that is available about the built environment. An extensive website has been created that is in excess of the original intended scope. Because little in the built environment has been configured in performance terms the response to the questionnaire has been limited. Much of the content of the website so far has been developed by the domain leader and research team.

Switching to a format based on the World Wide Web enables a potential user to access not only current practice, but also future practice if the respective web sites are maintained. The request to the contributors therefore switched to include relevant web sites.

The website describes the project, the domain objectives and for each sub-topic the definition that has been used and a brief description of the scope of the topic. Twenty-one sub areas have been developed so far. Some are further developed with long lists of actions and areas that have to be considered. Few are developed as performance specifications, although all have an implicit expectation that by adopting new practices in each area then the overall performance objective will be achieved. Work has commenced to review the information in each area and to produce a performance oriented text that links the many websites and information sources. To review every site and every piece of information and to evaluate it as state of the art or not is an impossible task. This realization has led to the development of the domain as a support system to users who themselves would have to develop an intimate knowledge of those topics and areas that are relevant to their particular project. Therefore, a user or client needs assistance to identify the relevant topics and also a means of accessing and stating the basis of the performance requirement once they have understood the issues. That understanding can be supported by the international research that is now accessible via the domain website.

2.7.1.5 Domain 5: Organisation and Management



PeBBu Domain 5: Organisation and Management defined its objective as successful management by all stakeholders of the built environment and its processes on the basis of performance (rather than prescription). The PBB State of the Art was structured under the following main categories

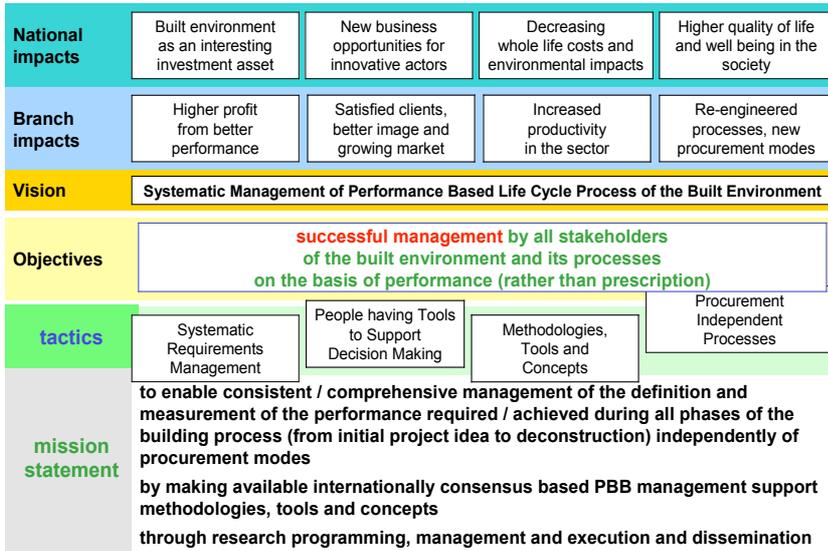
- 1) Methodologies, tools and concepts
- 2) Systematic requirements management
- 3) People having tools to support decision-making
- 4) Procurement independent processes.

Recommendations were drawn to achieve the desired impacts

- a)
 - satisfied clients, better image and growing market
 - increased productivity in the sector
 - re-engineered processes, new procurement modes
- b) at a European dimension
 - built environment as an interesting investment asset
 - new business opportunities for innovative actors
 - decreasing whole life costs and environmental impacts
 - higher quality of life and well-being in the society.

The mission statement guided the work

- to enable consistent / comprehensive management of the definition and measurement of the performance required / achieved during all phases of the building process (from initial project idea to deconstruction)



- independently of procurement modes
- by making available internationally consensus based PBB management support methodologies, tools and concepts
- through research programming, management and execution and definition.

Figure 7.: Framework developed for organisation and management of PBB

The framework developed at D5 (see Figure 7) for Organisation & Management of PBB can be used to implement and exploit the results in practice.

2.7.1.6 Domain 6: Legal and Procurement Practices



The initial PeBBu outline for this Domain stated that there is no current state of the art which could be applied across the EU; rather a collection of national practices. The work of the domain is to review these practices and procedures with a view to collecting best practice and producing guidelines. This position is restated here.

The definition of the quality in terms of performance criteria raises problems for construction procurement and legal issues. The establishment of pragmatic performance criteria is fraught with problems; and the legal framework may lay down liabilities in differing ways depending on whether the building is prescribed by result or by performance.

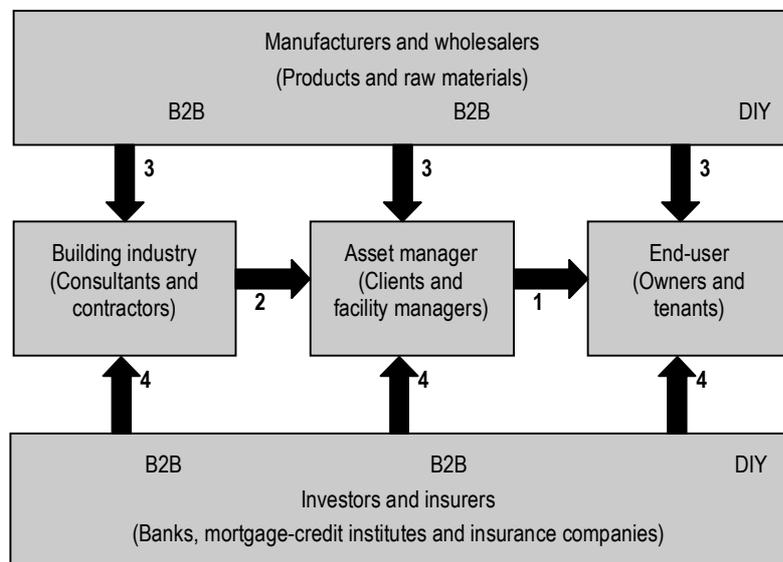
The term state-of-the-art produces special problems in this domain, since it is also used as a legal term in some jurisdictions. In the UK, for example, the duty on a designer may vary between a duty of care (design only) and a duty to provide a building fit for the purpose intended (design and construct). Simply put under a duty of care a defence may be available that the designer used the knowledge that was available at the time i.e. the state of the art. Under a duty of result no such state of the art defence is available. Professional Indemnity insurance cover (at least in the UK) is often restricted to claims arising from negligence on the part of the insured i.e. non-negligent errors are excluded. This point is often used by designers in seeking to restrict their liability for design errors to those involving negligence. They seek the ability to use a "state of the art" defence if they have one.

Factors may be driving shifts in procurement towards PBB might be considered under three headings: International competition, government policies and European policies. Influence from international competition has arisen from experiences of multi-national companies around the world and a desire to replicate best practice in other countries. Significantly better results were experienced in design and build

procurement leading to an increase in the use of this procurement, see e.g. Royal Institute for Chartered Surveyors (2001) for a UK analysis. Similar results are reported elsewhere e.g. the USA.

Since the early 1980's government influences have been founded on two things. That governments are responsible for the large part of construction output described above; and that governments need to maintain or increase output, particularly on infra-structure whilst at the same time reducing public sector expenditure. In order to reconcile these two opposing forces governments have increasingly turned to methods that involve private finance in projects. These methods include Design and Build (D&B); Design Build Fund Operate (DBFO); Build Operate Transfer (BOT); Build Operate Own Transfer (BOOT); Private Finance Initiatives (PFIs); and Public Private Partnership (PPP). Currently it is reported that in excess of 100 countries are procuring construction and engineering works under the generic heading of PFI. Private activity in infrastructure grew dramatically between 1990 and 1997, from about US\$16 billion to US\$120 billion.

In future years, the Commission of the European Communities, as part of its role as promoter of legislative and operational initiatives, may consider defining the general lines of policy across the EU. The collection of best practice and producing guidelines will allow the views expressed to contribute to that definition of general lines of policy. Analogies could be made with other EU initiatives; specifically with the



current Green Paper on Alternative Dispute Resolution in Civil and Commercial Law (European Commission, 2002). Both international competition and government policies have resulted in moves towards PBB since performance specification lies at the heart of both D&B and PFI philosophy.

The main results of the domain are an analytical framework and conclusions on the lack of analytical data. Figure 8 synthesises the analytical framework deployed in Domain 6 illustrating the actors and markets of the building/housing cluster

Figure 8.: Overview of the context.

Note: B2B = Business-to-Business (professional). DIY = Do-It-Yourself (non-professional).

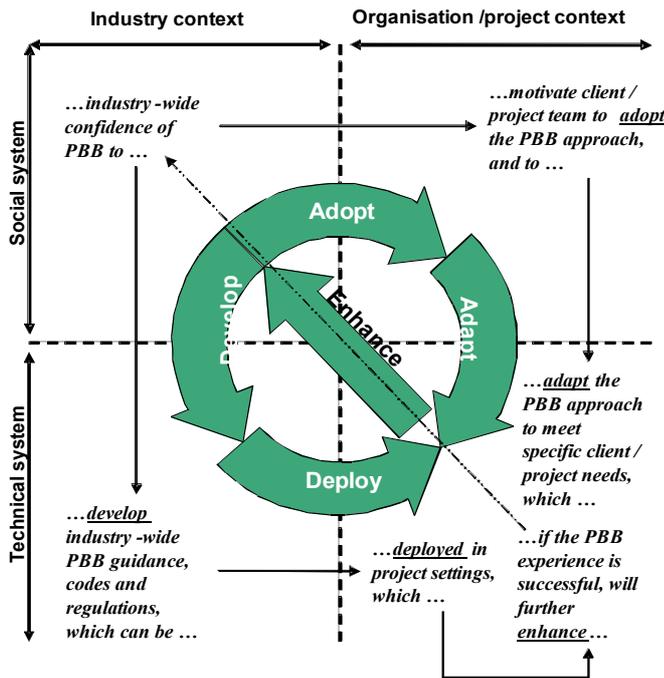
The framework provides us with an overview of the context in which the actors of the building process have to operate. Framed by governmental regulation and the knowledge system, the building/housing cluster can be divided into five subcategories of actors linked through four separate markets. The five groups of actors are the end-users, the asset managers, the building industry, the manufacturers, and the investors and insurers. The four markets are the property market (1), the building market (2), the product market (3), and the capital and insurance market (4). Focus in Domain 6 has been on the relationships between the building industry and the asset managers on the building market.

2.7.1.8 Domain 8: Innovation



Innovation is recognised as far from being a linear, simple process: rather, it is iterative and complex. A range of ideas is progressively sifted until the most likely to succeed are implemented, of which some succeed and others fail. In practice, it is a disjointed, opportunistic activity that builds on past experience, assumptions and constraints in fits-and-starts, and changes direction as the perceptions and actualities of circumstances change. It is the pragmatic activity of changing the status quo to achieve desired ends through whatever means are available. In this way, it is very suited to a goal orientated PBB approach, although it is likely that performance requirements will emerge from, as well as provide focus to, innovative activities.

Successful innovation is defined as ‘the effective generation and implementation of a new idea, which enhances overall organisational performance.’ Innovation and performance requirements in relation to construction need to be broadly conceived. Construction is the principal change agent/ source of innovation, and so performance metrics need to address both actual and desired characteristics of the built environment as well as simply the construction process itself.



Similarly, the rationale for the built environment depends on the needs of society, both in terms of quality of life and competitiveness. So, construction innovation must be seen as a means to a means to an end and not as an end in itself. As such, performance metrics at all three levels are needed so that connections can be made between society’s needs, built environment implications and construction drivers.

To make PBB a reality, clarity on the needs that are being addressed is required. That is, the performance criteria of the various stakeholders on the project need to be made explicit. This must include a heavy emphasis on clients/ customers needs if the construction industry is to succeed, but also the interactive needs of the industry players so that synergistic approaches can be derived.

Figure 9.: An evolutionary model of performance based building

Innovation performance objectives and measures need to focus on what is important (hard and soft factors) to all of the various stakeholders, and within a global framework they need to be particularised to the construction industry and within that to more specific sectors, clients, companies, or even projects to reflect the actions needed in these local circumstances and demands. The findings from both Phase I and Phase 2 have produced two schools of thought regarding the relationship between performance based building and innovation: content and context. The ‘content’ school of thought has advocated that PBB is the innovation in itself, and that PBB approaches replace traditional prescriptive approaches with a new paradigm. In contrast, the ‘context’ school of thought has argued that performance based building provides

the enabling environment to stimulate a raft of innovation activity which may include prescriptive, as well as performance-based, elements. The two schools are not in conflict; indeed, there is significant value in recognising and integrating them to form an evolutionary approach which promotes continuous development and use. A framework is offered (see Figure 9) which conceptualises the performance based approach as an evolutionary cycle of innovation across industry and project contexts, and between social and technical systems.

2.7.1.9 Domain 9: Information and Documentation



The original proposal envisaged establishing a task-oriented international network of researchers and subsequently of practitioners concerned by and involved with performance based building (PBB).

It was the domain's belief that adoption of the performance approach to the design of buildings (PBB) and the subsequent specification of materials and products imposes novel requirements on the flow of information within and into the building process. While the adoption of the performance approach is not the only change that is impacting on the information requirements of the building process (the adoption

of electronic communications and e-business, for example, are changing the way information can, and probably should, be made available to decision-makers), it has significant consequences.

Hypotheses:

Problem areas concern, for example:

- The information required in order to proceed from the functional programming step to establishing appropriate performance criteria.
- The information required in order to evaluate the performance characteristics of a design in the course of its being developed.
- The information required in order to specify materials and products in performance terms.

They are problem areas in the sense that not only are new kinds of information required (and they are often hard to come by) but also because the professional decision-makers will be working in novel ways and will be expecting that the information be presented to them in new forms and in new sequences.

Bearing in mind the contextual changes occurring at the same time (the adoption of electronic communications and e-business, for example), it can readily be understood that there is a double challenge to be taken up.

Research that is required to 'flesh out' the domain (and consequently provide the basis for the proposed network) by, for example, addressing the following points:

- The problem areas.
- The information acquisition habits.
- The need for information integration.

Because of the findings that virtually no work is being done into what is referred to as "the problem of information about information" in the construction sector, and bearing in mind CIB's proactive initiatives under the broad heading of "Agenda 21 ... ", a proposal was prepared regarding an international initiative that seemed appropriate and necessary. The document bears the title: Agenda 21 Information and Documentation and bears the date October 2004.

2.7.2 User Platforms

Detailed task reports of all 3 PeBBu user platforms can be found under Annex I.10 to Annex I.12.

2.7.2.1 User Platform 1: Owners, Users & Managers



The purpose of the User Platform was to establish a group of senior clients, owners and users of buildings and other constructed assets, who had particular interest, and expertise in the delivery and operation of buildings and infrastructure from a Performance point of view. The group was to assess and guide work underway in defined research areas within the nine PeBBu Domains.

The responses to the questionnaire prepared by UPI, showed that the respondents believed that the design brief and design stage were the times where PBB could be most influential. This is an interesting finding for two reasons – firstly because these are

potentially the most influential stages because without 'buy in' at the design stage PBB is very difficult but the findings also show that the concept of PBB has not reached into the construction and occupation phases. This finding is in many ways reinforced by a later question that found that the materials and components and the whole building facility could be influenced by PBB – but the implications are that this occurs at the design stage and not later on.

The main conclusions from the questionnaire responses are that:

- Many owners and users have heard of performance based building and see it as a helpful approach.
- Although they their experience is limited they would be willing to be involved in PBB projects but there is a concern about the drafting of specifications in the performance base format.
- They see PBB as stimulating innovation and allowing a wider range of solutions which can provide a more functional building.
- Currently it is perceived that PBB is most appropriate at the design stage – both for new build and for refurbishment/change of use. PBB appears to be making less of an impact at other stages – particularly during the actual use and occupation of the building.
- There is a greater emphasis on the materials and the building envelope than on what takes place within the building.

The questionnaire also asked the respondents to identify topics and areas which they believed needed to be addressed in order to increase the uptake of PBB. The main ones identified were:

- Innovation – presumably examining the ways in which PBB can stimulate innovation.
- Fire engineering – particularly smoke control and people's behaviour.
- Measurement – some metric is required to assess to benefits of PBB – something that goes beyond cost.
- Legal responsibility for defects – who is responsible if something does go wrong or where the new approach makes traditional responsibilities unclear.
- Internal environments – this seems to be an area where owners and users have seen very limited impact from PBB.
- Exemplar buildings/projects – well documented examples of successful project are required to support future projects.

This User Platform allows an assessment to be made of interest in performance based building to be made at two levels. The first is within those associated with the project where there was a lot of support and

enthusiasm, but this is in stark contrast to the initial support from owners, users and managers. The questionnaire received better support but there is clearly a considerable gulf between the enthusiasm of the academic world for PBB and the actual uptake of those responsible for buildings.

2.7.2.2 User Platform 2: Building & Construction Industry



The User Platform is one of the communication means with the major stakeholders in the field, in this case, User Platform 2, the building and construction industry: construction companies, contractors, design and engineering offices, manufacturers of construction products and building components, assessors of innovation, project managers acting on behalf of the client. In order to obtain the views of the relevant industry sector on the Performance Based Building approach, a User Platform was set up with high level representatives of European stakeholder organisations of the building and construction industry. This concept received too little response and therefore the work plan had to be altered. Representatives of the building and construction industry were approached through a questionnaire developed for this purpose. The results are compiled in a final report and a research agenda.

The results are compiled in a final report and a research agenda.

The **Research Agenda** was a specific topic in the questionnaires distributed. However, only few respondents made the effort to go through the end of the questionnaire where the research agenda table could be completed. Therefore, the response is rather poor.

From the few responses, the following topics emerge:

- Acoustic comfort
- Hygrothermal and energy performance: Research on the consumption of the building
- Research in simplified monitoring of indoor air quality. Increase the number of IAQ parameters to be measured.
- Communication tools between project partners
- Responsibility of the contractor and financial implications
- Risk analysis in case of no preliminary study of soil, or environmental impact, ...
- Need to normalise the non-technical aspects:
 - Who is responsible?
 - What are the rules of the game?
 - How to deal with aesthetics? Not quantifiable. Expressed as 'one class higher than reference building Y'
- Co-ordination with existing local regulations and standards.
- Insurances and liabilities
- Correlation between different countries in relation to building methods

Respondents indicate the following **opportunities** from the PBB approach:

- High level of technical solutions that can be achieved.
- Performance based regulations (e.g. energy performance) means extra business for consultants, etc.
- more freedom to the contractor to present his own solutions.
- Bigger markets
- Better approach in case non common technologies are proposed

Respondents indicate the following **barriers and difficulties** in case a PBB approach is proposed:

- How to model thermal comfort, energy consumption, etc

- Communication with the persons responsible for the project. Sometimes it is easier to specify technical solutions rather than describing their performance.
- The uncertainty and different approach philosophies. The sensibility of customers to indoor air quality issues and the willing to improve it.
- Special studies, such as structural engineering (concrete) and special techniques (building services) should be optimised.
- The contract should be not as a percentage of the costs of the special techniques, but as a lump sum combined with an incentive for improved performance (lower energy consumption, shorter execution time, ...)
- The contractor has a new role due to the PB brief: from simple executor of prescriptions, he now is involved in more engineering, more simulations, more coordination,... The communication with the other partners (architect, engineers, project developer, ..) in the team is important. This increased liability is translated into financial terms.
- Physical, measurable performances: no problem, but there is a need to normalise the non-technical aspects:
 - Who is responsible?
 - What are the rules of the game?
 - How to deal with aesthetics? Not quantifiable. Expressed as 'one class higher than reference building Y'
- The brief should specify why certain performances have to be met. If you don't know why, then you also don't know how important it is for your client. In some countries certain demands will be easy (read: cheap) to fulfil while in other countries these same demands can be expensive.
- A performance based brief written by a foreign client may contradict local standards and regulations.
- A performance based brief causes a lot more uncertainties at the start of studying the project.
- How to prove the performances? Checking if the execution of the project meets the performance based specifications will be more difficult
- Correlation between different countries in relation to building methods
- Knowledge and new building details/design
- Lack of knowledge of the people who have to execute the work. They are not familiar with the regulations and scientific backgrounds of it.
- No project has been realised on the basis of these performance based regulations. The intended projects appeared to be too expensive which is an indication of the difficulties contractors have with such kind of documents
- The introduction of PBB has to be accompanied by supporting actions, training, etc, of the executors of projects to learn them how the performance based specifications can be achieved.

2.7.2.3 User Platform 3: International Standardisation & Conformity Community



The purpose of the International Pre-Standardization Platform was:

To stimulate and facilitate the transfer of Performance Based Buildings research results and pre-normative knowledge into (pre-) standardization processes.

To stimulate and facilitate the transfer of actual knowledge about the characteristics of Performance Based Buildings standardization issues into their respective research projects.

To facilitate co-ordination between International,

European/regional and National Standards Bodies in the area of into (pre-) standardization processes associated with Performance Based Building

The specific objectives for the Platform were:

1. The organisation and provision of two international workshops towards the beginning and the end of the Thematic Network programme.
2. The provision of a detailed report which will include:
 - International status concerning the inclusion of the principals of Performance Based Building in National, European/Regional and International Standards
 - An assessment of results available from research on Performance Based Building as concerns possibilities for inclusion in Standards together with an indication of further research required in support of future standardization.
 - Recommendations to standards organisations.

It was considered that the International move towards Performance Based Buildings and the development of Performance Based regulations and codes indicated that International interest in the PeBBu project will be strong.

In order for ongoing work in the development of performance based buildings and performance based concepts to be implemented or applied it was considered necessary for the requirements to be embodied in Standards, Code and Regulations.

The main Standardisation bodies were regarded as including ISO, CEN, CENELEC, ANSI, ASTM etc. However, it quickly became apparent that collective communication with the main Standardisation bodies was not practical or beneficial to the project as the development of standards takes place within the Technical Committees and Sub-Committees. Some Technical Committees and Sub-Committees were identified – in particular within ISO and CEN and although the brief for the Standards bodies is to produce performance based standards where ever possible, it became apparent that many of the standards under development were equipment/product standards and a large conceptual leap and a considerable period of gestation/development would be required to establish any meaningful understanding of the PeBBu concept within the product standard community.

The definition of standardisation bodies and pre-standardisation bodies was then widened considerably to include Regulators, Code Developers, Technical Approvals Bodies, Building Code Officials etc and a meeting was convened in Brussels. It was quickly recognised that the development objectives within PeBBu would interact with aspects of the Essential Requirements as covered by the EU Construction Products Directive (CPD) therefore a new Task was established – Performance Based Building and the Construction Products Directive (CPD) under the leadership of Eric Winnepenincks, Luck Vandaele and Piet Vitse of the Belgium Building Research Institute.

Therefore the bulk of the initial interest in pre-standardisation had now moved significantly into the area of standards, codes, approval bodies and European Directives, this making the interested parties even more product standardisation focused and prescriptively biased.

Presentations were given to several Technical Committees within ISO including TC21 and TC 92 – the two main fire safety committees.

This Platform aroused considerable European interest largely because it was perceived as a new initiative, which might interfere with other developments within the European Arena – in particular the EU Directives and the Essential I requirements of the Construction Products Directive. The initiative did further raise the profile of moves towards performance based codes and standards. However, it is a relatively slow transition from prescriptive codes and standards to performance based ones and there is a

significant amount of resistance to the move as manufacturers and enforcers find that performance based quantitative objective criteria are both difficult to set and measure.

2.7.3 Regional Platforms

Detailed task reports of all 4 PeBBu regional platforms can be found under Annex I.13 to Annex I.16.

2.7.3.1 Regional Platform 1: North European



The objectives for the North European Platform is to stimulate and facilitate a maximal alignment between the PeBBu activities and national research and dissemination activities concerning the development and implementation of PBB in the Nordic countries and the Baltic states. Specific objective to this regional platform at the project outset was to engage additional member/observers from the region and in special from those countries not originally participating.

New members/observers are attracted from

- Norway
- Iceland
- Estonia
- Lithuania; the member has not been active
- Sweden (industrial and standard institute observers)

The Platform has performed the three Workshops scheduled in the project programme, and a number of additional Nordic and national workshops and seminars. The Platform network has aligned with other projects, e.g. on Lifetime Engineering and LCC, and standardisation networks with the purpose to support efficient stimulation and facilitation of PBB.

National PBB Platforms have been established in Sweden and Norway.

A number of project programmes and applications for funding have been launched on basis of the PeBBu networking and project results.

A North European PBB State-of-the-Art and the regional perception of R&D needs is summarised in this report.

The PeBBu regional platforms have, among their objectives, had the role to seek to capture the perception and state of the art of PBB in their respective regions. The north European region reflections on these aspects are mirrored in this report. Performance based building approaches in building and construction are considered to be a prerequisite for market development including the necessary harmonisation of codes, regulations, and standards, an improved or true innovation climate and process in building, and to reach sustainable construction goals. It is, however, noted that the market penetration of PBB is slow. It is a common opinion of the PeBBu North European Platform network that the PeBBu project, and its regional focus platforms, has provided a useful mechanism to highlight the challenges and opportunities of PBB. The European interest in PBB approaches and development is pretty well and consistently documented in EU and national regulation and R&D priorities. It is important that the process of stimulating and focussing the performance based route in building and construction does not conclude with the ending the PeBBu project. The examples of national platforms set up in the north region will have a responsibility to stimulate further work, but coherent European programmes focussing the area are recommended. The focus should be on shaping the stimulus mechanisms for real market penetration.

2.7.3.2 Regional Platform 2: West / Central European



The Regional Platform West and Central Europe consists of the PeBBu national contacts from Belgium, the Netherlands, France Germany, the United Kingdom and Ireland. National reports have been drafted for each of these participating countries and discussed at two platform meetings. These reports describe the state of the art regarding performance based building for the various domains of the building and construction activities. An attempt to set up national PBB platforms was not very successful. The final report of the task describes the alignment and discrepancies between the approaches in the different countries and presents a research

agenda for further work.

There is a diversity of influential factors that make the construction sectors in the West and Central European countries quite different from each other. The organisation of the profession and the responsibility of the architect, the contractor, the project developer, ...the regulation and control by the authorities, ...can be very different.

One common great influence over the European construction approach is exercised by the Construction Products Directive (“Whereas performance levels and requirements to be fulfilled by products in future in the Member States shall be laid down in classes in the interpretative documents and in the harmonized technical specifications in order to take account of different levels of essential requirements for certain works and of different conditions prevailing in the Member States”). The interpretative documents give the six essential requirements (Mechanical resistance and stability; Safety in case of fire; Hygiene, health and environment; Safety in use; Protection against noise; Energy economy and heat retention).

These requirements are performance based.

In most of the countries PBB is present in legislation and regulations, especially for some domains, more and more depending on the European requirements: fire safety, hygiene, health and environment (indoor climate), protection against noise, energy economy and heat retention (energy efficiency), accessibility. Other requirements will be enforced in a performance way: mechanical resistance and stability, safety in use, etc.

2.7.3.3 Regional Platform 3: East European



The PeBBu **Regional Platforms** have been established in the participating EU and EU Associated countries to stimulate and facilitate the national PeBBu activities, to make an input of typical national and regional characteristics into the international programming of projects and to prepare for the necessary future national implementation activities.

The countries represented in the PeBBu **Regional Platform from East Europe (EEP)** are **Bulgaria, Czech Republic, Hungary, Poland and Slovakia**. East Europe is a very special region of Europe due of its unique historical, political, educational, and economical conditions. In most of the East European countries, the concept of PBB is quite new and

mainly present in regulation/legislation and/or research. A wider implementation in practice is a major challenge in the region.

The major task of the Platform was the preparation of the **EEP Status Report** while another Report was made for the NAS (Newly Associating States of Europe). The preparation of the Report was based on the contribution of the task members, the National Status Reports and 4 special EEP workshops organised on the project duration.

Comparing the East European Regional Platform's Status Report of PeBBu with the NAS Status Report, the **EEP Status Report focuses on regional aspects, describing status in each country and based more on national reports and status in the countries.** The NAS Status Report provides many further PBB related information for these countries and focuses on status and the common features as a consequence of the common historical background and analyses the situation related to historical periods as the time of socialism; the transition period and the present time after the EU accession. Vision to the future and overall strategies of PBB implementation is also described in the NAS Status Report. Thus, the two reports complement each other and **a complete overview of the status and future of PBB of the EEP/NAS countries is provided by the EEP Status Report and the NAS Status Report together.**

The EEP Report also gives a detailed description of the status of PBB of the EEP countries considering the PeBBu **scientific domains & other domain areas** and the **new PeBBu tasks** (CPD, CRISP, Decision Support Toolkit). On the annexes PeBBu **RTD Agenda of the EEP countries** and also the Status of PBB in several **EEP priority themes** is described as: housing, durability, energy, recycling and maintenance.

The importance of the Regional Platforms was clearly showed on the various PeBBu workshops and events. The national situation of the EEP countries show similar characteristics and problems of the countries in the region partly originated from regional, climatic factors and partly from the similar historical backgrounds. Relatively small number of best practice examples of PBB can be seen in the region and still plenty of barriers are against PBB. The **EU extension has a significant positive effect on PBB in the region.** Obligations are an important aspect that comes with the EU extension. Dissemination of the PBB concept and raising the awareness of it is important in all countries of the region. **National PeBBu Platforms** would be important to develop in order to raise the awareness of PBB and overcome the barriers of languages in the participating countries. National Platforms would be important also in disseminating the result of the PeBBu project. PeBBu **results will be disseminated** in the regions also in education and training activities, conferences and workshops and various publications.

2.7.3.4 Regional Platform 4: Mediterranean

Within the Mediterranean Platform, there is no common approach to the performance concept. In some countries some aspects are more concerned than others by this concept and this reflects the specific political, social, economical or physical conditions of each country.

Historically, the performance based approach originates everywhere at the beginning of the 70s, through different studies and researches and the first voluntary standards. Over the following years, due to political and social problems, in some countries this process went through a setback, while in some other countries the performance concept has slowly but constantly got a footing.

Today, the main obstacle to the achievement of the performance approach is represented by a lack of effective parameters. Designers and contractors are used to thinking in prescriptive terms. That's why they

deem that an approach based on objectives to be achieved, as known today, is in many cases too generic and implies too many responsibilities.

However, during the three meetings the discussion about the national state-of-the-art of the six countries represented in the Platform underlined some essential aspects of the performance approach that can be associated with the Mediterranean context, namely:

- influence of diversity factors with the other European Platforms;
- major scientific areas to be carefully dealt with within the Mediterranean countries.

It is quite evident that the main diversity factors with respect to other European countries are, generally speaking, of a climatic, geographic and socio-cultural nature. Starting from the above evidence, during the last workshop the conclusion of the previous works was finalized to draw up an Agenda containing the main RTD needs with a particular emphasis on Mediterranean needs.

During the project life, the scheduled activities have been realised and nearly all the results have been obtained. In particular:

- contribution to the international State-of-the-art report has been submitted by all the countries of the Mediterranean Platform and updated yearly;
- the Regional synthesis of the five countries was completed by the Task Leader;
- the first and second Platform Workshops, organised and held in Milan, allowed to compare the situation of each country related to the nine scientific domains of the project, thanks to a lively and fruitful debate among the Platform partners. The results of this debate are included in the Workshop minutes. The third Workshop was held in Rome and produced, thanks to the efforts of all participants and the active coordination of the PeBBu Programme Manager, an RTD Agenda in which, in addition to the general needs for RTD in the field of PBB, the specific needs for the South European Area are underlined;
- all the above mentioned documents and news articles are available on the PeBBu website and represent an important contribution to the database for the achievement of final objectives;
- a great attention was focused on the possibility of establishing National Platforms, with the involvement of universities, professionals associations and stakeholders. In Slovenia and Israel, National Platforms are already established and operational while in Italy the implementation is being delayed by many difficulties;
- many attempts have been made to attract two NAS countries, Cyprus and Croatia: no reply from these countries. Slovenia applied for being relocated to the Mediterranean Platform and it has become a full member of the Platform since 2004.

2.7.4 International Research Mapping



Detailed task report of this task can be found under Annex I.17.

One of the defined tasks in the PeBBu project is the development of a database with information on research and development that is of special relevance to Performance Based Building. The aim of such a Mapping is to contribute to future policy making as concerns Performance Based Building. The final objective has been to develop this into the world's foremost portal to information on Performance Based Building. To a large extent, this has been successful. As an important portal containing information on PBB, this database is of strategic importance to various organisations working with PBB principles. It should be kept in mind that this is an ongoing task and would not end with the ending of the PeBBu project.

This PeBBu Mapping database contains information on ongoing Research Projects, Publications, (recently published scientific) Papers, Organisations and Contacts (with their expertise) as of special importance to the further development, implementation and application of PBB. The result contains an information

system on different levels of detail for the research and for the organisations involved, including: databases in searchable formats, with adequate links to information sources and with several degrees of accessibility. The appointed PeBBu Designated Contact in each organisation is responsible in his / her organisation for incorporating as many as possible relevant Projects, Publications and Papers and stimulating other PeBBu members in the organisation to add the papers. Designated contacts can also add more contacts in this database that can further add papers.

This database can be accessed from: <http://www.pebbu.nl/maincomponents/mapping/>

During Year 1, discussions took place with representatives of the Thematic Network E-CORE, aiming for an alignment of the PeBBu and E-CORE Research Mapping database infrastructures, such that the outcomes are optimally compatible. For PeBBu, this resulted in a delay of the work that was initially envisaged to take place early in the PeBBu project. However, later this cooperation fell through and PeBBu project had to start working on developing it's own database for the mapping.

In the second half of Year 2 the infrastructure was developed, tested and finalised for the mapping of PBB research projects, expertise, publications and published scientific papers (in journals or in conference proceedings in a relational database. First examples were included and all members have been invited to start populating the database via remote on-line data entries. The functionality of the system has been specified by the Secretariat after examination of various available models including CERIF. Contractors were engaged by CIBdf to establish an inter-relational database on the Internet. It is capable of remote entry of research capacity, projects and results by the actual researchers. In this way, the information can be kept up-to-date and of greater value to users.

It was envisaged that in the middle of Year 3 the PeBBu Research Mapping database would be launched outside the PeBBu network. However, in year 3, work started on redesigning the PeBBu website to make it more user-friendly and also to include information on all the new tasks which were introduced by the mid-term intervention. Then it was decided to also redesign the mapping database to increase it's user-friendliness and navigation ease. This took longer than initially thought. However, it was ready for public-use in year 4 and launched again. Various PeBBu members and contacts have made many entries following this launch.

2.7.5 NAS SotA Report

Detailed task report of this task can be found under Annex I.21.



In the course of 2001, when it became obvious that the EU would be expanded to include the EU-NAS – Newly Associate States, the response of the PeBBu Network was to manage a **PeBBu NAS expansion** that formalised through a PeBBu contract amendment in the beginning of 2003. This ensures a **complete European perspective for the stimulation and establishment of Performance Based Building practices.**

One of the main tasks under the PeBBu **NAS programme** was to produce a **State of the Art Report** on PBB in the NAS countries.

The PeBBu **NAS State-of-the-Art Report** addresses the background, the present situation and the vision and strategies of future implementation of PBB – Performance Based Building in the respective NAS (newly associated states of Europe) countries. Task members are 13 organisations from **Bulgaria, Czech Republic, Hungary, Lithuania, Slovakia, Slovenia and Poland.**

The **NAS SotA Report** aims to enlighten, why the NAS countries show plenty of **common features** even if they are belonging to different regions, different language families, they have different

historical background, different size and economical situation. A main feature of this report is to investigate the situation, the barriers and the opportunities of PBB related to the **historical background** of the NAS countries that strongly determined the possibilities of PBB and still influence the development of the construction sector. First of all this is due to the artificial socio-economical system that developed in these countries after the 2nd World War during the time of socialism.

Comparing with the East European Regional Platform's (EEP) Status Report of PeBBu, the NAS Status Report thus focuses on status and the common features as a consequence of the common historical background and analyses the situation related to the following historical periods: the time of socialism; the transition period and the present time after the EU accession. In contrast, the EEP Status Report focuses on regional aspects, describing status in each country and is based more on national reports and status in the countries.

The NAS members discussed also the status of PBB in general in the NAS countries considering the PeBBu **scientific domains & other domain areas. Vision to the future and overall strategies** of PBB implementation in the NAS countries were also determined by the partners. A **table of barriers, strategies & actions** related to historical periods were worked out and several **best-practice examples of PBB** in the participating countries were presented. The NAS Status Report also reflects these achievements.

As regards the **methodology** of the work, the NAS Platform organised special PeBBu NAS workshops; collected PeBBu documents and all PeBBu NAS members contributed to the work. The NAS Status Report also utilized relevant literature and the scientific background of the task leaders.

PeBBu results will be disseminated in the NAS countries through National Platforms that should be developed and also in education and training activities, conferences and workshops and various publications.

2.7.6 Generic Tasks

Detailed task reports of all 3 PeBBu generic tasks can be found under Annex 1.22 to Annex 1.24.

2.7.6.1 Generic Task 1: Construction Products Directive (CPD)



Objective 1: To inform PeBBu domains about the CPD. This objective has been achieved through Part A of the "CPD supporting document".

The first objective of this activity was to provide basic info on the CPD to the PeBBu domains and tasks and to receive and incorporate feedback in a final report that aims at linking PeBBu with the CPD. More broadly, part A of this document can be used to widely inform people about the CPD.

The Construction Products Directive (CPD - 89/106/CEE) defines six essential requirements for construction works, which are detailed in interpretative documents. Starting from those essential requirements for works, the European Commission, after consultation of the Member States of the European Economic Area (EEA), specifies the regulated characteristics for construction products and kits in mandates to the European Standardisation Committee (CEN) and the European Organisation for Technical Approval (EOTA) to develop harmonised technical product specifications, i.e. harmonised European standards or European Technical Approvals, for the performance assessment of the building products.

The EC New Approach directives in general and the CPD specifically introduce a mandatory system of conformity attestation throughout the construction products sector. For some parts of the industry, CE Marking is not really new, due to other existing EU Directives, but the CPD has important particularities.

Thanks to the CPD, the way technical product specifications are being written has changed. It is expected that the CPD technical specifications should be a driving tool towards performance based works specifications and regulations in a very large part of geographical Europe.

Objective II: To examine the relationship between product conformity attestation (the CPD) and works having been installed using a performance based approach.

Although the CPD starts from the 6 essential requirements for works, it leads to product conformity attestation only. It does not provide the link between the performance based approach used in product specifications and a performance based approach for works.

Therefore, in Objective II, this project examined how such a link is being or could be established.

Attention has been given to the European voluntary product assessment systems, which exist for many years in most European countries, and are expected to remain in place, although their scope might be very different, as far as they are not in conflict with the CPD and if there is a market driven demand.

At the moment, the CPD is at the end of its first phase, with the first generation of harmonised technical specifications becoming available and being used in the construction sector. The activity explored domains that the CPD does not cover for the time being and where supporting standardisation activities are ongoing (e.g. dangerous substances, durability, life cycle analysis, environmental declarations, ...).

2.7.6.2 Generic Task 2: CRISP Sustainability Indicators (CRISP)



This Generic Task studied how construction and city related sustainability indicators as collected and validated in the CRISP network may be used in performance based building. An improved internet browser was developed to view and search relevant performance indicators. Finally, recommendations were drawn for future work.

The indicator work was started quite late in PeBBu even though the CRISP results have been accessible for some time. The lack of a universal framework for performance based building hindered further progress in this task.

Even though the CRISP indicators are believed to add value for sustainable construction, they were not found sufficient as such to encourage innovations in performance based building. The internet tool was improved and many useful indicators were found. The innovations, However, are expected to be achieved in future work starting from the PBB needs and exploiting the results of earlier work, e.g. this PeBBu study.

The study on CRISP indicators (Construction and City Related Sustainability Indicators) showed the following

- the indicator framework as developed in CRISP based on different classifications relevant to sustainable construction (as suggested by international bodies, such as UN, EEA, OECD, WBSCD, ISO or CIB) needs to be simplified and re-engineered to meet the needs of performance based building
- a clear definition is needed for performance indicators

- individual indicators may contain different units or measurement methods, thus making it difficult for a same single indicator to belong into several indicator systems, or to have a possibility of defining new representative indicators systems by selecting relevant individual indicators from the database
- absolute target values for performance indications is not recommended to be given, since they often relate with local content
- an efficient indicator browser should give the opportunity of using different hierarchical levels in order to show the indicator systems in a representative manner
- as a conclusion the use of CRISP work as it is now still requires considerable improvements to add value for performance based building.

2.7.6.3 Generic Task 3: Decision Support Toolkit for PBB (DST)



This Generic Task gave an overview on decision support tools for performance based building. The most promising ones were presented in detail and their applicability was tested in selected PeBBu Domains using simple software prototype applications. Recommendations for further development were drawn and integration of feasible tools was proposed.

Seven value management, value engineering and process management tools were selected so that they can be used in different phases (briefing, design, delivery, operation) of performance based building as follows

- Check Lists
- Requirements Management (EcoProp)
- Quality Function Deployment (QFD)
- Multi Criteria Decision Making (Hipre)
- Design Structure Matrix (DSM)
- iBuild
- Post Occupancy Evaluation (POE).

These tools were tested in two occasions together with the PeBBu community in its Scientific Domains. Experiences from those tool tests were described and recommendations drawn based on them. An extensive list of references was collected into the main report.

The main conclusions as recommendations for the future work are summarised below

- a common international framework and universal performance classification
- an integrated platform with interoperable applications
- a performance based building roadmap
- value adding whole life services
- information dissemination, regulations and education.

2.7.7 Compendia

Detailed task reports of the 2 PeBBu compendia can be found under Annex I.25 and Annex I.26.

2.7.7.1 Compendium 1: Compendium of Building Performance Models



The Compendium of Building Performance Models is an on-line library of software tools (descriptions and links), currently presented on the Aus-PeBBu web-site and specifically compiled to facilitate the implementation of Performance Based Building. The setting up of the Compendium commenced as a CIB task in 2000, under the leadership of Dr Greg Foliente of CSIRO, Australia. In 2003, the further development of the Compendium was taken over as one of the activities of Aus-PeBBu, and the Compendium was installed in the "Performance Models" section of the Aus-PeBBu web-site, www.auspebbu.org.

Since 2003, the Compendium has been expanded and updated to include a total of 37 performance models entries. In addition, a separate Guide to Environmental Design and Assessment Tools (incorporating 27 Australian and international environmental rating tools) has been incorporated.

The term "building performance models" refers to computational procedures and/or computer programs that can be used in:

- developing quantified performance criteria for building codes and standards;
- designing a building or part of a building to a target performance; or
- evaluating the whole building or any of its part as built at commissioning or at any time during building occupancy, e.g., as part of a performance review or audit.

The availability of such models is at the heart of the implementation of performance based building.

The Compendium is intended as a "one-stop shop" for the building, construction and property industry worldwide, so that building professionals, product manufacturers, building officials and researchers can find in one place all of the building performance tools that are needed to support, implement and further develop performance based building.

Since the performance models are intended to be used in supporting, implementing and developing performance based standards, emphasis is given to models based on "first principles" and which target "in-service performance".

2.7.7.2 Compendium 2: Compendium of Statement of Requirements



The Compendium 2 project was set up as an aligned Task by the CIB to confirm what is understood by a Performance Based approach as it applies to Building (PBB). The Compendium 2 team was mandated to prepare a "consensus based conceptual framework" for the PeBBu project overall. This consensus has been significantly accomplished by presentations, papers and other communications with members of PeBBu throughout the project.

The two primary objectives for this project were to (1) help the PeBBu Domains and Tasks to prepare their own conceptual frameworks within an overall understanding, so that they would be congruent, and (2) present case studies of PBB projects to trace how the Statements of Requirements were created and used throughout the projects.

In order to accomplish these objectives, the team for the Compendium 2 project prepared the following deliverables:

- PBB Conceptual Framework (presentations, supporting papers and articles). The PBB Conceptual Framework synthesizes the overall concept of the Performance Based Building approach.
- Compendium of PBB Statements of Requirements (SoR), including Case Studies. The Compendium 2 reports on case studies of PBB projects, the Statements of Requirements that were prepared for those projects and the lessons learned from the projects. It includes a template and an interview guide to be used by others to prepare similar project studies.
- Related Bibliography, Terminology, List of Key Words for Research Mapping, and Glossary of Abbreviations, Acronyms and Initialisms.

The Compendium 2 and related documents are expected to be published as a printed version and also to be posted in electronic form at the CIB Website. The case studies are expected to serve as examples so that others can use the template to prepare similar case studies and upload them to the CIB Website. In time, this active Web Page is expected to become a repository of information and lessons learned so that stakeholders starting a PBB project will be able to set up such a project with more confidence and avoid some of the difficulties that have been encountered on projects in the case studies.

It is recommended that the Research Agenda include funding for such case studies as one of the research proposals.

This Compendium project is the first of its kind in that it presents studies of completed building projects that were procured using a PBB approach. It is therefore in and of itself a “State-of-the-Art” report. This Compendium and the other documents prepared for this task provide access to references, terminology and definitions that will give researchers an up to date view of the consensus about PBB reached in the course of the PeBBu project.

It should also be noted that Statements of Requirements are a key element in the ISO 9000 series of standards. To be able to measure quality, provide quality assurance and quality management systems, it is essential to explicitly state the requirements of the customer, and to include a process that ensure that the quality of the end product, expressed by a level of performance for a given cost, be measurable and verifiable. Thus, this task makes explicit how PBB links to ISO 9000.

2.7.8 2nd International SotA Report on PBB

Performance Based Building, PBB, is a building market environment in which all the stakeholders involved in the various phases of the building process address the need to ensure performance-in-use of buildings as an explicit target. PBB is expected to facilitate the development and introduction of innovative technologies and building systems into the market, to reduce the technical barriers on free trade, and enhance the overall quality of buildings. Its implementation can be achieved by using innovative, strictly performance-based, procedures and documents in design, construction tendering and procurement, but may also include the more conventional tools and procedures that are based on well documented and approved prescriptive provisions, which are known to supply given levels of performance.

To supply the European building market with State of the Art knowledge on PBB, the 4-year Thematic Network PeBBu – Performance Based Building has been launched in 2001 within the 5th European Program under the umbrella area of Sustainable and Competitive Growth, with CIB as Technical and Managerial Project Coordinator.

The 2nd International State of the Art Report includes two parts. The first part includes 7 Chapters, which highlight the SotA of the PBB subject addressing the following topics: Definition/Scope of PPB, Conceptual Framework, Stakeholders, User Needs, Performance Requirements and Criteria, Fitness for Use, Assessment Methods, Regulatory Concerns, Standardisation, Economic Performance, Decision-Making

Tools, Performance Measures and Key Performance Indicators, Risk Analysis, Quality Management, Research Needs, Incentives and Barriers, Strategic and Operative Routes for Further Implementation. In addition, it presents a summary of the Network's main outcome, the proposed PBB Research Agenda. The contents of the report are based on the vast PBB-relevant existing literature as well as on the outcomes of the Thematic Network PeBBu. The second part includes 27 Annexes, composed of the individual summary reports for the Network Tasks and new activities triggered by the Network.

Some main findings include: The simplest, most widely cited definition of the Performance Concept in Building is: "the practice of thinking and working in terms of ends rather than means". Some Tasks use it emphasising that enabling specified (usually improved) performance-in-use of buildings is the main feature of a PBB environment, whereas working in terms of ends is not an end in itself, but rather a means of implementation, which may be adopted at various points along the process, as needed and suitable. The building facility is regarded as a system with a very long life cycle composed of many interconnected items (materials, products, components, etc.). Its relevant user needs comprise a dynamic set of performance requirements, established by the numerous stakeholders, as well as by the regulatory framework, which addresses also the anonymous users who are not engaged in the building process. It is the task of the regulatory framework and of the knowledge domain to supply the tools for a smooth match between the performance-demand and the solution-supply sides. User Needs are stated in general terms and refer to the building as a whole, while activities are located within the spaces. Achievement of the conditions needed in every space in order to fulfil its User Needs depends on the building elements separating it from other spaces or from the outside, thus imposing performance requirements on the building fabric. These must be stated in physical terms to enable quantitatively-accountable design and assessment by means of suitable design and evaluation tools.

PBB concepts have been adopted in some regulatory frameworks. In most cases, prescriptive provisions are stipulated as deemed to satisfy solutions to facilitate design when a performance based approach seems too complicated. In contrast, performance based assessment has been an intrinsic methodology in the evaluation process and procedures for approving innovative building systems and components since the 1950s. The basics of the Performance Concept in building are covered in the popular professional literature, but profound research is still needed in many areas to bridge the gaps in knowledge, as outlined in the Research Agenda developed by the Network. Main emphasis should be put on thorough and comprehensive analysis of relevant Case Studies. In practice, PBB calls for more intensive team work in design, ensuring that all performance aspects receive due coverage in design. Risk analysis and life cycle economic optimisation are emerging cutting edge tools for PBB implementation. Numerous incentives have been pointed out for PBB implementation, with main emphasis on the facilitation of innovations. However, they are hampered by a multitude of barriers. Given the unique features of the building market, (each building is unique) PBB implementation should refrain from an overall revolution in the entire building process. Piece-wise implementation of performance based procedures in design, tendering or procurement, according to specific needs of a given project should be enabled by the regulatory framework, and remain the free choice of entrepreneurs. Strategies and activities for enhancing implementation should be in harmony with the building sector's unique features.

2.7.9 Research Agenda

TO BE ADDED (to be supplied by Greg Foliente)

2.7.10 PeBBu Prototype Interactive Website for Educational Purposes – a guide to PBB

The goal of this task was a prototype interactive website to open up (part of) the extensive PeBBu information to the interested parties in the building process. For that the website has been made relatively straightforward. It should give good guidance to the most interesting information for the visitor. This

means that the visitor can find the information that is of interest to him/her within a few steps. It has not been the intention that all available information is gathered in this website. Instead, it should present an easy to use starting point that refers, through hyperlinks, to available stakeholder-specific information. This information, to a large extent, is obtained from the PeBBu project.

A 2-D matrix is applied with the stakeholder (e.g. the visitors profession) on one axis and building related (in the form of PeBBu Domain and Task) topics on the other. The latter has been chosen as it can be related directly to the PeBBu project and with that to the content that has become available. This was the most simple lay-out to guide a visitor through the website, identifying the main interest of that visitor in relation to the Performance Based topic. The ultimate idea is to complete for each combination of stakeholder and topic a separate web page with information and links to other sites that support this content. For some combinations there will be no or a very limited amount of information, other combinations may have an overlap in the information (i.e. reference to the same [type of] information). As the Task has a limited budget, currently, only a section of the matrix contains links to separate (prototype) information pages. Nevertheless, the structure is such that the open spaces can be filled along the way and there is no limitation to the content for a specific combination.

List of Deliverables



CHAPTER 3



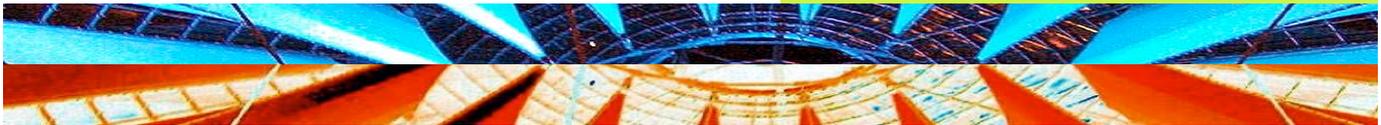
3 LIST OF DELIVERABLES

3.1 Comparison of Planned and Actual PeBBu Tasks & Deliverables during the entire project

Planned PeBBu Tasks and Deliverables in Years 1 and 2			Planned Delivery	Delivery Status
Nine Scientific Domains (3 domains terminated after mid-ter)	Contribution to first State-of-the-art Report		Year 1	Delivered
	First Domain Workshop	Workshop Preparation Report	Year 1	Delivered
		Workshop	Year 1	Delivered
		Workshop Minutes	Year 1	Delivered
	2 Domain workshops as part of series of domain meetings	Workshop Preparation Report	Year 3-4	Delivered
		Workshop	Year 3-4	Delivered
		Workshop Minutes	Year 3,4	Delivered
	All Domain Reports including final		Year 1-4	Delivered
	Input into PeBBu Website		Year 1-4	Delivered
	Communication with PeBBu Compendia		Year 1-4	Delivered
	Supplying regular news articles		Year 1-4	Delivered
RTD Agendas		Year 4	Delivered	
Assessment of Project Proposals		Year 1-4	Not relevant	
Three User Platforms	Contribution to both State-of-the-art Reports		Year 2 & 4	Delivered
	Platform Workshops	Workshop Preparation Reports	Year 1-2	Delivered
		Workshop	Year 1-2	One held. Others cancelled after review
		Workshop Report	Year 1-2	Not applicable
	Questionnaires	User Platform 1	Year 3-4	Delivered
		User Platform 2	Year 3-4	Delivered
	Final Reports	User Platforms 1 and 2	Year 4	Delivered
Four Regional Platforms	Contribution to both State-of-the-art Reports		Year 2 & 4	Delivered
	3 Platform Workshops	Workshop Preparation Reports	Year 2-4	Delivered (except 1 workshop of RP2)
		Workshops	Year 2-4	Delivered (except 1 workshop of RP2)
		Workshop Reports	Year 2-4	Delivered (except 1 workshop of RP2)
	Initiation National PeBBu Activities		Year 1-4	Delivered / ongoing
	Launching National Platforms		Year 1-4	Some formed
	Attracting observer-members from other regional countries		Year 1-4	Partly achieved
	News articles		Year 2-4	Delivered

Mapping EU Research Activities	Framework and Infrastructure		Year 1	Delivered in Year 2	
	Inventory / Validation		Year 2	Delivered in Year 3	
	Inventory Report		Year 4	Delivered	
Steering Committee	Annual Meetings	Meeting Preparation Reports	Year 1-4	Delivered	
		Meetings	Year 1-4	Delivered	
		Meeting Reports	Year 1-4	Delivered	
Technical Committee	Annual Meetings	Meeting Preparation Reports	Year 1-4	Delivered	
		Meetings	Year 1-4	Delivered + extra meetings in Year 2&4	
		Meeting Reports	Year 1-4	Delivered	
Network Secretariat	Two Annual Technical and Financial Reports		Year 1-4	Delivered	
	2 International State-of-the-art reports		Year 2&4	Delivered	
	Website	Development Infrastructure		Year 1	Delivered. Improved greatly in Year 3
		General PeBBu Information		Year 1 & 2	Delivered
		Relational Database		Year 1-4	Delivered
		PeBBu Newsletters		Year 1-4	Delivered
		Electronic Publications		Year 1-4	Delivered
	Technical Support Unit	Support Project Elaboration		Year 1-4	Delivered in EU IP proposals
		Project Assessment Reports		Year 1-4	Not Relevant
	Project Management	Attracting new Members / Observers		Year 1-4	Delivered
		Coordination other Programmes		Year 1-4	Delivered (E-CORE and IP proposals)
		EU Contacts		Year 1-4	Delivered
		Supervision Secretary		Year 1-4	Delivered
Financial Network Coordination			Year 1-4	Delivered	
EU-NAS Extension		NAS SotA Report	Year 3-4	Delivered	
3 New Generic Tasks	GT1: CPD final report		Year 3-4	Delivered	
	GT2: CRISP final report		Year 3-4	Delivered	
	GT3: DST final report		Year 3-4	Delivered	
RTD Agenda Synthesis			Year 4	Delivered	
PeBBu Prototype Interactive Website for Educational Purposes			Year 4	Delivered	
Aligned CIB Commissions projects			Year 1-4	Delivered	
PeBBu Compendia	Comp. 1: PBB Models		Year 1-4	Delivered	
	Comp. 3: Final Report including Case Studies		Year 4	Delivered	
	Comp. 3: Consensus based PBB conceptual framework		Year 2-4	Delivered	
	Comp. 3: Glossary of Acronyms / Key terminology		Year 2 & 3	Delivered	
Final PeBBu Conference Helsinki, 2005			Year 4	Delivered	
Launching of Aus-PeBBu			Year 2	Delivered	

Comparison of initially planned activities and work actually accomplished



CHAPTER 4



4 COMPARISON OF INITIALLY PLANNED ACTIVITIES & ACTUAL WORK ACCOMPLISHED

4.1 Overall activities

Description of Work	Work Performed
9 Domain Reports	All final Domain Reports are available on the PeBBu Website. www.pebbu.nl These include the RTD agendas.
1 st & 2 nd International State of the Art Reports on PBB	The 1st International SotA on performance based building was compiled and published in end 2003. This highlighted the benefits of PBB, and evaluated its positioning and uptake in, primarily, the PeBBu Thematic Network member countries within a number of key domains. The report was updated in 2005 by a 2nd international SotA that reviewed the progress and uptake of PBB and its subsequent value proposition across a greater number of countries and domains.
Expansion of network via observer-members / liaisons	26 observer-members and liaisons representing 15 countries have become part of the network since the start of the PeBBu network. A list of these can be viewed in Annex 11.
Additional Activities	
3 new generic Tasks	With the interventions proposed by the steering committee in August 2003, 3 domains were to be terminated. With the budget withdrawn from these, several new tasks, which are emerging as important themes with respect to PBB were initiated. These are PBB and the Construction Products Directives (CPD); Decision-making Tool kit, CRISP Indicator-Analysis..
PeBBu NAS Expansion	The PeBBu Network expanded within the 1 st two years to include the EU-NAS countries.
East European State of the Art Report (NAS SotA)	As part of this extension, a new deliverable is the East European SotA report. This was scheduled to be finished by the end of Year 2. However, now it is finalised.
Aligned Activities	PeBBu Network has been involved in for supporting several aligned activities in addition to the workplan, which are important for achieving the PeBBu objectives. These activities such as the 2 PeBBu compendia are not budgeted from the PeBBu-budget. Details on the deliverables of these activities are given in the next section.
Aus-PeBBu	An Australian PeBBu Network has been launched in Australia in October 2003 with complete support and co-ordination from the (EU) PeBBu programme. More details can be viewed in Annex 5.2

4.2 Individual tasks

4.2.1 Scientific Domains

4.2.1.1 Domain 1: Life Performance of Construction Materials and Components

Planned Activities during the entire project ⁴	Actual work Accomplished
Contribution to both international PBB SotA	Performed
1 st Domain Workshop	Performed
1 st Domain Report(s)	Performed (the Report was regularly up-dated).

⁴ Information indicated as bold is part of the specifically mentioned activities in the project. Other activities are not explicitly mentioned in the proposal, but are referred to.

	Available on PeBBu website.
Survey amongst industry on Factor Method/Reference Service Life	Performed
Development of pedagogic application examples	Performed
Test training of practitioners	Prepared / Conduction planned for Autumn '05
Academic courses on DI subject	Ongoing; not included specifically in original Workplan
Initiate/co-ordinate international R&D	Performed/ongoing
Interaction with/co-ordination of international R&D projects	Performed and ongoing
Initiation of R&D projects	Performed and ongoing
Academic merits (Licentiate/Doctor exams)	Performed and ongoing (not included in original Workplan)
Interaction with other organisations in the subject area	Performed and ongoing. DI has well established contacts and co-operation with ISO, CEN, EOTA, national standards institutes, CIB, RILEM, fib, and business organisations e.g. CEPMC and national
Provide regular News articles	Supplied
Final Domain Report	Delivered (including RTD agenda)

4.2.1.2 Domain 2: Indoor Environments

Planned Activities during the entire project ⁵	Actual work Accomplished
Year 1	
Contribution to 1st International PBB SotA	Information provided for
1st Domain Workshop (incl. preparation report and workshop minutes)	workshop held September 02, 2002 (preparation report and workshop minutes made available)
1st Domain Report	draft report made available before 1 st Workshop (July 2002), Final version made available September 26, 2002.
Year 2	
Survey of National contributions of participants PeBBu Domain 2	1 st version November 01, 2003. Updated afterwards.
Website Domain 2	Fall 2002
NAS workshop Domain 2	workshop held March 25, 2003 (preparation report and workshop minutes made available)
Contribution to the Task #3 Compendium of State of Requirements project (additional)	over the runtime of the PeBBu project
Integrated Project Proposal ECOSPACE	Spring 2004
Update State-of-the-Art report	November 01, 2003
Dissemination of PeBBu (Domain 2) through publications	see publication references
Year 3	
2nd Domain Workshop (incl. preparation report and workshop minutes)	workshop held January 12, 2004 (preparation report and workshop minutes made available)
2 nd Domain Report	final version made available July 30 2004 (i.e. a further elaboration and update of the 1 st Domain Report)
Dissemination of PeBBu (Domain 2) through publications	see publication references
Year 4	
Contribution to Final PeBBu Report	information provided for through synthesis report
Research Agenda	May 09, 2005
Final Domain Report	August 26, 2005
Contribution to the Generic Task 2 DST (additional)	Workshop, Delft – NL, organised October 18-19, 2004
Dissemination of PeBBu (Domain 2) through publications	see publication references
To stimulate and pro-actively facilitate international dissemination and implementation of PBB	Through the workshops (including presentations), the domain report and the website a summary has been

⁵ Information indicated as bold is part of the specifically mentioned activities in the project. Other activities are not explicitly mentioned in the proposal, but are referred to.

	made of the status thus far. This reports facilitates the dissemination of the PBB approach. All the developed information is available on the web. Papers have been written for the International Healthy Buildings Conference. The PBB-concept has been given an important position in the 6 th FW Ecospace proposal.
To programme and coordinate international R&D within domain's scope	A close link has been established between the 5 th FW Project HOPE. Developments within PeBBu are translated to this project and reverse. Through a questionnaire, national and international research has been gathered and compiled.
To establish relationships with other international experts' or stakeholders' networks.	The indicated HOPE-project allows for a very useful extension of experts in the field of indoor environment. Stakeholders are addressed on an individual base, e.g. within the development of the Ecospace proposal; Through publications (e.g. Healthy Buildings Conference) we seek for relationships with other experts and stakeholders outside Europe.
Production of methods, guidelines, protocols and tools to evaluate / measure the health status of buildings or designs of buildings	The developed framework has been applied in the EU-project HOPE. From this a methodology is developed within HOPE to evaluate the health status of an existing building. This methodology in principle should be extended for use in the design phase.
Required international standardisation.	Again, in close connection with the HOPE-project performance criteria for healthy buildings are derived, with the intention to present them for pre-standardisation. First results of these criteria are found in documents developed within the HOPE-project (http://hope.epfl.ch/)

All planned workplan items have been accomplished. Other activities, mostly started at the beginning of the project, have been continued over the runtime of the project. The website presents the results of this continuation and elaboration of the work started in Year 1.

The interrelation with the other PeBBu Domains has been established through the Synthesis Reports. Cooperation with Domain 3 has been established through participation in the Workshop and correspondence with the Domain leader on the overlap between the two Domains. The PeBBu Meetings in Manchester and Porto proved to be efficient for the interrelation with other PeBBu Domains and PeBBu Tasks.

Developments within Domain 2 towards a conceptual framework and definition of the PBB-methodology, as described in the Domain Report have resulted in a close cooperation with the Task Compendium 2 work. There is no difference in the general understanding of what PBB is. Given its importance to the topic, Domain 2 has also provided extra input into the Generic Task 2 on Decision Support Tools

The issues that are presented as specific for the Domain have found their place in the Final Domain Report. As the work in PeBBu was limited to literature study and information gathering, i.e. no research, this mainly has been limited to presenting the most important references. With respect to standardisation, developments already are ongoing in that direction. The EPBD provides the context for the European dimension. Nationally, developments are visible but have to be taken up by the national representatives. The PeBBu work can act as a reference to that. Several of the members of the Network have a close connection with standardisation bodies in their respective countries.

4.2.1.3 Domain 3: Design of Buildings

Planned Activities during the entire project	Actual work Accomplished
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Planned Activities during the entire project	Actual work Accomplished
1 st Domain Workshop, including workshop preparation report and elaborated workshop minutes	Accomplished (July 2002). However, the workshop minutes are incorporated / have taken the form of the 1 st Domain Report (the 1 st Domain Report serves as workshop minutes).
1 st Domain Report	Accomplished
Contribution to the 1 st International PBB State-of-the Art Report	Accomplished
	NAS Catch-up Workshop (March 2003), including preparation papers and elaboration of the workshop results in the 1 st Domain Report.
2 nd Domain Workshop, including workshop preparation report and elaborated workshop minutes	Accomplished (Manchester, January 2004)
2 nd Domain Report	Accomplished
	Provision and elaboration of a pilot project (flexible office building), as an input for Generic Task 2 “Decision Support Toolkit” (as presented by the Generic Task 2 leaders in the 3 rd Domain Workshop, Porto, November 2004).
	3 rd Domain Report as an update of the 2 nd Domain Report and as a preparation for an extra, 3 rd Domain Workshop in Porto, November 2004.
	3 rd Domain Workshop (Porto, November 2004), including elaborated workshop minutes
	Preparation and presentation of a paper “Performance-based Design: bringing Vitruvius up to date” in the CIB conference “Combining Forces” (Helsinki, June 2005)
	Preparation an presentation of a keynote speech about performance based Building in general in the CIB conference “Combining Forces” (Helsinki, June 2005)
News articles	News article “Performance-based Design explained” (December 2004) News article “Ten reasons for performance based Design” (September 2005)
Development of practical guidelines for design professionals concerning the management of user requirements – as defined in terms of performance requirements – throughout the design process	Accomplished, the emphasis of the guidelines is aimed at explaining the concept and the importance of performance based Design to design professionals, as the international state of the art review shows that these professionals are hardly aware of PBD as yet
Development of modules for programmes that aim for the education and training of design professionals	Pilot module for an electronic education system (cd-rom), disclosing relevant results for design professionals from essentially all PeBBu Domains and Tasks
Domain Research Agenda	Accomplished / in progress
Contribution to the Final PeBBu Report	Accomplished
Participation in the PeBBu Technical Committee	Accomplished + Participation in the PeBBu Steering Committee
	Active participation in the development of the “PeBBu Conceptual Framework”
Supply of input into the PeBBu website	Accomplished
Assessment of proposals for international research and dissemination projects	No assessments have been made, as no proposals within the Domain’s scope were submitted
Provision of domain related input for the workshops of the PeBBu User Platforms and Regional Platforms and acting upon domain related recommendations from those workshops	Input provided by making available the Domain Reports. Participation in a User Platform Meeting (Industry) and a Western European Regional Platform Meeting (Brussels, 2003)
Programming and coordination of international R&D that falls within the domain’s scope in order to insure	Programming and coordination work has been started with the identification of issues to be addressed. These issues were discussed in the First Domain Workshop and fully accepted by the participants. After that,

Planned Activities during the entire project	Actual work Accomplished
internationally accepted prioritising of such R&D, maximal stimulus of international collaboration an maximal compatibility of results of such R&D	an international state of the art review was made concerning the respective issues. This review continued, as contributions from Domain members kept coming in.
Establishing relationships with other international expert's or stakeholder's networks that have overlapping scopes and objectives	Relationships were established in the context of international meetings of the CIB working commission W60 'Performance concept in building' in e.g. Wellington, New Zealand (2001) en Hong Kong (2002). Thus, promising contacts were established with research institutes in e.g. Hong Kong, Singapore and Canada that are active in the domain of performance base briefing and design. The domain leader participated in the Western European Regional Platform and especially planned to participate in the User Platform for building owners, users and managers in October 2003. Unfortunately the User Platform meeting was cancelled because of lack of participants.
Management of user requirements – as defined in terms of performance requirements throughout all phases of the design process	This objective is one of the main 'issues to be addressed' in the Domain's work and therefore is intensively debated in the Domain workshop. A 'Body of Knowledge' ('Knowledge Centre for Building Process Innovation') on this subject has been established in the Netherlands, in which the Domain leader is participating. Other participants are the Dutch Government Building Agency, TNO and the Technical University of Delft. The Knowledge Centre recently started an R&D project to develop an innovative building process model that is based on the performance approach and full participation of end users and that is aimed on creating maximum added value for both the client and the supplier. Gained knowledge will be brought back into the PeBBu network. The Knowledge Centre is in the process of establishing contacts with international bodies of knowledge that are active in the same domain.

4.2.1.4 Domain 4: Built Environment

Planned Activities during the entire project	Actual work Accomplished
Domain Workshops and Report	The domain workshop was held as planned and the workshop reports were produced and are available on the web. The deliverables so far have been internal to the project. Since this domain seeks such a wide range of inputs and there is lack of information and research on this domain, this domain is to be terminated.
Input into the PeBBu Website	The domain reports have been published on the website. Use of the PeBBu website has been developed in this domain to be the primary method to access the knowledge that is available about the built environment.
Contribution to the International SotA Reports	Delivered.
Assessment of proposals for international research and dissemination projects	No PBB proposals have been developed in the area relating to the Built Environment therefore no assessment necessary.
Participation in the PeBBu Technical Committee	Participated regularly in all meetings.
Survey using Delphi techniques concerning the definition of the performance concept as possibly to be applied to the urban design community	The development of the questionnaire was done on schedule. It was complex and few returns were got because the built environment had not been described in the performance terms before so respondents had difficulty in replying.
Definition of the Domain	Completed 100%
Questionnaire survey of collaborators	Completed 100%
Identification of Performance Specification in the Built Environment	50% complete

State of the art Final report	Completed 100% (based on available data)
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4.2.1.5 Domain 5: Organisation and Management

Planned Activities during the entire project	Actual work Accomplished
Year 1 1st domain workshop including workshop preparation report and elaborated workshop minutes <ul style="list-style-type: none"> Organised by the domain leader Domain members participate and contribute to the domain's work programme 	The 1st Workshop was held in Scheveningen, The Netherlands, in 10th-11th June 2002. The workshop preparation report was distributed before the workshop. The elaborated workshop minutes was distributed June 2002.
Year 2 Results from testing performance models in participating countries as concerns: <ul style="list-style-type: none"> Methodology, tools, procedures, and organisational aspects Quantitative and qualitative benefits Main challenges to be solved 	This information has been continuously added the Domain 5 overview report. This report contained information on 19 different examples of using/testing cases of performance models.
During the four year period Provision of domain related input for the user platforms and regional platforms workshops and acting upon domain related recommendations from those workshops	Domain leader has participated in relevant workshops when invited.
Support to national testing of such classification and verification methods	Ongoing activity in Finland with several cases/year. Strong national and international support from the whole Institute of VTT Building and Transport.
Input into the PeBBu mapping activity in terms of information on research and research competence as far as relevant to the domain's scope.	No activities on this area.
Input into the PeBBu website (task 20)	Workshop reports, domain reports, information on ongoing research has been produced as planned.
Input into PeBBu Compendia (if and when in place) Conceptual framework and terminology Best practice and state-of-the-art examples	VTT ProP® classification is exploited by the Compendium Outline by the CIB Program on performance based Building
Assessment of proposals for international research and dissemination projects	No inquiries for assessments have arrived yet.
State of the Art Final Report	Delivered
Implementation Experiences	90 % completed
Recommendations	40 % completed
Background information	Partly completed

4.2.1.6 Domain 6: Legal and Procurement Practices

Planned Activities during the entire project	Actual work Accomplished
Year 1	
State of the Art Report	State of the Art Report completed
1st Domain Report	1st Domain Report, including member country reports.
Hold Domain Workshop	Domain Workshop held
Produce Elaborated Minutes from Workshop	Minutes Produced
Develop Scenario Case Studies	Incorporated into Monograph. Produce Domain Website Hold Domain Workshop for NAS members Report on Domain Workshop produced
Year 2	
Develop Monograph Guidelines	Developed Monograph Guidelines

Develop Survey Instruments for report on: <ul style="list-style-type: none"> • limitations to innovation; • effect on PBB of value and tendering restrictions; • effect of legal and national jurisdictions 	Incorporated into Monograph.
Produce Report on: <ul style="list-style-type: none"> • limitations to innovation; • effect on PBB of value and tendering restrictions; • effect of legal and national jurisdictions 	Report produced and sent to Domain members for their response.
Documentation of limitations placed on innovation in by: i) professional indemnity insurers, ii) tendering rules and requirements and iii) professional practice	All completed see Domain Website http://www2.umist.ac.uk/construction/research/management/pebbu/home.htm
Investigation of how initiatives towards value and tendering restriction affect PBB – Performance Based Building	All completed see Domain Website
Investigation of how national and legal jurisdictions affect PBB	All completed see Domain Website
Year 4 Production of a review of national practices and procedures in the context of a worldwide status/best practice report	See Final Report
Contribution to International SotA Reports	Done
Final Domain Report including RTD agenda	Delivered

4.2.1.7 Domain 7: Regulations

Planned Activities during the entire project	Actual work Accomplished
State of the art report	Discussed and supplemented at the Manchester meeting
Four Domain Workshops	Brussels, May 2002; Budapest, March 2003; Manchester, January 2004 & Porto, November 2004.
Analysis of PeBBu regulatory systems internationally	Surveys from participating countries and analysis
Dissemination	Changes in task leadership caused delays & late dissemination of materials
Presentation of Findings	CIB Symposium, Helsinki, June 2005
Domain Reports – updates and final	Delivered as planned
Domain news articles	Supplied
Contribution to International SotA Reports	Done

4.2.1.8 Domain 8: Innovation

Planned Activities during the entire project	Actual work Accomplished
Stimulus Paper I	Delivered: October 2001
International State-of-the-Art Report	Delivered: April 2002

1st Domain Report	Delivered: August 2002
Phase 1 Industry Report to CIBdf (Synthesis Report)	Delivered: August 2003
Delphi Study Report	Delivered: April 2003
Stimulus Paper 2	Delivered: October 2003
Domain 8 News Article	Delivered: February 2004
Delphi Study News Article	Delivered: February 2004
Stimulus Paper 3	Delivered: November 2004
4th Workshop (Lisbon, Portugal)	Delivered: November 2004
Phase 2 Industry Reports	Delivered: March 2005
RTD Agenda	Delivered: May 2005
Contribution to International SotA Reports	Done
2nd Domain Report	Delivered: July 2005
Programme and co-ordinate international R&D that falls within the domain's scope in order to insure internationally accepted prioritising of such R&D, maximal stimulus of international collaboration and maximal capability of results of such R&D	Domain 8 work gathered and integrated contributions from key stakeholder groups through PeBBu meetings. Through this process prioritisation of action was developed; both for individual stakeholders and supply chains, and for national policy agendas. The work was exposed to, and calibrated against, relevant international work.
To establish relationships with other international experts' or stakeholders' networks that have overlapping scope and objectives	Integration of Domain 8 work with other relevant work through PeBBu Delphi study (see below), shared meetings with other PeBBu domains, engagement with CIB international network, dissemination of work (and subsequent feedback) through reports and papers.
Establishment of how connections can be created and sustained between performance objectives and innovative activities throughout the various phases of the building process and the lifetime of a building. In the context of which comparable experiences in other industries and sectors will be drawn upon	Domain 8 set out the focus of its work as 'performance of building in use'. This focus captures the whole lifecycle of the building from the need, through to use and recycling. Innovation is required in product, process and capability development. Key performance indicators and principal stakeholders responsible for their progression have been determined. This provided a robust platform for the second phase of Domain 8's work.
Delphi Study amongst international experts	Delphi panel set up, with representatives from all nine PeBBu domains. Three rounds completed. The results generated a consensus definition of PBB, key performance indicators and associated stakeholders.

4.2.1.9 Domain 9: Information and Documentation

Planned Activities during the entire project	Actual work Accomplished
Domain Workshop and Report	Domain workshop held and workshop reports and related documents produced.
Input into the PeBBu Website including news article	Done
Contribution to the International SotA Reports	Delivered
Development of practice recommendations for PBB related information and documentation systems, as to be applied in a) building project, including recommended practice guidelines for project clients, designers and contractors and b) project independent information on construction materials, products, processes, procedures and technologies.	<p>A conceptual model has been developed along with the PeBBu Domain 9 SotA report. An action plan was also developed, in which the following aspects were highlighted, namely:</p> <ul style="list-style-type: none"> - identifying and describing the new information requirements, including e.g. briefing and design information and information related to construction products, as they are significantly modified by applying PBB - identifying and describing the required development and introduction of user friendly methods for the gathering / making available and processing of both general and project-specific information.

Final Domain Report	Delivered
RTD Agenda	Delivered

4.2.2 User Platforms

4.2.2.1 User Platform 1: Owners, Users & Managers

Planned Activities during the entire project	Actual work Accomplished
1 st Workshop – October 2003	Planned but cancelled due to lack of support
2 nd Workshop – Spring 2005	Held as part of the CIB Conference June 2005 Helsinki
Circulation of Questionnaire – May to August 2005	Circulated as scheduled.
Final Report of User Platform I	Delivered as planned

4.2.2.2 User Platform 2: Building & Construction Industry

Planned Activities during the entire project	Actual work Accomplished
Organisation of workshops with European industry representatives	Cancelled due to limited response
Enquiry via national contacts	Distribution of questionnaire
Distribute questionnaires	Done by Belgium and The Netherlands
Compile results from questionnaires	Very limited response
Research agenda	available
Final report	available

4.2.2.3 User Platform 3: International Standardisation & Conformity Community

Planned Activities during the entire project	Actual work Accomplished
1 st Workshop – Early 2003	Held 23 June 2003
2 nd Workshop – Late 2004/ Early 2005	Not held due to change in emphasis and direction regarding EU Construction Products Directive (CPD)
3. Final Report	Not delivered due to change in work scope and objectives
4. Task Report to the EU	Delivered

4.2.3 Regional Platforms

4.2.3.1 Regional Platform 1: North European

Planned Activities during the entire project	Actual work Accomplished
Contribution to international SotA	Done
Three Regional Workshops and Reports	Done
Formulation of national Platforms	Achieved for Sweden and Norway
Attracting new PeBBu observers and members from the region	Achieved for Norway, Iceland, Estonia and Lithuania
Publications	Many publications delivered. See task report
Initiation and Alignment of and Funding for National PeBBu Activities	Alignment with international, European and national standardisation projects established. Funding for aligned projects in area Domain I achieved
Production of National SotAs	Delivered.

4.2.3.2 Regional Platform 2: West / Central European

Planned Activities during the entire project	Actual work Accomplished
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Set up of national platforms	Failed
Draft national SotA report	Done
First regional platform meeting	Brussels 29 th September 2003
Update of national SotA reports in agreed format	Available
Workshop on exchange of national experiences with setting up of PBB platforms	Cancelled
Enquiry via national contacts	Distribution of questionnaire
Distribute questionnaires	Done by Belgium and The Netherlands
Compile results from questionnaires	Very limited response
Regional Platform meeting	Meeting Delft 25 th August 2005
Research agenda	available
Final report	available

4.2.3.3 Regional Platform 3: East European

Planned Activities during the entire project	Actual work Accomplished
Contribution to International SotA	National SotA Report for member countries is completed.
To organise the kick-off meeting of EEP	The kick-off meeting (1st workshop) of EEP was held in Budapest 28th March 2003. EEP 1st Workshop Minutes was prepared after the workshop
Formulation of National Platforms	National Platforms in Hungary, Poland and Slovakia are being organised.
Attracting new PeBBu observers and members	New members - Poland, Czech Republic, Slovakia, Romania, Bulgaria and Slovenia were attracted to the task group. All member countries are involved with several representatives
Production of National Status Reports	All member countries prepared the National Status Reports.
To develop further the 1st State of the Art Report	1st State of the Art Report Update
To organise the Hungarian National Platform Kick of Meeting	Kick of Meeting of Hungarian National Platform was made in Dec. 2003
To make Regional Platform Meeting in the beginning of the year	Regional Platform Meeting – 13th of January 2004 Manchester
To organise a 2nd Workshop for EEP	2nd Workshop of EEP was held on 8th July 2004, Budapest. EEP 2nd Workshop Minutes was prepared after the workshop
To attract new members / observers	Observers from Romania were involved in the 2nd Workshop of EEP
To develop further the State of the Art Report	Draft of 2nd State of the Art Report was prepared
To organise a 3rd Workshop for EEP	3rd EEP workshop was organised in the 12th April 2005 in Bratislava. EEP 3rd Meeting Minutes was prepared after the workshop
To collect best-practice examples of PBB in each participating countries	Task members presented best-practice examples of PBB on the workshops and it was used for the EEP and NAS Reports
To work out defined priority themes of the platform	Each task member worked out a selected priority theme of EEP and it was attached as an annex to the EEP Report
To organise the 4th Workshop for EEP	4th EEP workshop was organised in the 21st –22nd July 2005 in Sofia
To work out the final draft of the EEP Report	The task leader prepared the final draft of the EEP Report and sent to the partners and domain leaders for commenting
To prepare the final EEP Status Report	After integrating all comments the task leader prepared the final version of the EEP Status Report
Contribution to International SotA	The contribution to International Status Report was prepared by the task leader

4.2.3.4 Regional Platform 4: Mediterranean

Planned Activities during the entire project	Actual work Accomplished
Contribution to	The contribution was organised around the scientific domains and tasks of the project and

International SotA	further themes, deemed to be strategically important for the application of the performance concept.
Three Regional Workshops and Reports	The first Regional Platform Workshop was held in Milan on 19/09/2003. The second, also held in Milan, on 17 September 2004 and the third in Rome on 8 July 2005. Each Workshop minutes were used for input into the International SotAs. These focussed on the specific regional context of the Mediterranean region and the future and current status of PBB with respect to this Region.
Initiation and Alignment of and Funding for National PeBBu Activities	Where lacking, some contacts have been established
Contribution to Final PeBBu Report	Each country contributed to the final Report. Italy, as Task Leader, is preparing the final draft
Establishment of National Platforms	At present, Israel and Slovenia have implemented a national Platform. In Italy it is currently under consideration
Attracting new PeBBu Members/Observers	No replies from Croatia, Cyprus and Malta selected contacts. Slovenia, at first belonging to the East European Platform, was relocated to the South European Platform

4.2.4 International Research Mapping

Planned Activities during the entire project	Actual work Accomplished
Develop the data structure and the technical infrastructure within the PeBBu website	Developed
Develop the contact network for the collection and assessment of the respective data	Developed
Inventory and assessment of data and processing of data into the database	In its new role as database moderator, CIBdf did not assess data but encouraged the contributors to properly classify and update entries.
Establishment of technical and contact infrastructures	Done
First inventory report on PBB related research competence, research activities and recent research results	Delayed but delivered later in the project
Final inventory report	Delivered

4.2.5 Steering Committee

Planned Activities during the entire project	Actual work Accomplished
Hold meetings every 2 years	Meetings held every year (4 meetings in total)
Preparatory reports for the meetings	Developed
Minutes of meetings	Developed and circulated
Interventions	A SC Meeting held in August 2003 has resulted in the proposal of certain interventions such as termination of 3 domains, introduction of new tasks and some budget reallocations / changes etc. These interventions are detailed out in Annex 3.

4.2.6 Technical Committee

Planned Activities during the entire project	Actual work Accomplished
Hold meetings every year	Meetings held every year. 5 meetings in total
Preparatory reports for the meetings	Developed
Minutes of meetings	Developed and circulated

4.2.7 Network Secretariat

Planned Activities during the entire project	Actual work Accomplished
PeBBu Technical & Financial Reports	All technical and financial progress / management reports have been prepared and submitted on time.
Website Development & maintenance	www.pebbu.nl PeBBu website was already up and running in the first year. In the 3rd year it was redeveloped to include several new features, more user-friendly and easily navigational. It is a source of varied information including general information on PeBBu, updated information about all Tasks, links to domain websites, domain reports and domain synthesis, regional platform synthesis reports and all workshop reports, International State of the Art Report, newsletters, Mapping database, PeBBu network contacts, aligned projects such as the compendia projects, information on becoming a member of PeBBu etc.
Aligned Activities such as Aus-PeBBu, Compendia	PeBBu Secretariat has been involved in supporting several aligned activities in addition to the work plan, which are important for achieving the PeBBu objectives. These activities are not budgeted from the PeBBu-budget. These activities include the Aus-PeBBu, PeBBu Compendia, 3 Generic, cross-cutting Tasks etc.
International State of the Art Reports on PBB	The 1st International SotA on performance based building was compiled which highlights the benefits of PBB, and evaluated its positioning and uptake in, primarily, the PeBBu Thematic Network member countries within a number of key domains. The report was updated in the 4th year by an international addendum that reviewed the progress and uptake of PBB and its subsequent value proposition across a greater number of countries.
International Research Mapping	The secretariat launched the International PBB Research Mapping Database and invited the PeBBu members to input their own data in this.
Newsletters	PeBBu has posted several newsletters to its members (also present on the PeBBu website). These range from news articles about new research or development in the field of performance based building, news about domain work, upcoming meetings, new appointments / observers in the PeBBu network., information on aligned activities. Several news articles were prepared on the main conclusions from domain work and regional platform, launching of the Aus-PeBBu and National Platforms, etc.
Support to the Network Domains, UP and RP	PeBBu Network Secretariat has provided good support to all activities of the network domains, Regional Platforms and in planning and organisation of the 2 series of domain meetings held in Manchester in January 2004 and in November 2004 in Porto.
Facilitate Network Steering and Technical Committee Meetings.	Successful facilitation of all steering and technical committee meetings during the 4 years. All necessary pre and post information was distributed to the members of the Technical and Steering Committees.
Establishment of Strategic Relationships	Many strategic relationships have been established which would result in a better propagation of PBB principles.

4.2.8 NAS SotA

Planned Activities during the entire project	Actual work Accomplished
To organise the kick-off meeting of NAS	The kick-off meeting (1 st workshop) of NAS was held in Budapest 27 March 2003. NAS 1st Workshop Minutes was prepared after the workshop
To make NAS Meeting in the beginning of 2004	NAS Meeting – 13 th of January 2004 Manchester
To organise a 2 nd Workshop for NAS	2 nd Workshop of NAS was held on 9th July 2004, Budapest. NAS 2nd Workshop Minutes was prepared after the workshop
To attract new members / observers	Observers from Romania were involved in the 2 nd Workshop of NAS
To develop further the NAS Status Report	Draft of 2 nd NAS Status Report was prepared
To work out strategies and vision for	Each NAS member worked out strategies and vision for PBB implementation

PBB implementation in the NAS countries	in own countries, presented in next workshop and this was integrated in the NAS Status Report
To organise a 3 rd Workshop for NAS	3 rd NASworkshop was organised in the 12 th of April 2005 in Bratislava. NAS 3rd Meeting Minutes was prepared after the workshop
To collect best-practice examples of PBB in each participating countries	Task members presented best-practice examples of PBB on the workshops and it was used for the EEP and NAS Reports
To work out best practice examples	Each task member worked out best practice examples of PBB in own countries and it was attached as an annex to the NAS Report
To organise the 4 th Workshop for NAS	4th NAS workshop was organised in the 21 st July 2005 in Sofia
To work out the final draft of the NAS Report	The task leader prepared the final draft of the NAS Report and sent to the partners and domain leaders for commenting
To prepare the final NAS Status Report	After integrating all comments the task leader prepared the final version of the NAS Status Report
To prepare the NAS Task Report	The task leader prepared the NAS Task Report

4.2.9 Generic Tasks

4.2.9.1 Generic Task 1: Construction Products Directive (CPD)

Planned Activities during the entire project	Actual work Accomplished
Draft report on CPD for discussion	Accomplished (Jan 2004)
First revised report on CPD	Accomplished (March 2004)
Circulation enquiry questionnaire	Accomplished (March 2004)
CPD Document	Accomplished (December 2004)
Final Report	Accomplished (1 Sep 2005)

4.2.9.2 Generic Task 2: CRISP Sustainability Indicators (CRISP)

Planned Activities during the entire project	Actual work Accomplished
CRISP Study	100 %
Internet browser	100 %
Recommendations	100 %

4.2.9.3 Generic Task 3: Decision Support Toolkit for PBB (DST)

Planned Activities during the entire project	Actual work Accomplished
Inventory Report	100 % completed
Tool prototype testing	100 % completed
Recommendations	100 % completed

4.2.10 Compendia

4.2.10.1 Compendium 2: Compendium of Statement of Requirements

Planned Activities during the entire project	Actual work Accomplished
Present definitions and a conceptual overview of PBB at each meeting of the PeBBu Network	The leaders of this activity presented at all such meetings
Present at the two last CIB Congress	Papers and presentations were prepared for both the 2001 and 2004 CIB Congress
Prepare papers and articles about "Why is PBB important, "What is	Papers and News articles were prepared and published at the CIB Website



PBB”, etc.	
Prepare a structure to capture PB Statements of Requirements and Case Studies of PB projects	A Template was created, pilot tested and used to report on several Case Studies. An interview guide was prepared to help others to use the template and study PBB projects in the future in a consistent way
Case Studies and related documentation	A report has been assembled with the Case Study Reports and related documents about Functional Statements
Related Terminology	Assembled
Related Bibliography	Assembled
Access to information	Glossary of related Abbreviations, Acronyms and Initialisms, with entries from many countries., and List of Key Words for research mapping

From this section, it can clearly be seen that the PeBBu Network has been well operational and has managed to achieve most of the objectives defined in the PeBBu Workplan. Apart from the defined objectives, several additional deliverables and tasks have also been achieved. This is a good success factor for any network.

Plans for Use & Dissemination



CHAPTER 5



5 PLANS FOR USE & DISSEMINATION

This section outlines the preliminary plans for use and the dissemination strategy for the PeBBu deliverables that are already delivered in Year 1 & 2 and also the future expected deliverables. At first, a table is provided which details out the overall the target groups, dissemination strategy for all PeBBu tasks. It also indicates the need for additional resources where necessary. After this table, the plans for use and dissemination for individual tasks (domains and regional platforms) have been given.

5.1 PeBBu Overall Deliverables: Plans for Use and Dissemination

All PeBBu Tasks and Deliverables from Years 1-4		Target Groups	Use and Dissemination Strategy	Need for Additional Resources?	
Overall	Final PeBBu Report	PeBBu Members, Observers, Design and Construction, Professionals, Research Community, Education Bodies	To be submitted to the EU and disseminated widely amongst and beyond the PeBBu community. Via publications of summary, website, news articles, presentation of main results in conferences / seminars.	No	
Nine Scientific Domains	International State-of-the-art Report	Construction Policy Makers, PeBBu Members, Observers, Design Professionals, Research Community, Education Bodies, International Standardisation bodies	Both the International SotAs, have been published for dissemination. The complete version is electronically downloadable from www.pebbu.nl .	For a larger-scale publication & dissemination of the International SotA summary, extra resources to be tapped.	
	Domain Workshops	Workshop Preparation Reports	Internal Deliverable	Via emails / PeBBu website.	No
		Workshops	PeBBu Members, Market Actors, Research Community	Workshops are themselves a means of dissemination and knowledge gathering	No
		Workshop Minutes	Internal Deliverable	Downloadable from PeBBu website.	No
	Domain Reports		PeBBu Members, Observers, Design Professionals, Research Community, Education Bodies	Domain reports constitute a basis for R&D programming. These are downloadable from the domain websites or the PeBBu websites. Since the reports are huge, it is only feasible to publish the summaries of these. A paper newsletter is	For a wider range of dissemination, some resources might be needed. For an electronic dissemination

				planned to disseminate the achievements of domains.	, however, this is not necessary.
	Domain Websites		PeBBu Members, Observers, Design Professionals, Research Community, Education Bodies	They are themselves a means of dissemination.	No
	9 International R & D Agenda's and resulting RTD Agenda Synthesis publication		For prioritising the future R&D research in the relevant areas of PBB	To be first reviewed by other experts for comments. News-articles, websites, presentation of results on conferences / seminars / other events, through own network. Later project proposals can be developed from these. RTD synthesis publication to be widely disseminated	No
Three User Platforms	Platform Workshops	Workshop Reports	Internal Deliverable	Via emails / PeBBu website	No
		Final Reports	Input into domains. Standardisation bodies such as ISO / CEN, owners, architects, contractors, building consultants, building users / owners, civil engineers, etc.	electronic reports, website, news articles.	No
Four Regional Platforms	Platform Workshops	Workshop Preparation Reports	Internal Deliverable	Via emails / PeBBu website	No
		Workshop Reports & Final Regional Platform Reports	For input into domains. Regional stakeholders in the field of building and construction, national regulatory bodies, research community etc.	Via website, news-articles, papers in journals, electronic publication.	No
	National PeBBu Activities / Platforms		All national stakeholders in building & construction sector	Promotion through conferences, workshops, papers, website, direct contact	Yes
Mapping EU Research Activities	Framework and Infrastructure		Development of website	Website	No
	Inventory / Validation		PeBBu community, international building research organisations and individuals, design professionals etc.	Website, reference lists, publication in journals, news-articles	No
	Inventory Report		PeBBu community, international building research organisations and individuals, design professionals etc.	Website, reference lists, publication in journals, news-articles	No
Steering	Annual Meetings	Meeting Preparation	Internal Deliverable	Via emails, PeBBu website	No

Committee		Reports			
		Meeting Reports	Internal Deliverable	Via emails, PeBBu website, news articles	No
Technical Committee	Bi-annual Meetings	Meeting Preparation Reports	Internal Deliverable	Via emails, PeBBu website	No
		Meeting Reports	Internal Deliverable	Via emails PeBBu websites, news articles	No
Network Secretariat	Annual Technical and Financial Reports		Internal Deliverable	Not for dissemination	No
	General PeBBu Information		All stakeholders in building and construction sector, design and construction / structural engineering students,	PeBBu Website, search-engines (google, yahoo etc.) news articles, presentations in conferences and seminars, articles in journals, word-of-mouth promotion.	No
	Relational Database		PeBBu Network,	Website	No
	PeBBu Newsletters		All stakeholders in building and construction sector, design and construction / structural engineering students,	Website, emails	No
	Project Management	Adding / attracting new Members	All stakeholders in building / construction sector– users , architects, designers, engineers, regulatory bodies, research community etc.	News articles, website, email / personal contact, participation in seminars / conferences / writing papers in journals	Yes
Additional PeBBu Tasks & Deliverables					
EU-NAS Extension		NAS SotA Report	NAS members, stakeholders in NAS countries	Attracting more members / observers from NAS countries, Spread of PBB via PeBBu website / news articles etc.	No
Domain Synthesis Reports			PeBBu community, new members, User and Regional Platforms	Produced as a publication as part of the International SotA Report. Website, emails, presented in Conferences etc.	No
PeBBu Compendia		Comp. 1: PBB Models	PeBBu community	Website, report to be published and distributed.	No
		Comp. 2: Statements of Requirements – Case Studies	PeBBu Community	Report, PeBBu website	No
		Comp. 2: Consensus Based PBB conceptual framework including annexes such as bibliography, glossary etc.	PeBBu Community	Report, PeBBu website	No
		Comp. 2: Glossary of Acronyms / Key terminology	PeBBu community	Website, emails, annexes to main report of conceptual framework	No
Aus-PeBBu			Design / construction professionals in Australia and later expanded to include other countries in south-east asia	Various means of disseminations. Follows similar structure as (EU) PeBBu and will have multiple deliverables to be	No

		disseminated	
PeBBu Prototype Interactive website for educational purposes	PeBBu community, educators, architectural / building science related students,	Website and CDs	No
Publications / Articles or papers by PeBBu/CIB/other PeBBu members on PBB related issues	Building and Construction sector community, students, research community	For promotion of PeBBu and PBB principles, gaining new members. Publishing articles is a strategy in itself	No
Input by PeBBu members in other scientific conferences / journals to promote PBB internationally	Participants of seminars.	For promotion of PeBBu and PBB principles, gaining new members. Presenting papers is a strategy in itself	No
Helsinki conference 2005	Building / Construction Research Community and other stakeholders	Link in with rest of research community in a broader area of organisation management design etc. Ideal way to propagate PBB and network with research community	Not yet.
Involvement of PeBBu members in national / international codes and committee's which establishes codes and standards	National and international Codes and Committees or standardisation bodies	Setting up of new codes and regulations based on PBB principles.	No
Involvement by PeBBu members in developing curricula's and incorporation of PBB in education (moving the knowledge frontier)	Students (future professionals), PhD. Students etc.	Promoting PhD. Topics in PBB related area. Introducing PBB in the academic curriculum.	Not yet
Dissemination in university system and professional education	Architectural, structural / civil Engineering students, PhD. Candidates	Via introduction of PBB-related issues in academic curriculum, promotion of PhD. topics in this field, websites and conferences, presentations in universities, exhibitions, publications	To an extent this is already happening via the domain leaders who are involved in the education area. For a greater expansion, more resources / members needed.
Professional Training (of existing systems / professionals)	Design and Construction Professionals	Websites and conferences, Exhibitions, Publications and Articles in known journals, expansion of the network	Needs extra resources. A PBB special edition was published in journal " Building Research and Information "
More targeted actions linked to certain domains	Varies: refer to individual domain strategy below	Varies: refer to individual domain strategy below	

5.2 Use & Dissemination Strategies for PeBBu Tasks Results

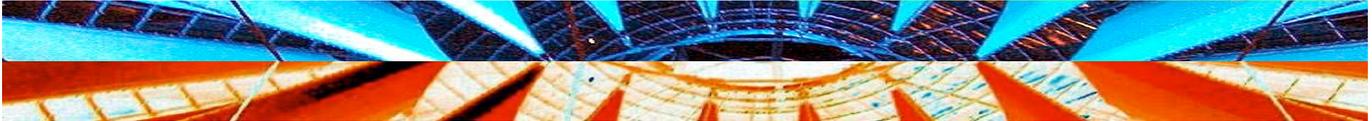
The individual plans for use and dissemination of each PeBBu task are given under the task reports of each task from Annex I.1 to Annex I.26.

5.3 TECHNOLOGICAL IMPLEMENTATION PLAN (e-TIP)

A Technological Implementation Plan in the form of an e-TIP has been submitted separately.



Management & Coordination Aspects



CHAPTER 6



6 MANAGEMENT & COORDINATION ASPECTS

6.1 Overall Performance of Task Leaders / Members

In general, the appointed Task Leaders performed well and according to the agreed work plan. This was also the case with the two Domain Leaders from outside the EU who depended on their own resourcing; although one of these task leaders (Beth Tubbs, ICC, USA, leader of Domain 7 on Regulations) had to leave. This position was filled in temporarily from ABCB (an observer-member from Australia) and later was taken over as a voluntary task (without minimal funding) by Mr. David Pilzer representing Technion, Israel (a PeBBu Member). All task leaders participated regularly and actively in all Technical Meetings and helped in positive and constructive discussions to enable the best possible results from the PeBBu project.

Concerning appointed domain members and national contacts the situation was slightly less positive. At the time of the project initiation, an assumption was made that the PeBBu member organisations would all be active in PBB related research and consequently, would be interested in being involved in an international coordinating activity in the same area with little or no extra resourcing (only “travel money” for the domain members and only Euro 2000 personnel costs for the national contacts). This assumption is now known to be wrong. Only a few of the PeBBu member organisations are indeed active in the respective area and for most domain members and national contacts their work to be performed according to the PeBBu work plan is considered as “extra and non-funded” work. The consequent level of motivation to perform in the time apart from the meetings according to the work plan requirements in most cases was therefore, relatively low. From an attendance analysis of all domain and regional platform meetings over the 4 years, the following can be concluded:

Domains

- The attendance rate by registered domain members at the various domain meetings was 72% (171 members including overlap), 65% (115 members including overlap) and 81% (129 members including overlap) respectively. Over all the 4 years of meeting an average of 72% attendance (495 members including overlap) has been noted, which is regarded optimal in such a dynamic network (the non-attending members were asked to and agreed to “refund” the respective budget allocations.) Over the years, the attendance rate increased as compared to earlier years. Planning the domain meetings as a series of meetings instead of stand-alone meetings greatly improved the attendance as well as the participation of the members.
- Apart from the members participating in the meetings, several observer-members, liaisons and guests participated in the meetings meaning that the absolute number of participants was higher.

This analysis has been presented in an overview in Annex I3.1.

Regional Platforms

- The average attendance rate by registered regional platform members at the various meetings was 87% (135 total attendance). The non-attending members were asked to and agreed to “refund” the respective budget allocations.
- Apart from the members participating in the meetings, several observer-members, liaisons and guests participated in the meetings meaning that the absolute number of participants was higher.

This analysis has been presented in an overview in Annex I3.2.

At several points during the project attempts were made to provide additional resources the national contacts in their active role in PeBBu for preparing and kicking off national PeBBu platforms aligned with

the international PeBBu network. However, this due to various reasons was not possible. Some national platforms emerged despite of lack of EU funding. These platforms in EU are of Sweden and Israel and to a small extent in Poland and Norway.

6.2 Network Management

6.2.1 Steering Committee

As planned in the work plan the Network Steering Committee had 4 annual meetings. The average attendance rate was 75%. See Annex 13.3 for details.

Halfway the project the Steering Committee reviewed all tasks, objectives and actual accomplishments and decided to recommend a substantial intervention, that amongst others included:

- Closing off three of the nine scientific domains
- Initiating three major new activities
- Aligned interventions on the budget allocations

Annex 2 entails the elaborated recommendations for intervention, that all are supported by all member organisations concerned.

Especially the preparations for the implementation of the recommended budget re-allocations required a substantial extra time investment by the Network Secretariat, which resulted in a support by all influenced member organisations, including those that now are recommended to accept a decrease of their budgets.

In the second half of the project duration, the Steering Committee met regularly (once a year) and regulated the smooth operation of the project. At the last SC meeting held in Helsinki, June 2005, some new tasks were introduced by the Steering Committee, which would add on greatly to the work done by the PeBBu thematic network. These included the production of a RTD agenda synthesis document and a PeBBu Prototype Interactive Website for Educational Purposes.

6.2.2 Technical Committee

The Technical Committee, in which all appointed Task Leaders are members, was planned to have only two bi-annual meetings over the four-year period. It has however, been concluded that this committee needed to be more active, in order to both facilitate an optimal alignment and cooperation between the various defined tasks and to enable the definition of a consensus based conceptual framework and key terminology, which proved to be necessary in support of achieving compatibility between the envisioned outcomes from the various tasks.

In support of such more active role, the committee had an extra meeting in year 2 and its members became involved in the aligned project on such framework and terminology. Two of the recommended Steering / Technical Committee intervention decisions are in support of achieving a better cooperation between the scientific domains and between these domains and the user and regional platforms:

- To aim for series of domain and user platform meetings as opposed to stand-alone meetings as envisaged in the work plan (the financial implications from this are that the planned meeting costs as incorporated in the domain and user platform leaders' budgets, are to be transferred to the Secretariat's budget. For this provisions are incorporated in the recommended budget intervention.
- To initiate certain new activities that required a coordinated cooperation by and input from the various domains and platforms.

Task Leaders of main aligned activities, the planned outcomes of which are crucial to achieving the PeBBu objectives, have been incorporated as member in the Technical Committee. This includes the leaders of:

- Compendium with PBB models: CSIRO, Australia
- Preparatory studies for the Compendium of PBB Statements-of-Requirements: ICF, Canada and BRE, UK (these studies include the development of the PBB Conceptual Framework and Key-Terminology)
- Aus-PeBBu: CSIRO, Australia
- Leaders of the 3 new Generic Tasks included during the mid-term intervention

These additional committee members do not require financial contributions for their participation from the PeBBu budget.

6.2.3 Network Secretariat

The composition of the PeBBu Secretariat, as provided by CIBdf, is as follows:

- Wim Bakens: Coordinator, strategic supervision
- Mansi Jasuja: Programme management including management of the PeBBu Website and Newsletters, coordination between all tasks and management of external relations
- Tom Heyblom: Financial and contract management
- Peggy van Asch: Membership administration and database management

Additional secretarial support is provided through CIB staff, without these requiring financial contributions from the PeBBu budget.

During years 1 and 2, three replacements took place for the fulfilment of the position of Programme Manager. The situation stabilised in year 3 and 4.

In general, the role of the network Secretariat has been much more pro-active and time consuming than envisioned in the work plan. This encompassed:

- A more active role on both financial management and on the management of external cooperation
- Two incidental activities: the NAS extension and (the preparations for and the provisional implementation of) the Steering Committee MTA intervention in the PeBBu Workplan and budget
- The decision to organise series of domain meetings instead of stand alone meetings, with the secretariat facilitating it, has also put much extra work on the secretariat.
- An extra series of domain meetings, not initially envisaged in the workplan was also organised by the network secretariat in Porto, Portugal in November 2004.
- The final PeBBu results were presented in a big conference in Helsinki held in June 2005. Planning and organisation of the 'PeBBu day' fell on the network secretariat, again a task not present in the initial workplan.
- Other's included participation in several non-PeBBu events to present the network results, publishing articles in journals, producing several publications.

6.2.4 Internal and external communication

The PeBBu website has become a major information platform within and outside the project and can rightly claim to be the main global portal for PBB related information. This relies on a good communication and coordination amongst the various PeBBu members, task leaders and the secretariat. This includes amongst others:

- All background information on PeBBu including workplan (initial and amended), information on the project coordinators, steering and technical committees, network secretariat etc.
- Database with information on tasks, events, contacts/members and organisations
- All published news articles.
- All tasks workshop related reports and final state of the art reports.

- Links to domain websites
- International state-of-the-art reports.
- Mapping database (requires login to edit)
- Information linked to aligned activities
- Various PBB related resources such as literature, papers, publications, websites etc.
- A discussion forum for task members
- All progress reports to the EU
- Information for observer-members on how and why to join the PeBBu network

The almost final outcomes from the network were presented at an international conference that took place in June 2005 in Helsinki, Finland. This was a CIB conference with a focus on organisation, management and building economic issues in general, within which a separate stream of PeBBu related activities was organised. (In the Steering Committee recommendations for budget re-allocations a relative small but new budget allocations for the preparation of this was incorporated)

6.2.5 Publications

In the initial work plan and budget, the assumption was that all PeBBu publications and also the PeBBu news article and newsletter to be published and distributed in an electronic format only.

At a recent meeting however the Steering Committee decided on a preference for some publications to be produced in a traditional paper format (in addition to the electronic format). This especially concerned some, more crucial of the final PeBBu reports and the annual newsletters. It was recommended to aim for a small budget to be added to the network Secretariat's budget allocation for this. The final report has been produced in this manner, however, the annual newsletters were not produced. Instead, the regular electronic news articles were redesigned to have a more attractive and reader-friendly look. This led to several positive reactions from the PeBBu members and a wider reading target group.

6.2.6 Financial Management

The PeBBu contract stated that BBRI, Belgium is the Financial Coordinator for the PeBBu Network, but that the respective work to be carried out by the Network Secretariat that is provided by the Technical Coordinator CIBdf. After some communication hick-ups during Year 1, BBRI and CIBdf developed an operational and positive cooperation related to the financial management of the network.

As concerns financial management and especially the dealing with the annual cost statements, the PeBBu Secretariat developed an approach that is substantially more pro-active (and time consuming) than average in most EU Networks. This more pro-active approach entailed the following.

- All members first provided draft cost statement to the PeBBu Secretariat
- These were assessed in detail on i) whether the EU rules and the financial rules as incorporated in the work plan were properly applied and ii) whether requested payments were in line with both what is in the work plan and with the realised accomplishments. This assessment resulted in request/recommendations to the respective member to – if necessary – adjust the draft cost statements. Often in practice, this involved detailed explanations, convincing people on the justification of such recommendations and in some case defining compromises.
- In almost all cases, the final cost statements were in line with the Secretariat's recommendations and could subsequently be supplied to the EU. If not, the Secretariat provided an advice to the EU on how best to deal with the respective cost statements.

The cost tables for year 4 on the EU format with the data aligned with the detailed cost statements of each partner is presented in Annex 15.

It must be concluded that some members, especially some appointed domain members, have been less

active than was envisaged in the work plan, in particular that they did not attend domain workshops for which travel money has been allocated for them. During the Mid-Term evaluation, the Steering Committee recommended that in such cases, allocated budgets for such members to be decreased. Communications by the network Secretariat with all such members have resulted in such budget decreases being supported by them.

Given decreases of costs of flights within Europe during the last years, especially the cost of flights from West, Central and some South European countries, it now can be concluded that the allocations in the PeBBu budget for travel costs for members in these countries are relatively high compared to actual expenditure. It was subsequently assumed that the EU rules included enough flexibility in such cases to allow for a remainder of budget allocations for such travel costs to be available to cover possible extra personnel costs made by respective members.

6.3 Network Composition / Membership

6.3.1 NAS Extension

In addition to the initial 33 member organisations in the beginning of Year 2, 13 new member organisations were added to the network through the so-called NAS extension. To facilitate an active incorporation in the network the network Secretariat organised a successful one-week series of events that took place in March 2003 in Budapest, Hungary and for which EMI, Hungary acted as the local host, including:

- A kick-off meeting open to all contacts in the respective NAS countries, in which general information on the network was provided and general issues were discussed
- In parallel, nine special domain workshops to introduce the new appointed domain members from these countries to the domain objectives and work plans
- A first meeting of the East European Regional Platform

In order to optimise the alignment with the PeBBu work plan and to maximise the relevance of PeBBu to the building and construction developments in the NAS countries, the production of a PBB NAS State-of-the-Art report was initiated. The final version of this has been published recently. From this report, it can be concluded that:

- At present little work on PBB is actually going on in the respective NAS countries and consequently little experience is as yet available
- Given the foreseen developments of the building and construction sectors in general and developments concerning building and construction regulatory systems in NAS countries, the incorporation of leading organisations from these countries in the PeBBu project was very appropriate in support of an actual implementation of PBB in the immediate future.

6.3.2 Observer members and Liaison Organisations

In addition to above-mentioned 13 new network members from the respective NAS countries, during Years 1 and 2, 21 official Observer Members and 5 so-called Liaison Organisations have been incorporated in the network (see annex 11 for a listing of these organisations).

In this context, the Liaison Organisations are organisations that have committed to being active in the network, but who for internal procedural reasons are not able to sign the observer agreement.

A point of disappointment however, is that almost all observer and liaison organisations were actually attracted through the Network Secretariat. The network members and the appointed task leaders were not very active and/or successful in attracting such organisations.

6.4 External Cooperation

6.4.1 Other EU programmes and networks

In March 2003, two proposals were submitted for IP's – Integrated Projects – for EU funding in the 6FP, in which major PBB related components were incorporated with the full support of the respective industrial partners:

- CityHome2010, that aims for developing a new European industry for the industrial production and delivery of affordable housing
- EcoSpace, that focuses on the development and application of new technologies for the monitoring and control of indoor environments in spaces, including spaces in buildings.

The PeBBu Secretariat was involved in a co-leading role in the production and submission of these proposals and was able to convince the involved industrial partners to embrace the principles of PBB as a necessary way forward towards required technological and organisational change. However, both submitted proposals were declined for EU support in 2003 and were re-submitted later in 2003. EcoSpace was rejected again. CityHome was accepted in the form of a new project called ManuBuild, but then the PeBBu Secretariat was no longer involved in the respective consortium.

6.4.2 Aligned CIB projects

The PeBBu programme has initiated a multitude of new international cooperation projects that are being carried out on a voluntary basis under the responsibility of CIB Task Groups and Working Commissions and that contribute to accomplishing the PeBBu objectives. A listing of such projects is included in Annex 3.

CIB commissioned the development of a Compendium of PBB models for the assessment of – performances as incorporated in – designs for and construction of buildings. This compendium has been maintained by CSIRO, Australia, the work for which is being funded through Aus-PeBBu.

CIB commissioned studies in preparation of the development of a Compendium on PeBBu Statements-of-Requirement, which included the development of a consensus based PBB Conceptual Framework and Key-terminology and also international comparative PBB case studies..

6.4.3 Non-EU Co-operation

The PeBBu network incorporated various non-EU participants, including:

- Appointed task leaders for two of the scientific domains from Canada (one of which was replaced temporarily by one from Australia and finally by a voluntary task leader from Israel)
- Observer-members and liaison organisations from Canada, USA, Australia, Croatia, India, Saudi Arabia and Japan.

An Australian version of the PeBBu Network has been launched in October 2003 in Australia. The Australian programme, referred to as Aus-PeBBu, is similar in structure to (EU) PeBBu. (More information in Annex 5.2) With the launch of Aus-PeBBu, Australia is now participating in the global move towards the performance approach, which has occurred in Australia and elsewhere through regulatory changes from a prescriptive to a performance based building code.

During 2004-2005, Aus-PeBBu has been expanding to include countries in the Pacific Rim and South East Asia with which Australia had cooperation agreements in place (such as New Zealand, China, Malaysia, Vietnam, Hong Kong, Singapore, Indonesia and India).

Through cooperation with such non-EU Regional as well as national platforms (EU-) PeBBu has developed into the central platform for a worldwide cooperation in support of the further development and application of PBB.

In the USA, the GSA – General Services Administration, responsible for public procurement policies – has been involved in the PeBBu network through a substantial co-funding of the preparatory studies for the development of the Compendium on PBB Statements-of-Requirements, which amongst others included a USA case study. Also in the USA, funding was applied for by a Canadian PeBBu Observer-member for a study that was to analyse USA experience with past PBB application. The first case study to be delivered is not a PBB project. Nonetheless, this case study will be beneficial and will include comments and conclusions that point to the usefulness of performance requirements statements, and performance measures.

The Liaison Committee of International Associations of Civil Engineering (including as members: CIB, ECCS, FIB, IABSE, IASS and RILEM) has the establishment under preparation of a joint committee that is to deal with Performance Based Building and pre-standardisation issues in civil engineering. It is to be envisaged that via CIB the work of such joint committee will be aligned with the PeBBu work.

In general, it is to be concluded that there has been growing awareness worldwide of the PBB potential and in parallel a growing recognition of PeBBu as cooperation platform. This offers a multitude of opportunities for a further profiling and positioning of PeBBu as the world's foremost cooperation platform on PBB related issues. Following up to and profiting for such opportunities, however, requires resourced capacity of a magnitude that so far is not available within the PeBBu budgets. With the ending of the EU funding in 2005, it will be hard to keep up the network's momentum in promoting PBB principles. However, it is hoped that under EU Framework 7, a continuation of the PeBBu project in some form would be possible. A few current PeBBu task leaders have taken the lead in this aspect.

6.5 Domains and Platforms

6.5.1 Coordination of domain activities

It may be concluded from the scientific and technical assessment of the domains in chapter 2, that in general the scientific domains have functioned well, even though a relative long preparation time was required to accomplish this. The decision at mid-term to have a more intense cooperation established amongst the domains in order to enable a truly inter-disciplinary approach to the multi-faceted challenge of further developing and actually implementing PBB proved to be a successful decision. As indicated earlier in this document such cooperation was stimulated and facilitated through:

- A replacement of the so far planned stand-alone domain workshops by series of joint and coordinated domain workshops
- The initiation of 3 new generic tasks as incorporated in the recommended Steering Committee interventions in the Workplan, that explicitly aimed for the enhancement of such inter-domain (and inter-platform) involvement.
- A more active role for the Technical Committee with a focus on supporting such cooperation.

6.5.1.1 Termination of 3 domains

The mid-term recommendations by the Steering Committee for interventions in the work plan included the recommendation to close of three of the nine scientific domains. These recommendations were based on the assumption that a continuation of the domain work would add substantially less value to achieving the network's objectives than the recommended new generic tasks. The three to be terminated domains finalised their work with the production of:

- A full domain report

- An international R&D agenda in support of the further development of PBB as far as relevant to the respective domain.

6.5.2 User Platform activities

The three PeBBu User Platforms were established to facilitate the involvement in the programme by the main European and international PBB stakeholder organisations and enable an impact by the stakeholders' interests on the network's work plan.

There was one information workshop held in year 1 for the User Platform for Standardisation and Conformity.

In this workshop several high level representatives of EU stakeholder organisations were present e.g. representatives of European commission for CPD. In this meeting, there was an agreement to set up a User Platform for Standardisation, to coordinate activities regarding PBB and regulations. At the moment, EU did not commit to this and later it withdrew due to internal reorganisations. This led to a loss of incentive to the other organisations.

After this, another meeting for the Standardisation platform was planned to be held in October 2003. However, due to a variety of reasons, this meeting was postponed. The main reason was unexpected cancellations due to illness/holiday. The meetings planned for the other 2 user platforms namely Owners and Industry were also not successful. The main reasons for these were: not being able to attract enough high-level organisations since PeBBu is still in a more theoretical stage of research and development and it was premature to expect such high-level representatives in a meeting without any funding.

In a Technical Committee Meeting held in January 2004, it was agreed that for the Standardisation platform, the idea of a meeting of stakeholders would still be pursued. For the other two platforms, a more individual approach seemed more feasible. The idea of making a PBB-related questionnaire geared specifically to the owners or industry is being developed and then circulated by the national contacts in their network/region. A draft of such a questionnaire for the industry platform was prepared in November 2004 jointly by the task leader of the industry platform, Dr. Luk Vandaele, BBRI, Belgium and an expert commissioned from within the PeBBu network – Assoc. Prof. Rachel Becker, Technion, Israel. This questionnaire aimed in giving local or regional feedback on the main issues surrounding the application and implementation of PBB with respect to those stakeholders. The questionnaire for the User Platform on Owners was prepared by Mr. Tim Yates, BRE, UK and sent to all National contacts for distribution. Several responses were received for this questionnaire.

It was decided by the Steering and Technical Committee in a meeting held in November 2004 in Porto to wait for the results of the Domain 7 on Regulations to see how the results of this domain can help us in making any progress with the work on the User Platform on Standardisation. However, it was concluded that at this stage the setting up of this User Platform was too ambitious. First, more awareness on PBB principles would be needed and steps would have to be made to further the PBB approach from a largely theoretical concept to a more applicable concept in order for such Standardisation Platform to have a substantial chance to be successful.

6.5.3 Regional Platforms activities

In addition to the international research and dissemination projects that were a part of the PeBBu Programme, national activities were necessary in preparation of the actual implementation of the principles of PBB. It was envisaged from the beginning that such national activities would be aligned as much as possible with the international PeBBu activities.

The four Regional Platforms as planned had all their regional workshops during the course of the project (with the exception of one workshop not held for West / Central Regional Platform) and as indicated in Chapter 2, have functioned well.

Amongst others, the regional workshops provided substantial comments on the domain reports that enabled an optimisation of the alignment of the domains work to specific regional characteristics and requirements. Other contribution by the regional platforms to the domains included preparation of regional R&D agendas.

6.5.3.1 National PeBBu Platforms

The Regional PeBBu Platforms in collaboration with the Network Secretariat coordinated and supported possible national programme proposals and request for possible international funding for the included “kick off” activities, as far as those aimed at establishing a more long term National PeBBu Programme that is sufficiently aligned with international activities of the PeBBu Network. The final aim in this context was to establish permanent National PeBBu Platforms.

The objectives of such National Platforms was:

- to stimulate and facilitate the programming and coordination of national projects, which are necessary in preparation of the actual implementation of the principles of PBB programmes
- to achieve a maximal alignment between those national projects and the international activities as performed in the context of the PeBBu Network.

The participants of each National Platform were typically envisaged to include representatives of building owners, design, construction and regulatory communities as well as research organisations.

Discussions with the appointed National PeBBu Contacts resulted in the following conclusions:

- There is in several EU countries an actual interest in PBB related issues in parallel with the awareness of the potential contribution by application of the PBB concept to achieving improved performance of the industry and enhances industry-customer relationships
- The national contacts display a high level of enthusiasm for preparation for the establishment of National PeBBu Platforms in their country
- All these national contacts face resource problems as the main barrier to actually committing to work towards preparations for such national platforms.

The EU was asked during mid-term, to investigate options for providing additional resources in support of the establishment of National PeBBu Platforms in (a selection from) the 22 (EU and EU-NAS) countries that so far were involved in the PeBBu Network. Such resources were to facilitate the preparations for and the actual launch of such platforms under the assumption that national resources would be available for the further maintenance of these national platforms. However, this proposal was not accepted by the EU.

At present three National/Regional platforms have been established, namely Australia, Sweden and Israel. These are reported in Annexes 5.1 to 5.3. The Australian platform is growing to have a regional focus by including south-Asian countries in its fold. In Poland, a national level platform has been incorporated in setting up the ECTP platform in which PBB is also an issue although of a minor significance. The South African national platform is still under consideration. There were some initiatives for setting up a national platform for PBB in the US but they have faded away.



Conclusions



CHAPTER 7



7 CONCLUSIONS

The performance based building (PBB) concept provides a flexible and technically non-prescriptive framework for building design and construction. Performance based building, is a building market environment in which all the stakeholders involved in the various phases of the building process address the need to ensure performance-in-use of buildings as an explicit target. PBB is expected to facilitate the development and introduction of innovative technologies and building systems into the market, to reduce the technical barriers on free trade, and enhance the overall quality of buildings as defined and perceived by owners / principles. Its implementation can be achieved by using innovative, strictly performance-based, procedures and documents in design, construction tendering and procurement, but may also include the more conventional tools and procedures that are based on well documented and approved prescriptive provisions, which are known to supply given levels of performance.

Application of the performance concept is gaining worldwide interest and acceptance. It is becoming increasingly recognised as the basis for harmonisation and globalisation of the building market. An international awareness with respect to PBB is growing and much of this credit can go to the PeBBu Network.

The PeBBu Network, established in 2001, has been facilitating in enhancing the existing performance based building research and activities by networking with the main European stakeholders. It has produced synergistic results for dissemination and adaptation of performance based building and construction and has had a key role in triggering off a global interest in the principles of Performance Based Building.

The main objective of the PeBBu Network has been “**Stimulation and pro-active facilitation of international dissemination and implementation of Performance Based Building in building and construction practice**”, and in that context to maximise the contribution to this by the international R&D community. This objective is achieved through many sub objectives.

The **main initial components** of the PeBBu Network include the 9 Scientific Domains, 4 Regional European Platforms, 3 User Platforms, the Research Mapping Database and the Network Secretariat.

The main criteria of success for the PeBBu Thematic Network have been its operation and growth as a network. In both these aspects, PeBBu has been a very successful network. By the end of the second year, the PeBBu network was already **established and operational**. The enthusiasm of the partners, internal and external communication of the network and the exchange of experiences and ideas within the network have been exemplary. In addition to this excellent cooperation of the initial partners, over the 4 years, the network has expanded in many spheres.

The PeBBu **website**, www.pebbu.nl, with its state of the art design and navigation, has become the main platform for internal communication and exchange within the network. It is beginning to be acknowledged as the world's premier portal to information on PBB. All the PeBBu deliverables, reports and publications, news articles and contact database information are available and downloadable from the PeBBu website.

The PeBBu Network included from the start 33 Member organisations in EU countries plus 2 organisations in respectively Canada and the USA that provided Task Leaders. In past 4 years, the network **expanded** to include a Newly Associated States (NAS) programme, acquired 26 (including NAS: 39) **new observer-members and liaisons from across the world** including non EU countries such as Canada, USA, Australia, Croatia, India, Saudi Arabia and Japan. The EU NAS countries include 13 new member organisations. One of the main results of this activity has been to produce an East European State

of the Art Report. Another major triumph has been the launch of an **Australian PeBBu programme** (Aus-PeBBu) in October 2003. This requires no additional funding from the EU and has enabled Australia to participate in the global move towards the performance approach that has occurred in Australia and elsewhere through regulatory changes from a prescriptive to a performance based building code. During 2004-2005, Aus-PeBBu has been expanding to include countries in the Pacific Rim and South East Asia with which Australia had cooperation agreements in place (such as New Zealand, China, Malaysia, Vietnam, Hong Kong, Singapore, Indonesia and India). In Poland, a national level PeBBu platform has been incorporated in setting up the ECTP platform in which PBB is also an issue although of a minor significance. A South African national platform is currently under consideration.

Apart from this, several **aligned activities** to promote PBB principles have taken place such as the 2 PeBBu Compendia, involvement with and support of several CIB commissions, 2 **proposals for EU IPs** where PBB was a major issue (Cityhome2010 [later renamed ManuBuild] / Ecospace). Another major **plan for dissemination** of PBB principles was achieved by being part of a major international conference that was held in June 2005 in Helsinki at which the main outcomes of the PeBBu network were presented. It was a very well attended conference and the keynote speech on PBB attracted much interest in the subject.

Other main achievements of the network include:

- Production of **22 State of the Art Reports** (See Annex 8) including 9 scientific domain reports, 4 regional platform reports in various themes of PBB.
- **Production & publication of the 1st & 2nd International State of the Art Report**, which give an overview of the status of PBB in an international context. The International SotA highlights the SotA of the PBB subject addressing the following topics: Definition/Scope of PBB, Conceptual Framework, Stakeholders, User Needs, Performance Requirements and Criteria, Fitness for Use, Assessment Methods, Regulatory Concerns, Standardization, Economic Performance, Decision-Making Tools, Performance Measures and Key Performance Indicators, Risk Analysis, Quality Management, Research Needs, Incentives and Barriers, Strategic and Operative Routes for Further Implementation. In addition it presents a summary of the Network's main outcome, the proposed PBB Research Agenda. The contents of the report are based on the vast PBB-relevant existing literature as well as on the outcomes of the Thematic Network PeBBu. The 1st International SotA has been published as a CIB publication and the 2nd one as a PeBBu publication. These are excellent tools to disseminate vital information on PBB.
- **Production of a final East European SotA Report** (NAS SotA).
- **Production of a high level, global synthesis of RTD agenda for PBB.**
- **Setting up of a prototype of interactive website for educational purposes** in 2 PBB themes of Indoor environment and design of buildings.
- **Establishment of many strategic relationships** with both European and international organisations.

The **Steering and Technical Committees** of the project have played throughout a very active, positive and leading role in steering the network. Halfway the project, the Steering Committee reviewed all tasks, objectives, actual accomplishments and decided to recommend a substantial intervention, that amongst others included:

- Closing off of three of the nine scientific domains
- Initiating three major new generic cross-cutting activities
- Aligned interventions on the budget allocations

One of the main deviations from the initially defined workplan has been in the setting up of the three **User Platforms**. After a few attempts to set up meetings with the targeted stakeholders, user platforms on owners and industry went for alternative approaches of producing and disseminating questionnaires via the PeBBu national contacts. These new approaches were rather successful. An amendment in the workplan revised the user platforms objectives to the alternative approaches. The path for the User

Platform on Standardisation has been a bit more difficult. It has now been concluded that at this stage the setting up of this User Platform is too ambitious. Firstly, more awareness on PBB principles would be needed and steps would have to be made to further the PBB approach from a largely theoretical concept to a more applicable concept in order for such Standardisation Platform to have a substantial chance to be successful.

Another issue, which has been highlighted from the experience of the last 4 years, is the importance for **establishment of National Platforms**. One of the objectives of a Regional Platform has been to establish National Platforms. However, this has proved to be very difficult without extra budget / resourcing. Despite this, 3 national / regional platforms have been formed as part of the PeBBu network. These include Sweden and Israel. As mentioned earlier, in Poland, a national level platform has been incorporated in setting up the ECTP platform.

In conclusion, the PeBBu Network is well under operation and has accomplished much. All the domains and regional platforms are functioning well and so are the technical and steering committees. As can be viewed in Chapter 2, a lot of scientific research and results have been achieved in various fields of Performance Based Building and these are starting to have an impact on the international stakeholder community. Many standards are being influenced with the cooperation of domains with the respective authorities.

It is also to be concluded that there has been growing awareness worldwide of the PBB potential and in parallel a growing recognition of PeBBu as cooperation platform. This offers a multitude of opportunities for a further profiling and positioning of PeBBu as the world's foremost cooperation platform on PBB related issues. Following up to and profiting for such opportunities, however, requires resourced capacity of a magnitude that so far is not available within the PeBBu budgets. With the ending of the EU funding in 2005, it will be hard to keep up the network's momentum in promoting PBB principles. However, it is hoped that under EU Framework 7, a continuation of the PeBBu project in some form would be possible. A few current PeBBu task leaders have taken the lead in this aspect.

