NORTH EUROPEAN REGIONAL PLATFORM
PeBBu Regional Platform 1

FINAL REGIONAL PLATFORM REPORT

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This work was performed as part of the tasks for the EU-funded Performance Based Building Network.

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.

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The North European Platform has primarily worked through workshops and seminars, partly organised by the Platform itself as part of the Work Programme, and partly as thematic contributions to seminars arranged by other projects working on adjacent fields. The alignment and co-acting with e.g. Lifetime (Lifetime Engineering of Buildings and Infrastructures; EU FPS) and the Nordic project “LCC in Building and Construction (Nordic Innovation Centre) has proven to be fruitful. The prominent link to European and International standardisation activities in the field of Sustainability in Building Construction and Service Life/Life Performance has been further developed and strengthened. Based on the networks a number of project proposals have been initiated, both on EU, trans-national and national level.

With the established network in place, and increased contacts due to new project proposals in the thematic field, the momentum existing in the Nordic Region should be used to further co-operation on topics related to Performance Based Building. The examples of national platforms established in the North European Region are offering important mechanisms to carry the work further on national levels. However important remaining research issues there are, a main focus in future ventures on PBB should be on shaping stimulus mechanisms for real market penetration through demonstration projects and co-action with market actors and standardisation. Coherent European programmes fussing the area are recommended.

This report accounts for the work pattern, main observations, and results achieved by the North European Platform. The Minutes of the workshops scheduled in the Work Programme are annexed. Workshop 3 focussed on research, development, and innovation needs, and the observations are summarised in the report.

The active work by PeBBu member and observer organisations and all contributions at workshops and via e-mails by companies, standards organisations, and authorities are gratefully acknowledged. Warm thanks goes to the Construction Sector Innovation Center (BIC), Sweden, and the Nordic project “LCC in building and construction” for co-arrangement of several successful events.
The objectives for the North European Platform are 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-/observership from the region and in special from those countries not originally participating.

New members/observers are attracted from
- Estonia
- Iceland
- Lithuania
- Norway
- 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 are summarised in this report.
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1 NORTH EUROPEAN REGIONAL PLATFORM ON PBB

1.1 Scope and Objectives

The objectives for each of the four Regional Platforms are 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 Transnational 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, transnational and national PeBBu related events.

Specific Scope and Objectives of the North European Platform are:

• To involve additional Members/Observers in the PeBBu Network from the following already represented countries: Denmark, Finland, and Sweden
• To attract new PeBBu Members/Observers from the following, not yet represented countries: Estonia, Iceland, Latvia, Lithuania, and Norway

1.2 Technical progress

1.2.1 Membership

New Members/Observers were, during the project period, received from:

• Estonia
• Iceland
• Lithuania
• Norway
• Sweden (industrial and standard institute observers)

Members/Observers from Latvia have not been attracted.

1.2.2 National Platforms

Two national platforms have been organised.
• The Swedish National Platform is established via BIC (the Construction Sector Innovation Centre, www.bic.nu). The BIC network comprises some 30 Swedish member organisations, predominantly industrial but also R&D and authorities

• A Norwegian National Platform was organised during 2004. It is operated by the Norwegian Building Research Institute (www.sintef.no) and the membership includes market actors, authorities and standardisation bodies

In Finland and Norway the PeBBu project has received input, and results have been disseminated via seminars and meetings arranged primarily on standardisation issues. Danish and Icelandic active participation in both PeBBu and other connecting projects, e.g. the Nordic Industrial Fund financed project “LCC in building and construction” and the EU-funded LIFETIME network, has meant effective cross linking.

1.2.3 Education and training

In Sweden, PBB is highlighted in academic courses at KTH (Royal Institute of Technology) and University of Gävle, predominantly at courses focussing materials and building technologies. Training courses targeting professionals (design engineers, builders, real estate managers, etc) are being arranged by SIS (Swedish Standards Institute) during the autumn 2005. The training courses focus the performance-based standards ISO 15686 on Service Life Planning and are primarily an outcome of the work by PeBBu D1 Life Performance of Construction Materials and Components. A guidebook on the service life planning process and the use of the ISO standards has been published in Swedish. An English version is printed as a co-operation between SIS and the PeBBu project and published by the SIS publishing house.

1.2.4 Workshops

The PeBBu North European Platform has in accordance with the Work Programme held three Workshops with different themes.

Workshop 1, Stockholm, 4 September 2003, focussed a review of each of the PeBBu Scientific Domains work programme and the so far reported state-of-the-art for each Domain. The scrutiny was based on specific North European perception and priorities. The Workshop gathered 13 delegates from Sweden, Norway, Finland, Denmark, Iceland, Estonia, and in addition UK (PeBBu central SotA reporting) and the Netherlands (PeBBu officers). The delegates mainly represented North European PeBBu membership but also commercial construction sector organisations and building materials producers.

Workshop 2, Stockholm, 29 October 2004, took the form of a thematic seminar/workshop with the chosen theme “Performance Based Procurement (PBP) – a way to meet end-user requirements”, as PBP is a highly focussed and prioritised issue in the region. The Workshop had the ambition to mirror all aspects of Performance Based Building from the perspective of the design and procurement process. In addition the Workshop aligned with and included presentations on other ongoing PBB relevant projects and activities with clear anchoring in the region, e.g. a Nordic study on “LCC in building and construction", the Nordic perception of the implementation and further development of the CPD, the Nordic input and work with Lifetime Engineering Methods. The Workshop, co-arranged together with BIC (the Swedish Construction Sector Innovation Centre), gathered 22 delegates from 7 countries. The workshop concluded with a listing of Observations, expressed as Challenges and Opportunities.

Workshop 3, Helsinki, 10 June 2005, focussed specifically on establishing an agreed input to the PeBBu R&D Agenda. The 8 present delegates representing the northern region PeBBu members established the basis for an R&D Agenda that also included identified challenges and opportunities for innovation and market implementation issues.
In addition to the above programme-scheduled workshops a number of national and Nordic meetings, seminars, and workshops have been held. Some main events are reported below:

- Information Meeting on PeBBu in general and Domain 1 in specific to Swedish market actors and stakeholders, 19 June 2002, Stockholm, Sweden
  - 23 national Swedish participants
- Workshop on “Performance Based Building – the road to satisfied customers?”, 2 April 2003, Stockholm, arranged by BIC (the Construction Sector Innovation Centre), Formas (the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning), SIS (Swedish Standards Institute) and PeBBu (Domain 1 and the North European Regional Platform). About 30 participants from Swedish industry and authorities
- Nordic Workshop arranged by the Nordic project on “LCC in building and construction”, financed by the Nordic Industrial Fund, 10 November 2003, Stockholm. The workshop focussed environmental assessment, life cycle costing, the setting of performance requirements and key values, and gave important input to the PeBBu work
- Nordic Workshop arranged by the project on “LCC in building and construction”, 10 – 11 May 2004, Reykjavik, Iceland. The workshop was targeted on Service Lives and Service Life Planning. The PeBBu D1 work was contributed
- Swedish/Finnish/Norwegian/Icelandic meeting in Stockholm on standards for life cycle aspects in building, life performance and service life planning, and LCC, 31 August 2004, arranged by SIS and University of Gävle. About 25 delegates from building research entities and standardisation bodies in the above countries, the ministries of environment in Sweden and Finland, companies and authorities.
Conclusions

CHAPTER 2
2 CONCLUSIONS

2.1 Observations and Conclusions

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 below. 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 the opinion of the 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 of 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 a real market penetration.

The following highlights, in condensed format, the main observations of the three Workshops scheduled in the Work Programme, and disclose a Nordic perception of the subjects treated.

2.2 PBB State-of-the-Art and a North Region Perception

The PBB concept is largely meeting an increasing interest in the north European region, but a coherent picture of the state of art and interest is not easy to perceive. A conclusion may be that the sector industry is in general showing active interest in realising possible benefits and opportunities by performance based building on an over-all perspective, but performance based concepts has generally not penetrated into daily business. In the Nordic countries the regulatory and juridical framework is largely adapted to performance based approaches. However, differences appear between the countries as well as between sub-sectors of building and construction within countries. The public sector, with road and railway management as examples, is a forerunner. Within the house building sector PBB has generally not been adopted. There is as well and generally a lack of understanding among market actors that a strive for “green solutions” or sustainable construction requires performance based approaches.

With the wide scope of the PBB subject there exists neither a common apprehension of what a PBB path involves in terms of barriers, challenges, and opportunities, nor a common view on priorities in terms of actions needed nor R&D needs.

The participants at the 1st North European Workshop, as a result of the performed scrutiny of the PeBBu project, expressed concern about the so far low participation by standardisation, regulatory and juridical bodies in the project.

It would be premature, with reference to the state of the national SotA’s, to affirmatively conclude on national characteristics or differences in the north European region. However, some observations are:
• the Nordic countries Denmark, Finland, Norway and Sweden, are in general at the same stage of
development, in spite of the fact that regulatory instruments and codes differ between the countries
• Iceland has ratified the Construction Products Directive but has not reached as far in regulatory
adaptation as the rest of the Nordic countries.
• The picture of the state of art in the Baltic countries is largely missing, but input at the 1st Platform
Workshop indicates that Performance Based Building is in a “cradle stage”, even if being met with
interest. However, in the area of load bearing structures the former eastern countries very early
adopted structural codes based on a performance concept.

The PeBBu project and the issues addressed are being met with interest, even if there are difficulties to
initiate true concerted actions within the national markets.

2.3 Performance Based Procurement

The 2nd North European Workshop concluded with the following Observations identified as Challenges and
Opportunities, to Performance Based Procurement and Performance Based Building:

• The legal level is not seen as a main problem or barrier, rather the market issues and how to promote
market implementation
  - provide good examples of Performance Based Building, establish well-documented demonstrators
  - show economic benefits of Performance Based Procurement and Performance Based Building

• Utilize the momentum on the market, which on a European level, is there partly due to the CPD
(Construction Products Directive) and the EPBD (Energy Performance of Buildings Directive,
2002/91/EC). The CPD implementation is vital, but
  - progress of instruments to support full implementation of the CPD on the market is too slow
  - resources are scarce for pro-active development of standards supporting the implementation of CPD
  and for marketing of existing standard approaches
  - pre- and co-normative R&D is not enough in focus, seemingly not at all by national funds and too
  scarce by the EU funding programs

• The role of clients; the competent and demanding client is a goal
  - focussed education and training programmes
  - educational material, handbooks, etc
  - education and training is in general a vital issue and should be directed to all stakeholders in the
building process
  - PBB should be given a strengthened role in relevant academic education

• Tools supporting approaches for Service Life Planning are needed

• Maintenance and operation issues are not specifically addressed at the moment, but need to be more
pronounced in focus

• Present concepts for dealing with intellectual property rights hamper innovation in construction and
hampers initiatives

2.4 A North European Region view on R&D-priorities

The North European Platform, in its analysis and prioritisation of R&D, chose not to focus solely on R&D,
but sought in addition to identify apparent Innovation and Market issues, as is also shown by the concluding
Challenges and Opportunities from Workshop 2. The following is a summary of the R&D Agenda and accounts also for the outcome of Workshop 3. The summary is basically structured following the PeBBu project organisation in scientific domains, which implies certain overlaps and repetitions of R&D needs, priorities and goals.

On a General Level there is a need for
- handbooks on PBB, well-documented demo projects and case studies accounting for application and experiences
- evaluation tools for the entire building life cycle
- adaptation of information (simplification) to meet user demands
- dissemination and co-ordination of dissemination of information on PBB as part of a market creation
- verification tools
- improved communication between actors/stakeholders and users on the construction market
- mechanism and methods for the transfer of performance requirements and knowledge including verification tools between different users of information

On the area Life Performance of Construction Materials and Components there is a need for
- modelling of performance demand and supply, relating the building level with functional subsystems and the materials/products level
- further development of and focus on the Reference Service Life concept. This should include information and training measures and campaigns, work on data base issues (formats, compliance with IFC standards, etc), R&D-support to generate data and data quality, and guidance for modification of Reference Service Lives in a service life planning process. The necessary standards and other regulatory instruments are primarily at hand, but the implementation and data generation needs support.
- focus on standards and application of standards in the innovation process

On the area Indoor Environment the needs focus
- guidelines and tools for handling requirements, attributes, and solutions in the building process including threshold values for demand of replacement
- design tools
- quality assurance measures to secure a healthy building outcome through the building process
- evaluation tools for the whole building life

On the area Design of Buildings the needs focus
- application of IFC (Industrial Foundation Classes) standard approaches in the design process.
- agreed approaches for management of performance information, which should include defining performance requirements, comparing achieved design with requirements, accounting of service lives used in the service life planning process (to constitute e.g. the basis for maintenance plans and to handle a life cycle perspective)
- demonstration of benefits including demonstration of achievements, cost efficiency of PBB approach, traceability and verification

On the area Legal and Procurement Practices the needs and priorities are summarised as conclusions of Workshop 2 where the North European Platform also concluded that the Legal and Regulation issues are not considered to be a main problem or barrier, rather the market implementation of PBB.

On the area Innovation the North European Platform concluded with an identification of a number of problems and questions not per se expressed as R&D issues or goals.
- There seem to be a common understanding that Performance Based Building approaches stimulate Innovation. Can this statement be proven, and if so, what is the stimulation mechanism? An ability to show a number of well-documented cases and/or general proofs may serve as good promotion of PBB.
- Part of the construction sector industry, e.g. the contractors, invest close to nothing in R&D, which creates well known problems. Innovation, on the other hand, may be solely market driven and not always an outcome of R&D, but does normally when occurring have effects on R&D. May market driven innovation initiated by PBB approaches act also as a stimulus to increased R&D investments?
Publications
The PeBBu project and the discussions in the network groups, e.g. North European Region Platform and the Domain I, has offered a significant stimulus for publications, both of a research and academic nature and of guideline and informative character. The following accounts for some of the more important publications:

Skarendahl, Å., Sjöström, Ch., A Swedish National Platform on Performance Based Building, PeBBu News Article, April 2004


Sjöström, Ch., Caluwaerts, P., Jernberg, P., Haagenrud, S., Ilomäki, A., Davis, H., Product Declarations with respect to Durability – A progress report, 10DBMC International Conference on Durability of building Materials and Components, Lyon 2005

Sjöström, Ch., EU-nätverk för funktionsbaserad byggprocess, (in Swedish), FORMAS magazine Miljöforskning, no 3, June 2002

Trinius, W., Sjöström, Ch., Chevalier, J.-L., Hans, J., Life Performance and innovation on construction materials and components, CIB symposium Combining Forces, Helsinki 2005

Trinius, W., Sjöström, Ch., Service Life Planning and Performance Requirements, Building Research and Information (March-April 2005) 33(2), 173-181

Trinius, W., Modules of Environmental Assessment related to durability and service life, 10DBMC International Conference on Durability of building Materials and Components, Lyon 2005


## Annex 1: Task Members & Contacts

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Annex 2 Minutes of Workshop 1

Minutes of Workshop 1
2003-09-16

PeBBu North European Regional Platform Workshop

Nordic Sea Hotel, Vasaplan, Stockholm, Sweden
4 September 2003, 10:00 – 17:00

Present:

Christer Sjostrom (CS), Centre for Built Environment (BMG), University of Gävle, task leader on behalf of KTH
Sven Haagenrud (SH), Norwegian Building Research Institute, Adjunct Professor at BMG
Erik Brandt (EB), Danish Building and Urban Research
Christer Finne (CF), Building Information Foundation, RTS, Finland
Roode Liias (RL), Tallinn Technical University Estonia
Hans Ewander (HE), Building Material Producers Association, Sweden
Ake Skarendahl (AS), BIC (Byggsektorns InnovationsCentrum), Sweden, also representing FORMAS, Sweden
Bjorn Marteinsson (BM), Icelandic Building Research Institution, seconded to KTH Research School, BMG
Mansi Jasuja (MN), CIBdf
Fredrik Waara (FW), Chalmers University of Technology, Sweden
Jack Bramwell (JB), CIBdf
Angela Lee (AL), University of Salford, UK

Lithuanian PeBBu member was not present at the Workshop

Opening of Workshop

Christer Sjostrom (CS) welcomed the participants and opened the meeting

PeBBu Introduction

Jack Bramwell (JB) gave the background to PeBBu, role of the Regional Platforms and expected deliverables.

A discussion followed on the difference between the definition of PBB in the 70:ies vs. the outcome of the new Delphi study. The main differences were seen as:

Perceived importance of user involvement
Objective measures

The new PBB concept involves the idea of performance of building over its entire life span

Review of Domain Reports

D1 Materials and components

Svein Haagenrud reviewed this report.
SLP- Service Life Prediction, Performance over time, Service Life Planning, rightly deserves high priority. Regulatory framework has bearing on material requirements. EU CPD is being implemented. Requires materials and products to perform in accordance to the design life (working life) of the building.

EU Energy Performance Directive also in place.

An EU dilemma is the present difference in approaches to service life declarations of products in product standards/approvals, where the so far CEN approach aims at declarations via implicitly pointing out test methods categories while EOTA aims at declarations based on service life declarations, as is the trend internationally.

The approach of declaring service lives is also applied in some national codes, e.g. in New Zealand. A critical review of the Domain work progress against objectives/goals is missing in the D1 Report.

Implementation of a common SLP approach will be a long process due to lack of data, methods, systems. Resources need to be given to this to speed up the process

Review

Overall a good report
SotA on SLP
Good priorities
Good SWOT analysis
Contains national SotA reports
Questionnaire issued and in progress
Critical review of progress missing. Partly unrealistic work-/time-plan
Strong support for new CPD focusing project
Negative attitude by CEN to SL declarations
Non-cohesive terminology

Work-plan:

Must be progressed in a step by step way
Gathering current wisdom

Challenges:

After NORDIC model developed slow funding and progress
The contradictory view on SL declarations between CEN and ISO
Attention to Marine environments needed in this Region
Global climatic changes
Traditional wood construction materials

Conclusions:

Good SotA report
Mismatch between PeBBu D1 objectives and resources.
CIB and NE members should propose a specific EU project
Reluctance of CEN to promote SL declarations

Discussion
CS: As regards product standards CPD Guidance paper F on durability ambivalent; CEN policy so far is not to declare service life b/c legal implications; next step is to form a long-term guide for next generation of harmonized product standards
Support for a CPD focusing project
Revision of CPD with focus on Environment
EC 6FP perhaps not an Integrated Project but a Targeted Project

SH: PeBBu too wide to tackle this area effectively
PeBBu has key people for an IP

AS: Agrees with CS on ways to approach EU 6FP

JB: PeBBu outcome is recommendations for next step.

Recommendations

Amend the Report with a critical review of international/European progress in the area
Overlook and adjust work- and time-plan
Support a CPD focusing project initiative to be taken by PeBBu/CIB

General comment: PBB issues should be included in other integrated projects

**D2 Indoor Environment**

Bjorn Marteinsson reviewed this report.

Energy, fire and structural aspects are not included
The focus on Indoor Environment limits out several building physics aspects
Domain 2 is focused on literature studies and gathering information
It appears to be a Netherlands based report (?)
Some findings/observations are not supported in e.g. Iceland. In the report it is stated that at component level the performance approach is widely used and there are numerous examples of standards and specifications that include test methods and criteria. It would be very informative if this assertion was more closely discussed and explained as it must be the experience in more countries than e.g. Iceland that assessment tools are not well developed and the criterias or user requirements often ill defined. Of course there are requirements that are easily put into quantitative terms that are by tradition well defined (structural properties, U-values, water and air tightness etc.) but others are not.

Well written report.
Chapter 5 on Performance Based Building is generic and applicable to all other Domains
Analysis of current methods and tools is missing
No link to human health
Performance specifications for components are better developed than for entire buildings.
Who will develop performance criteria for entire building?

Discussion

JB: Energy, fire and structure and other areas of PBB activity should be included in the national reports
CS: Mentioned the failure of the mandatory Swedish Ventilation Control; the missing links between indoor environment performance requirements and the ventilation control characteristics has made this regulatory framework toothless

Recommendations

Collect and analyse methods and tools in the area
The link to client satisfaction, e.g. human health, should be more clearly discussed

**D3 Design**

Erik Brandt presented this review.

USA developed performance concept in the 60’s
NBS US performance specifications

Discussion

CS: What are the Nordic issues?

CF: Building Information Foundation of Finland has published performance specification for painting, but does not include e.g. service life as a performance requirement.

EB: Denmark not very involved in developing new PBB tools

RL: No coordination from government in Estonia, but enterprise is interested. Only private practitioners are acting in this and introducing these specifications

SH: Product modeling should be focused - include in recommendations; describing the whole building – compare with the automotive industry. Strong and prioritized development in this area

Interoperability of various programs

Recommendations

Product modelling should be included in D3 programme. Product modelling to be used as a main tool for PBB

**D4 Built Environment**

Christer Finne reviewed the report.

City management issues
Creative city issues
Built Environment themes
Like a scoping study
Urban planning plus civil engineering (urban infrastructure)
More city – less space
Need ‘vitality’ and mixed uses for NE perspective
Sprawl and gentrification not issues in Nordic countries - stable population
Transportation not so bad in NE
Nordic issues: re-organisation of major state utilities into regulators, clients, contractors, urban migration, rural recession

Discussion

Discussion on how to design building which has a multiple use requirement using a PBB approach.

MJ: The issue of PBB and Renovation is not explored in detail within the PeBBu project

CS: Perhaps a potential 3rd new task for PeBBu?

Recommendations

Retain Civil Engineering (urban infrastructure) in PeBBu
PBB and renovation to be explored in greater detail

**D5 Organisation and management**

Christer Sjostrom reviewed the report.

Interesting but not specifically performance oriented
Doubtful value from a PBB perspective
Unknown NE perspective
Procurement important PBB area, but report adopts a procurement neutral approach

Recommendations
Continuation of research on PBB procurement in PeBBu

**D6 Legal and procurement**

Expected from Lithuania together with a national SotA. CS to contact Lithuanian PeBBu partners to explore progress

**D7 Regulation**

Christer Finne reviewed the D7 report

Good general impression
Encourage innovation
Trade liberalization
Qualitative statement of intent supported by quantitative components
Liability of practitioners a limiting factor
Line between mandatory and advisory
Risk informed regulations
CPD not included but must be
Are the “right” competences from e.g. the N Eu involved?

Discussion

Not common points within Europe
Finland used earlier the prescriptive approach, but anymore. Prescriptions are still there but preceded by performance based statements. Finland to be included in this Domain as an example.

Recommendations

A CPD perspective must be included

Improved anchoring in/involvement by regulatory authorities/competences in the work is necessary, e.g. from the N Eu countries

Since the scope of this Domain is huge, it is recommended to try to go forward where it is possible to progress.

**D8 Innovation**

Ake Skarendahl reviewed this work

AS has participated in some D8 meetings, but the full Domain report was not possible to download for AS. A. Lee will provide him a copy.

Few members in D8 from this region

Minutes reviewed.

No analysis evident

Misalignment with work-plan, but maybe work-plan does not target the right aspects and is unclear

Too much effort on defining innovation; not important

Metrics: way of measuring innovation

Discussion

CF:
Who needs innovation? Business does - owners want performance; focus this dichotomy

JB:
PBB enables innovation

Recommendations:

An N Eu Platform decision: AS will review the D8 report (A. Lee to provide a copy) and report back first week of October

Sharpen the focus on PBB and the innovation process

**D9 Documentation**

Erik Brandt reviewed this report

An understood D9 hypothesis that PBB changes information requirements and flow is not convincingly argued

Performance criteria (set by client) and performance characteristics (provided by building) is not expected to alter inherent characteristics of the documentation area

No state of the art report

Big overlap with other group

No real advancement or value
National State of the Art Reports

Denmark, Finland, Iceland tabled and will be emailed to A. Lee for the Int. State of the Art report. Also for CS to incorporate in the N Eu report together with SotA’s contained in the D1 Report.
Regional Synthesis

CS to use national format suggested plus regional comments on PeBBu programme and recommendations for future research and collaboration.

Final National Reports from this region to be sent to MJ within 2 weeks of the Regional Platform Meeting

Regional Progress Report to be prepared and sent to MJ within 3 – 4 weeks after the meeting

Proposal for Swedish National Platform

Will have a main focus on civil engineering structures
Will be BIC lead (Building Innovation Centre) and primarily based on the existing BIC network
Utilise existing BIC reports, activities and participants.
Extract PBB aspects.
Additional funding still to be explored.

Adjourment

Workshop was adjourned at 17:00

Participants - PeBBu North European Platform Workshop, 4 September 2003, Nordic Sea Hotel, Stockholm

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### Annex 3: Minutes of Workshop 2

**PeBBu North European Platform**  
**Minutes of Workshop 2, 2004-10-29**

#### List of Participants

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Minutes

Ch. Sjöström opened the Workshop and welcomed the participants. After participant introductions and presentation of the programme of the day

Mansi Jasuja presented scope, objectives and organization of the EU Thematic Network PeBBu (Ref. to PPT on PeBBu homepage, www.pebbu.nl )

Performance Based Building, PBB: practice of thinking and working in terms of ends rather than means, as applied to the building and constructing. PBB is primarily concerned with the description of what a building process does, rather than how it is achieved. Performance requirements by clients → PBB design procurement, construction ← regulation. PeBBu is organized in 6 scientific domains and 3 specific (new) tasks, 4 regional platforms, 3 user platforms. The 3 new tasks
- Support on the CPD
- CRISP indicator analysis
- Decision support toolkit for PBB

The six PeBBu scientific domains:
1 Life Performance of Construction Materials and Components
2 Indoor Environment
3 Design of Buildings
4 Cancelled
5 Cancelled
6 Legal and Procurement Practices
7 Regulation
8 Innovation
9 Cancelled
PeBBu is established outside Europe; AU – PeBBu is in function, under preparation is USA – PeBBu and SA – PeBBu

Facilities Management is not yet covered by PeBBu Domains, and Education and Training only partly. Intention to address barriers to PBB such as:
- Tradition; prescriptive approach “preferred”
- Fragmentation of the industrial sector
- Lack of R&D&I investment
- PBB application on component level rather than to entire buildings

PeBBu is open – interested people can become observer members in any domain of interest

Introduction on the Nordic project LCC in Building Construction, Svein Björnberg (Ref. to PPT on PeBBu homepage and www.lcc-bygg.com)

The project is running since 2001 and concludes end of 2004. Six Nordic workshops held during the project.
Scope/Value of Nordic Project:
- strengthen Nordic industry
- influence relevant ISO standards
- implement method of life cycle cost thinking into industry

Lifetime Engineering Network, Svein Haagenrud (Ref. to PPT on PeBBu homepage)

Lifetime requirement classes → lifetime quality / lifetime performance
- human conditions
- economy
- culture
- ecology

Domain 6 Legal and Procurement Practices, Kim Haugbölle (Ref. to PPT on PeBBu homepage)

Presentation based on the Danish situation - D6 is not so far advanced yet. The following is a summary:

Context of procurement and legal practices: business – government – academia
- procurement linked to and created by business
- legal linked to and created by government
- knowledge linked to created by academia
Building legislation, the DK example
Danish building act is completely performance based
Building regulation is in general PB
There are examples for direct prescriptions of solutions (e.g installation of lifts)
Examples of "non- solutions" → no pipes through the wet area of a wet room

Knowledge system
Norms and standards
specifications and solutions to comply with building regulation
Methods tools and instruments to verify compliance
Handbooks and guidelines
Academic and vocational training
Tacit knowledge
Procurement methods
Tendering Procedures
Contracts
Separate trades contracting
General contracting
Design/build contracting
liability
insurance / role of insurers

Some conclusions:

Even when legislation is performance based, procurement is still rather prescriptive. So no real direct influence from legislation and regulation
→ explore the conditions for successful application of performance based procurement
→ at some point on the way, you have to move to prescription. Question is when is the most appropriate time to make that kind of decision.

Discussion:

What is the hot topic for harmonization of PBB in Europe
  Find out whether legislation is performance based
  Then it is a matter of practice

Remark: concerning Danish regulation, same situation in FIN: considered commission study on liabilities?
Goal of study was a EU directive, but the project failed. Would be interesting to analyse why the directive failed.

Comment: PBB legislation and procurement - what actually happens is prescription based. Producing codified knowledge might be the solution. There model documents and tools should be developed

What is ongoing in North European countries?

Sweden – Ake Skarendahl

National policy on PBB
Strong support from authorities and industry, push for new regulation and standards
  We discuss a lot but do not seem to be doing anything to make it happen

Why is PBB not operational yet?
  Singular examples. Problem: move from detailed specification to PBB is a change of culture, lot of education and training, sad that there is no domain on education and training. Culture change, Risk management, tools – standards
  Successful examples of PBB application relies on individual interest and knowledge, it is not yet a basic mode of frequent application
  Performance based contracting may address the entire building or simply some chosen sub systems / products [ventilation and heating systems etc]

Advantages:
- offers possibility for industrialized production
- integration design and production
- innovation climate
- clear division of responsibilities
- meeting of set construction time
- increase satisfaction in work / bettering performing sector

Standards:
No one really takes up the task, especially when relating to performance requirements that represent general societal aspects. Industry does not participate in the financing of standardization efforts.

Conclusion on PBB in Sweden
- wide interest
- good experience
- very low use in routine production
- regulatory framework under development
- standards lacking
- focal areas: procurement procedures, PB standards, competence and skill

Finland – Christer Finne

PB procurement state of the art

Drivers of change for railroad administration (formerly governmental whole-unit)
- changes in public management
- sector’s growing economical importance
- infra technology program
- development of procurement and contracting methods (change or organization)
- need for innovation
- lack of common language
- need to move towards PB

Define performance requirements and define construction requirements
integrate performance and technical requirements into one comprehensive system

Were you have performance criteria, you should also have guidelines for work sections and construction elements

Design system for construction management contracts
- improve the structure of the procurement documents produced by all disciplines of design. Solution is guidelines for production of procurements documents.

Communication between the market and authorities

→ project: PROIT: product model data in the construction process

Iceland – Björn Marteinsson

Icelandic building market is very small, nearly all building materials, except cement, are imported.
Descriptive building codes. Market is flexible, so you can live with it, as you can break the prescriptive rules. Strictly prescriptive code is not good, so there is an opening, products with equal functionality is allowed. The building owners perform 50% of all maintenance. Large DIY share in the market. On small market, the funding of change is even more difficult. When client can point out a product, they find it easier to describe what they want, but cannot describe what they want before knowing the functionalities of the options on the market. No tendency towards PBB. Procurement methods; public owners are expected to have open tenders, whenever price is higher than 10,000€.

**Norway** – Svein Haagenrud

The national report not arrived yet. A PBB Network is established in Norway. Conditions in the area in Norway are similar to Denmark and Sweden. Naturally, as the market is rather inter-Nordic, with many contractors being active in the three countries. Product model. Huge pilot models, Statsbygg and other authorities act as driving forces, pilot projects, with industry, research and administration, building and construction reference library under constant development at NBI. Knowledge based system at byggforsk, building design sheets, reflecting best practice, possible to match them with expressed requirements. Some project going on: roads and school buildings, leisure hall in Oslo. Experience reports to be expected on these public private partnership contracts.

**Estonia** – Roode Lias

PBB – Estonia – no problems. Liability only 2 years, other items of PBB are in place.

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<th><strong>ordinary projects</strong></th>
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</thead>
<tbody>
<tr>
<td>Performance based procurement OK</td>
<td>Non-experienced client</td>
</tr>
<tr>
<td>Non-experienced contractor</td>
<td>Want to take the tools from prestigious projects for ordinary projects.</td>
</tr>
<tr>
<td>Client</td>
<td>Engineer</td>
</tr>
<tr>
<td>Quickly + cheaply</td>
<td></td>
</tr>
<tr>
<td><strong>Designer</strong> between <strong>Client</strong> and <strong>Engineer</strong></td>
<td></td>
</tr>
<tr>
<td>Architect designing the interior (educated in arts, not in engineering). Designer has no building technology education.</td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td></td>
</tr>
<tr>
<td>What is performance in this triangle?</td>
<td></td>
</tr>
<tr>
<td>Who knows how to apply the tools?</td>
<td></td>
</tr>
</tbody>
</table>

**CPD, Construction Products Directive** – Matti Virtanen

Implementation in harmonized product standards, in technical approvals, and in technical approval guidelines 32 mandates for harmonized standards and amendments 9 month period for consultancy on how to revise the CPD

Some differences from other NA (New Approach) directives:
- essential requirements are to buildings
- attestation of conformity rules differ from GA – modules (Global Approach)
- CE-marking is mandatory in other directives
A problem: when CPD poses essential requirements to buildings, and standards focus on products, then it is difficult to get them in line with each other.

European Policy for the promotion of Quality:

Market surveillance is an important factor.
Commission to be asked for the costs of CE marking of products. Some countries do not read that CE marking is mandatory, other do.
2 points in CE marking:
1. show levels of mandatory requirements
2. how to prove conformity / attestation
There will be mandatory CE marking within a couple of years.

Kerstin Wennerstrand:
40.000 construction products, harmonized standards may address about 2000? What about the rest?

“2008 there is a harmonized product specification for each construction product” Reinhardt Klein – EU commission – 2006 / 07 CE marking for main products.
Reference made to Eurocodes, compatibility creates demand for eurocodes

Future development of product standards:

Amendments
New standards
Regulated substances
One common test method for external fire performance of roof covering (now 4 different standards, German, Nordic, UK, France)
Durability; target to closing gaps between ISO 15686 concept and present “state of the art” approach in product standards [revised guidance paper open for discussion by November 26]

Performance based: CPD “standards shall be expressed as far as practicable in product performance terms”

Energy standards
essential requirement 6 and energy performance in buildings directive
standards should be ready by end of 2004
in practice by 2006/2007

Challenges for member states
adopt / change the regulations of member states according to hens
create requirement levels for characteristics of hENs
Translate Eurocodes and create national annexes + give up national regulations of structural design
give up national approval of construction products (in accordance with ends of co-existence periods of hENs)

essential requirement are the same in all countries
national interpretations are not the same
supporting standards are the same (when harmonized)
some of the questions should be high up on the agenda – contracts are the basis for performance based procurement. You need guidelines or standards. One standard for building maintenance, management etc. future development is needed.

**CRISP and Decision Support Tools** – Janne Porkka (ref. to PPT at PeBBu homepage)
http://crisp.cstb.fr
Tools: led by university of Reading and VTT
decision support tools
guidelines to select tools

Janne.porkka@vtt.fi

**Lifetime engineering** – Svein Haagenrud (ref. to PPT at PeBBu homepage)

**Cost Classification System** – Svein Björberg

The System is a main deliverable of the Nordic LCC project and will be brought into ISO/TC59/SC14 as a proposal for 15686-5

**Notes from Concluding Discussion**

- Legal level not being the problem, rather the market implementation
  how to promote market implementation
  provide good “examples”; demonstrators
  utilize momentum that is on the market, partly due to the CPD
- The CPD implementation is vital
- Stress role of the clients
  need more educated clients
- Education and training vital issue
- How to introduce/deal with the question of intellectual property rights; hampers innovation in construction
- Maintenance and operation issues should be focused; not specifically addressed at the moment

**Participants are asked to add to these bullet points.** The ambition is to convert the bullet points to R&D & Action points and process them further in the PeBBu network.

The Client is a very important initiator and promoter. New forms of collaboration is needed, where the client is an active actor, collaborating with the contractor and the consultants to get his idea through to the project. It was proposed to establish a client network with CIB as secretariat, problems should be brought to the attention of such a network. – a “client technology platform”. Reference was made to ECTP, European Construction Technology Platform. ECTP has the target of making input to the 7th framework.

Chair: Spain, secretariat: Belgium. Influence of the clients is not sufficiently expressed in ECTP

97% of the real estate is in place, therefore PBB must address existing buildings. Buildings must be dealt with in the same way throughout Europe. Operation standards are subject of cooperation in Norway and Sweden already. Maintenance language to be coordinated, like with the example LCC Research agenda, not just continue doing the same thing, new areas to explore, procurement needs to be more in focus. Procurement as such, but including legal aspects.

**The Workshop adjourned at 15:50**
Annex 4: Minutes of Workshop 3

2005-06-10
Building Information Foundation
Helsinki

Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Acronym</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christer Sjöström</td>
<td>ChS</td>
<td>BMG, University of Gävle, Sweden</td>
</tr>
<tr>
<td>Wolfram Trinius</td>
<td>WT</td>
<td>BMG, University of Gävle, Sweden</td>
</tr>
<tr>
<td>Erik Brandt</td>
<td>EBr</td>
<td>Danish Building Research Institute</td>
</tr>
<tr>
<td>Svein Haagenrud</td>
<td>SH</td>
<td>Norwegian Building Research Institute</td>
</tr>
<tr>
<td>Christer Finne</td>
<td>ChF</td>
<td>Building Information Foundation, Finland (part of meeting)</td>
</tr>
<tr>
<td>Sakkari Pulakka SP</td>
<td>VTT</td>
<td>Finland (part of meeting)</td>
</tr>
<tr>
<td>Pekka Vuorinen PV</td>
<td>VTT</td>
<td>Confederation of Finnish Construction Industries</td>
</tr>
<tr>
<td>Mansi Jasuja</td>
<td>MJ</td>
<td>CIBdf, Netherlands</td>
</tr>
</tbody>
</table>

Minutes

ChS opened the meeting and welcomed the participants to this last and concluding Workshop. He expressed warm thanks to ChF and the Building Information Foundation for hosting the meeting and for arrangements.

ChS informed about the UK/SE initiative on Sustainable Construction, to be held in Malmö, and at which he was invited to give a presentation and participate in a panel discussion. His intention was to use the forum to stress on the link from “Research – Development – Innovation – Market introduction” in the building sector, linking also Sustainable Construction to PBB. Information about the UK/SE is enclosed. Further information will be disseminated by ChS as soon as it is available.

The focus of the Workshop – the R&D Agenda - was discussed. The R&D-Agenda as a “key outcome” of the PeBBu project to promote the future development in the thematic field, and the work during creation of the D1 report is seen as most important.

Everyone was asked to review what publications might be of relevance to the PeBBu R&D-agenda, among these e.g. the special issue of BR&I on PBB (Vol 33 No 2 March – April 2005, see e.g. John Duncan on NZ experiences with PBB-code, mixed experiences, not only positive), the 10th DBMC documentation to be made available publicly. Identify publications relevant to our scope. Forthcoming events: CIB Conference Helsinki, 13 – 16 June, with a special PeBBu day. Send your comments a s a p!

The R&D Agendas are not separate publications, but part of the thematic domain reports. The Workshop focus is on the Nordic view on the issues of PBB.

Experiences from the PeBBu project – ready for application and implementation, input (knowledgebase) need to be integrated into e.g. IFC/IFG systems. SH mentioned the work by IAI and the co-operation between ISO TC59/SC14 and IAI. He also summed up the recent IAI meeting in Oslo, which demonstrated IFC based technologies. Conclusions were that technology is available, information input into the tech. is necessary now. Key was to manage to attract authorities to "e-government" leading to different information management related to the entire building decision making process and permitting. Involving authorities in development projects leads to them applying the projects content, hence creating a market. Government as a driver, industry to develop and provide the market, was a conclusion. ChS commented on the Swedish
situation: no coherent agenda so far, authorities do not work in the same direction, not yet co-ordinated actions.

MJ mentioned a possibility of more funding for the national contacts, which would be needed for further work with the questionnaires. May open a possibility to re-circulate the D1 questionnaires?

Everyone agreed that PeBBu has been a successful project and network - highly necessary. If Sustainable Development is the goal the focus is and should be on Building and Construction. For Sustainable Construction the Performance Approach is needed.

Different opinions on the European market was discussed; part of CEPMC has so far signalled a less favourable attitude to service life declarations. The CE-marking is a focus problem. An industrial attitude, in some cases, to avoid marking leads sometimes to fierce comments against SD, PBB, EPD, SLD. Service life information is demanded by the market, so industry will of course in perspective supply the information in some way.

Workshop

The R&D-Agenda should follow R⇒D ⇒ I ⇒M. Demo projects are important and should not be seen as only about buildings, but also focus processes.

The outcome of the workshop is shown in the attached PPT document.

Please comment on the PPT document, make amendments and adjust wording when necessary. Comments are needed asap but, with reference to the upcoming vacation period, not later than 1 August (2005)

After receiving the comments of the N. Eu. Platform, the R&D-Agenda will be circulated to the other domain leaders.

At conclusion of the Workshop it was discussed whether Domain 1 and the N. Eu. Platform would succeed meeting the deliverable plan and the time schedule. The opinion was that, even if the time frame was tough, it was within reach.

Adjournment

ChS thanked the participants for good work and adjourned the Workshop at 3 pm.
Annex 5: National SotA Denmark

Status of PBB in Denmark

The use of the performance concept in building began early in the 1970'es initiated by the Danish Building and Urban Research (DBUR) issuing a number of publications about the concept. Nowadays PBB is common in Denmark - although not necessarily explicitly discussed - and forms the basis for everyday design, even though the above mentioned publications have not been updated or reprinted. The European Construction Products Directive (CPD) was adopted in the beginning of the 1990’es.

PeBBu domains

Building materials & components

In Denmark use of building components chosen on basis of performance criteria has been common for many years.

Building regulations

The Building Code is generally performance based, or includes a possibility for choosing between prescribed values and performance criteria. This applies especially to the allowable heat consumption; the computer programme BSIM can simulate indoor climate (especially temperatures and energy consumption). In this way performance requirements in the Building Regulations can be checked. In Denmark, European building standards are compulsory, i.e. if requirements are set and EN standards are available they must be used. Other international standards are voluntary unless they are adopted as Danish standards as well.

Innovation

Traditionally, the public sector plays an important role in promoting development and innovation in Danish building. The results of the public programmes are mixed, but it is fair to say that they should be viewed as indicators that lack of innovation and lustre performance are seen as real problems by decision makers in the building sector. Furthermore, there is a general feeling that with the existing public sector procurement regulations and procurement practices, in recent years the public sector has not been successful in harvesting the benefits that PBB seem to offer. Rather, the public sector’s strong reliance on traditional main contracts and fairly restrictive procurement regulations has tended to focus competition on price rather than performance.

As already indicated, there is a feeling in Danish building construction that regulation has stifled innovation and not rewarded performance – and that routine and mechanical implementation has resulted as a consequence. This is somewhat paradoxical since in the Danish building sector there is a basic principle of “freedom of method” – meaning that the designer cannot specify how a contractor should perform his work. On the other hand, if the contractor is later accused of not having lived up to standards, the benchmark which is usually relied on in legal proceedings is the notion of “good, established practice and craftsmanship”.

5
Hence, legally it is risky for the contractor to choose his methods freely. Hence, the public sector of Danish building construction seems to be divided between normative and prescriptive principles.

**Other domains**

**Fire safety & engineering**

As regards requirements to fire safety there is currently a mix of prescriptive requirements and performance based criteria, i.e. well known products are allowed without further documentation whereas new products must have documentation for fulfilling the fire performance standards.
Annex 6: National SotA Estonia

Brief historical note

In 1992, shortly after the transitional changes in the Baltic States, an Estonian research and expert team as to the construction sector did the following statements trends in the nearest future in Estonia.

- Decline in the volume of construction. Regardless of the rise expected in 1995, the level of 1989 will not be reached. The optimum volume of construction for Estonia will be 70…80% of the level of 1989.
- Reduction of communal building activity to a minimum (only a few cultural and health care facilities will be built).
- Main customers will be individuals and limited liability companies. Major investments into industry come from abroad.
- Contractor is a private firm.
- New industry will be based mainly on modern technological lines which will be accommodated to the territories of the existing industrial enterprises, if possible, using the existing buildings. New buildings will be mainly light structures.
- In residential construction the building of single and 2-3-family dwellings will predominate. The renovation of large panel dwelling-houses will be started to improve their heat insulation and design of apartments. Districts of summer cottages surrounding the towns will be reformed into residential districts. Summer cottages will be rebuilt for year-round residing.
- The share of renovation will grow sharply in construction.
- The main criterion will be the heat-preservation of buildings. The heat insulation norms established require quite different structural design and choice of materials from those used so far.
- Construction firms will have a unique opportunity to adjust their production (panel houses) to new conditions. There are already projects and technology for that. Supplementary insulation of houses and setting of additional window pane to windows can be done from outside. In the course of the operation it will be possible to improve the facades appearance of buildings.

These conclusions are presented above as they became available in the research report then. Now, already more than 10 years have passed from this time and the construction market, but also technology and management have changed the considerable way.

General background for today

As there is still considerable difference in the salaries between east and west (Estonia and Sweden, for example), it is not reasonable to characterise the situation on the market only over financial numbers. Though for conversion, if required 1 € = 15.6 Estonian kroons (crowns) – this is the permanently fixed rate.

Estonian construction policy has developed following the example of several other European countries, which emphasize the economical use of environmental resources in order to ensure sustainable growth. Already in 1996, substantial investments were made to repair, reconstruct and renovate property. According to Estonia’s State Statistical Office, since then the share of repair and reconstruction is about the half of the total market-volume, in some years prevailing over new construction.

In 2002, about 38 900 people were directly employed in construction sector. This is about 6,6% from all the inhabitants in the age from 14 to 74 years – considered as potential labour-force. In the property sector this
share is slightly higher – 7.6%. Sometimes it is very difficult to distinguish a clear borderline between these two sectors, this why one may operate also with the total of these two sectors.

During the last, slightly more than 10 years, the employment numbers in the construction sector have greatly changed. Especially the economic crises in Russia and Russia dropping away from our contractors market-place have caused major decrease of construction workers in 1999. But in 1991, the share of construction workforce was 8.1%, since then it has constantly decreased. 1999 was an unfavourable year for construction workers, since the number of job orders continuously decreased in internal as well as foreign markets.

95% of the staff employed in construction (in absolute numbers 36 700) are employed in the private sector-companies, the rest in public sector – mainly employed in relevant supervision jobs. This means construction sector is fully privately run, compared to that before the transition changes started and there were only public sector companies there. About 70% of the people employed in construction have secondary or professional education, the share of higher education among the employees is 11%.

According to the data of the Central Register of Companies, in Estonia there is about 2,5 th. businesses involved in construction. When the market is booming, this number may increase as well, but during the last years it has not reached the number of 3 thousand. From these 5 subsidiaries of foreign construction companies, and about 100 independent entrepreneurs. Large national construction companies, such as EMV, Merko Ehitus, Koger & Sumberg, and Eesti Ehitus accounted for the major share of the construction market. The smaller companies (as for the number of staff members) are involved in repair and renovation works, but also being the subcontractors. The average number of employers in an Estonian construction company is 14 (in Europe slightly less that 10).

The development of the Estonian construction sector has been quite stable during the last years (XXI century). The decrease of investments to fixed assets by enterprises and private persons brought about a considerable decline in net sales of construction companies in 1999. The nadir was also reflected in the decrease in the sales volumes of the construction materials industry. Nevertheless, general economic conditions for the construction development have been improved after this period of crises. There has been the growth of GDP and real wages, lower interest rates have also attracted investments to fixed assets. Banks are offering reasonable credits for single families when buying/developing either detached houses or flats, but there are also housing renovation loans available for apartment-owners to improve the technical conditions in the blocks built during the Soviet era. Still, according to the conjuncture questionnaires, enterprises are continuously pessimistic, as the volume of construction orders and income has not increased as much as it should have been.

**Estonian Association of Construction Entrepreneurs**

The EACE is a voluntary association of construction enterprises created in order to support and co-ordinate its members actions in matter of industry related economic issues and relations with employees and employee unions. The EACE is established in 1991 and reorganised in 1993. The Association of Construction Entrepreneurs is an open structure, enabling formation of both regional and professional sub-societies. In 1995 was formed sub-organisation KATUSELIIT, which include roofs building companies. The Estonian Association of Construction Entrepreneurs approximately unites 100 companies active in Estonia whose overall turnover comprises more than 45% of the construction turnover of the entire Republic.

The members of the EACE have a representation in the National License Committee and in the Foundation for Construction Information through the Association, which enables participation in the formation of construction relations. Also, the representatives of the Association sit in labour dispute commissions and
have a representative of the state provisions among arbiters. Currently the association is heavily involved when introducing the national scheme for qualification in the field of construction.

**Construction materials industry**

Altogether, 144 enterprises with more than 4,600 workers deal with construction materials. The ten largest of these enterprises give three-quarters of total sales and employ half of the workers.

By 1996, the privatisation of the construction materials industry was nearly complete except for RAS Kunda Tehased, a major cement plant. In

the privatisation bid for this company, Nordic country construction materials firms showed interest. Also RAS Rakke Lubjatehas limestone production plant was sold to a new owner. The biggest limestone producer in Sweden, Nordkalk Storugns bought RE Vasalemma Kivi plant rented from the state. The Swedish firm exports quality limestone from Estonia and sells limestone gravel to Estonia’s domestic market.

The structure of sales on the construction materials market of local materials is about:

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>concrete, limestone, and gypsum</td>
<td>31.6%</td>
</tr>
<tr>
<td>glass</td>
<td>29.3%</td>
</tr>
<tr>
<td>cement and lime</td>
<td>28.5%</td>
</tr>
<tr>
<td>stone</td>
<td>5.7%</td>
</tr>
<tr>
<td>ceramics</td>
<td>3.6%</td>
</tr>
<tr>
<td>other</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

Limestone, dolomite, and some clay are especially highly regarded. By selectively mining these resources, they could be used to produce high-quality products for export. For local entrepreneurs this would require modernisation of production, which requires major investments.
Annex 7: National SotA Finland

2003-09-01, preliminary version
Christer Finne, The Building Information Foundation RTS, Finland
christer.finne@rts.fi, www.rts.fi, www.rakennustieto.fi

Status of PBB in Finland

PBB is currently gaining widespread interest and acceptance in Finland. The implementation of a performance based requirements management tool on various pilot study projects demonstrated its benefits, such as increased project communication, commitment and teamwork. In addition, a research study (based on experiences from the Netherlands) proved that the client's support aided:
- Better exploitation of the suppliers' expertise
- Design emphasis moves earlier in the process
- Communication between stakeholders improves

PeBBu domains

Building materials & components
Service books for buildings are mandatory. They contain information about building products and service life and maintenance intervals.

Indoor environment
The Finnish Society of Indoor Air Quality and Climate (FiSIAQ) have combined a number of specific performance criteria in order to come up with a classification of the indoor climate. This classification deals amongst others with target and design values for thermal conditions and the indoor air quality, with criteria for construction cleanliness and moisture control, with criteria for material emissions, with criteria for clean HVAC components and with the design, construction and installation. For all these topics, a categorisation is proposed. From this categorisation, requirements on target values and material use are derived including verification procedures, though not in detail. The classification affects the design as well as the construction phase. For the construction process categories are determined that rank the cleanliness of the construction. This also accounts for the building materials that are used. Classification labels have been developed that objectively qualify a building product. In general, the highest classification for construction and building materials is required to obtain the highest classification for the indoor climate.

The classification procedure was implemented in 1995 and has since been revised. Though the dissemination process has been slow, currently it is a code of practice to apply this classification of the indoor climate, especially when it is used for marketing purposes. Although the FiSIAQ-classification is voluntary, developments in the building industry, e.g. with respect to labelling of materials based on their emissions and cleanliness of HVAC systems, are adapted to this classification procedure.

Building design

The perhaps most significant change is that the emphasis has moved away from enforcing detailed prescribed solutions to enforcing good design. Building types are classified, as are architects and engineers. An architect or an engineer must have a degree of a certain level to be allowed to design buildings of a certain level.
The Finnish quality regulation system is called RYL. It is a reference database, similar to the Swedish AMA. The new version of RYL for painting and finishing work, makes it possible to set quality specifications either in a prescriptive way, or a performance based way. In the PBB way the architect chooses the strain class, the gloss class and the colour. The result is verified by a set of general reference surfaces.

**Built environment**

See the Domain 4 review

**Organisation & management**

No initiatives known to the author

**Legal & procurement**

Several new concepts, mainly variations of a Public-Private-Partnership concept have been piloted. In Espoo the realization of a school, “Kuninkaantien lukio” has been outsourced to a very large extent. The City of Espoo only reserved the rights to participate in the design, and to use the school during daytime. Everything else, including ownership and financing is outsourced. The agreement is a long term rental agreement, running for some decades. Another well-known example is the Lahti Highway, where the financing was outsourced, and the road gradually is transferred to the Finnish Road Administration using a long term fee arrangement.

The issue of how a client should choose a consultant has been the target of much debate. Methods which enables the client to use several other criteria than mere price is now in use.

**Building regulations**

During the last ten years the Finnish Building regulations have been coherently developed towards PBB. What used to be strict regulations, are now divided into regulations, which describe the performance, which are supplemented by guidelines, which present one acceptable solution. One reason is that the authorities want to avoid publishing detailed “recipes”, which later might prove inadequate.

**Innovation**

No initiatives known to the author

No initiatives known to the author

**Other domains**

No initiatives known to the author

**Fire safety & engineering**

See Regulations. The main principle is that buildings should not burn. If they do, the main concern of the regulations are the safety of the occupants of the building, and the rescuers. The safety of material assets are mainly left to be the concern of insurance companies.

**Accessibility**

No initiatives known to the author

**Facilities management**

The Finnish association of Clients and Building Owners has recently finished method for environmental classification of buildings. The criteria are divided into four groups: Human Health, Use of Natural resources, Ecological Consequences, and Environmental Risk Management.
Energy & water management
No initiatives known to the author

Environmental sustainability
A concept for environmental declarations were developed by the Building Information Foundation RTS as early as 1999, but haven’t reached large use. Now a new effort is being done jointly by the Finnish Confederation of Building Industries and RTS, where the Building Industries take larger responsibility for the structure and the actual operation as well.
In research done at Tampere Technical University (Prof. Ralf Lindberg), things have been brought to a very concrete and commonplace level. The research is based on several pilot projects. The main idea is to identify such factors that will affect the life time performance of a building. Five elements have been identified:
Constructions against the ground
Roofing constructions
External walls
Markätät
Ilmanvaihtojärjestelmä (Perhaps the most important of all)
For these elements critical factors have been identified. Much emphasis is on the worker who actually does the work. He is proposed to document carefully each phase, for instance by taking a digital picture of each finished work phase. This documentation will serve as input in a service book for the building.

Another factor, which strongly affects the life time performance of a building is the user. Much more emphasis should be put on the role of the user. A skilled user can get a mediocre building perform well, and vice versa.

Education & training
Research work is done at Tampere Technical University. See 1.2.2.10 Other

Intelligent buildings
No initiatives known to the author

Structural design & engineering
No initiatives known to the author

Construction products directive (CPD)
There could be two principles for product standardization: Local or multi-national. Local are often considered trade barriers, but it should be noted that large international standards are often complicated. This might in turn lead to difficulties for SMEs, which lack resources to be able to show that their products are compliant with the standards.

Opportunities & barriers for widespread PBB Finnish adoption
From the various PBB pilot study projects, a number of barriers were identified as potential prohibitory factors for its widespread implementation in Finland: -
Disintegration of design, engineering and construction
The fragmentation of the design and the construction disciplines
The guilds mentality
The low level of R&D investments in the construction industry
However, it is anticipated that through increased adoption, the potential of the first two barriers can be reduced. It is assumed that when i) architects and engineers exploit their core knowledge to create the overall technical solutions that fulfill the set performance requirements, and ii) construction companies have the possibility to take long-term responsibility for building parts developed together with architects, engineers and product suppliers, the quality of the end product improves. All too often, the client’s requirements are not always fully met in the final product. There are various reasons for this: - Cutting costs in some phase of the project, inability to find suitable design solutions to fulfill the requirement, forgetting the original requirement etc. To avoid this, an early and continuous verification has to take place in the design process (Ang et. al., 1999, Becker, 1999) The user has to be sure that the desired performance targets will be fulfilled. And if this is not possible, user knows this beforehand

Therefore, the objective of PBB is to support transforming user needs into performance requirements and managing design, construction, operation and maintenance processes achieving the desired performance over the life span. The building process organisation and management domain will result in: - A unified classification of building properties (identifying and documenting the performance objectives) Verification methods for assessing the desired performance of given building properties (checking that the desired objectives are met) Implementation (national testing within participating organisations) Validation of data (analysis of results in domain workshops) Dissemination (international internet distribution together with national reporting)
Annex 8: National SotA Iceland

General

Iceland still has a descriptive building code, but it has been the intention for years to make changes to the building law and then rewrite the building code in accordance with performance based criteria. The mentioned building law is said to be made valid any year now. In the meantime some changes have been made to take away the brunt of the old descriptive design environment, e.g. it is forbidden to mention product names as a quality- or performance criteria.

The market

The Icelandic market is small, the number of inhabitants in Iceland being 285 000. The small market, and a very limited types of domestic building materials (no useful natural resources of e.g. clay, wood or metals) results in an extensive import of building materials. The import comes from all over the world, but mainly from Europe (68%). The variety of products is thus big and it should be very important for the user/consult team to have a well-defined idea about quality and performance criteria. The small market and little domestic product development have though resulted in limited domestic knowledge and much of the descriptive texts used have always been based on foreign experience or information. Examples of products that do not fulfil required performance criteria on the market of course crop up now and then. The market usually learns quite fast what single products to avoid but general description of performance requirements are badly lacking.

The market is not unexpectedly split in their ideas about performance based descriptions. The contractors ask for the new approach, as this will give a greater freedom in choice of materials and methods. The consults pledge that a (total) change from descriptive to performance based methodology will make their work very difficult, and increase the design cost for small works unduly, as all general texts are still lacking (in Iceland).

Use of PBB methodology

Design of all smaller works, and even complicated bigger works (e.g. hydroelectric plants), is still (mostly) based on descriptive terminology but there are some examples of works based on the performance criteria methodology.

Reykjavik municipality (and at least one other municipality) has had schools built based on a general tender. The experience from this is mixed, some state that it is very difficult to describe the performance criteria explicitly and in such a way that the owner knows in advance what he will get (undue maintenance cost is mentioned as a problem). It is said to be easier to ensure the quality and performance wished for when they are working with the designers (then they can use an already built school as a reference object). The contractors state that the municipality will not get the schools built at a similar cost if they use the older methodology, but are not willing to discuss possible difference in quality.

The Road Authority has a set of well-developed performance texts, mixed with descriptive texts. They are using this “code” increasingly to ask for bids in general tenders.
**Factor Method**

Information about Service Life of products is very limited in Iceland, and almost no data is accessible for the general market. Service Life Planning (SLP) of works is still very limited in Iceland, it is stated to have been used in some works but no information is accessible on what methodology was used. The market is aware of the potential use of SLP and it is considered important to gather what data there is found on the market and start a general discussion concerning such information. The standardised Factor Method is little known in Iceland, and as long as there is not a kind of public agreement on the market what data to use in the method it is doubtful if the market will use it at all.

**Research, education and training**

Research in building science in general and building methodology is almost entirely done at the Icelandic Building Research Institute (IBRI). Research on snow avalanches and risks for the built environment mainly at the Icelandic Meteorological Institute and earthquake risk and the earthquake effect on structures at the Engineering faculty at the University of Iceland.

Education in the meaning of performance based thinking, sustainability, durability and service life is limited.
Annex 9: National SotA Norway

General

The move from descriptive and deemed to satisfy codes and norms to more performance based started with the Building Regulations of 1969. Very few detailed regulations remain pursuant to the Planning and Building Act, but still remains with some of the other mandatory standards.


Legislation

The Ministry of the Environment and the Ministry of Local Government and Regional Development are jointly responsible for the Planning and Building Act 1997.

Statens Bygningstekniske Etat, BE (The national Office of Building Technology and Administration) is the Norwegian government agency responsible for the Building Regulations under the Planning and Building Act 1997. The Building Regulations are divided in four themes published separately. The regulations most pertinent to the PeBBu Domain 1 field are:

- Technical Regulations. These regulations contain mandatory provisions which cover all types of buildings and also civil engineering works as far as they are relevant. They specify minimum levels of performance on a very general level.

- Guide to the Technical Regulations. This publication gives interpretations of the general mandatory requirements and defines acceptable levels of performance in more quantitative terms.

Areas not covered by the Technical Regulations under the Planning and Building Act 1997 are dealt with separately by Vegdirektoratet (Norwegian Road Administration), Jernbaneverket (Norwegian National Rail Administration), Avinor (Norwegian Air Traffic Authority) and Forsvarsbygg (Norwegian Defence Estates Agency). Their specific regulations and rules are in general far more descriptive than the Building Regulations.

These agencies support research and development within their own areas of interest.

Standardisation

Norges Byggstandardiseringsråd, NBR (Norwegian Council for Building Standardization) has been responsible for the development of Norwegian standards and Norwegian participation in international standardization work within the building and construction field. From October 2003 however all the Norwegian standardization organisations have merged. The new organization has been named Standard Norge (Standard Norway).

The development of standards for the building and construction sector follows closely the European avenue, involving extensive work not only in CEN but also within ISO (Sjöström et al, 2003).
Recommendations, information

Norges byggforskningsinstitutt (Byggforsk), Norwegian Building Research Institute. The performance concept has been a platform for much of the research and development work carried out by the institute since the late 1960ies. This approach is also adopted in the series of good building guides (best practise) published by the institute since 1957.

- Byggforskserien (Norwegian Building Research Design Sheets). More than 850 pamphlets of 2 to 8 pages each give easy to implement recommendations. They are published by the institute in a “cookbook” format, available on paper, CD and Internett. The recommendations cover most aspects of building including planning, architectural design, technical details, use of materials, maintenance, refurbishment and FM. One pamphlet in particular explains in detail the hierarchy of general performance requirements given in the Building regulations, interpretations of the requirements in the guide to the regulations and performance based recommendations given in Byggforskserien. The design sheets are used by the whole industry for reference, as a tool for good design and as a tool for meeting the performance requirements presented in the Building Regulations.

- The institute also publish norms for the design and construction of ventilation systems (Ventilasjonsnormen) and wet rooms (Byggebransjens Våtromsnorm) as well as reference- and textbooks on e.g. Timber Frame Buildings, Moisture in Buildings etc.

Norsk Byggtjeneste, Norwegian Building Information centre is a company which supply the construction sector with information mainly via the channels described below.

- Publication of the Building Regulations and other normative documents
- Byggkatalogen. Product information from manufacturers presented in a standardized format on paper and Internett.
- Byggenormserien. Information and guidance about regulations and codes. The series also have extensive lists of products holding sertificates, approvals and other types of third party documentation

Product documentation

The system for documentation of Construction products is described in the Technical Regulations as laid out in the Construction Products Directive. Several Norwegian institutions are notified for certification and/or testing and inspection under CPD. The Norwegian Building Research Institute being the biggest with notification for 33 product areas. The Institute is also notified by the National Office of Building Technology and Administration as the approval body in Norway to issue European Technical Approvals.

NBI Technical Approval is a voluntary national approval procedure for building materials, components and construction systems managed by the Norwegian Building Research Institute. Approval of a product under this quality mark is based on performance assessment (fitness for use). As a result of the slow progress in issuing harmonized European standards a number of industry initiated approval systems related to particular products still remain. These will gradually be terminated.

Service Life Planning and Service life data

Research and development
The area of durability is of paramount importance for building performance and thus an essential issue in NBI’s work programme. Some important activities are:

**EU-projects**

Participant in “G1RT-CT-2001-05038-Performance Based Building (PeBBu)”, Thematic network within the “Growth” area of EU 5th FWP

Participant in “GTC1-2002-43046-Lifetime Engineering of Buildings and Civil Infrastructures (LIFETIME)”, Thematic network within the “Growth” area of EU 5th FWP

Participant in “G1RD-CT-2000-00378 Lifecycle Management of Concrete Infrastructures for improved sustainability (LIFECON)”. RTD project within the “Growth” area of EU 5th FWP.

**ISO**

ISO/TC59/SC14 “Design Life of Buildings”, developing the ISO 15686 “Service Life Planning” series, where NBI(professor Haagenrud) was instrumental in establishing the standardisation work item. NBI is convener of WG7 “Performance evaluation and feedback of service life data from practise”.

ISO/TC59/SC17 “Sustainability in Building Construction”. NBI has been instrumental in establishing this group and chaired it from the start in 1999.

**CIB commisions (www.cibworld.nl)**

W80/140 PSL- “Prediction of Service Life of Building Materials and Components (Joint CIB – RILEM Commission)”. Prof. Haagenrud has participated in the commissions from the 1980-ies, and is now chair of Working Group 2.

W 106 “Geographic Information Systems”. Professor Haagenrud were among the initiators and is now co-chairing it.

**R&D agreements**

Agreement with the Royal Institute of Technology and the University of Gävle, Sweden, since 1996, see Appendix C

Agreement with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia of since 21. Feb 2003, see Appendix C

**Strategic Research Programmes**

Ongoing:

The R&D programme, “Climate 2000 – Building constructions in a more severe climate” programme (see www.byggforsk.no/prosjekter/klima2000). It was initiated in August 2000, and will continue until the end of 2006. The programme’s principal objectives are to

- Survey and increase knowledge about potential impacts of climate change on the built environment and how society can best adapt to these changes.
- Develop and update methods, tools and solutions in principal for the planning and design of buildings (materials, structures and external enclosures), in order to increase both durability and reliability in the face of external climatic impact.
- Define more accurate criteria and Codes of Practice concerning building performance in severe climates.

The programme is being conducted in conjunction with the following main partners:
Norwegian Defence Estates Agency (NDEA), the Norwegian State Housing Bank, Norway’s Directorate of Public Construction and Property (Statsbygg), the Norwegian Financial Services Association (FNH), Undervisningsbygg Oslo KF, Norway’s National Office of Building Technology and Administration (BE), the Research Council of Norway and the Norwegian University of Science and Technology (NTNU). 30 partners from the construction industry and Norwegian research bodies are also contributing to the carrying out of the programme.

Planned:

• Service Life Prediction and Planning for a Sustainable Built Environment – 4 year programme
• ICT-platform for object oriented knowledge in the Building and Construction Industry

**Service Life data**

NBI produces extensive sets of durability and service life data through our R&D work and our testing and documentation activities. These data have a good basis in practice and in close contact with the building industry. Furthermore these data are gathered and widely disseminated to a broad audience through the Byggforskserien (Norwegian Building Research Design Sheets).
Annex 10: National SotA Sweden

General

Sweden has since the end of the 1980’ies gradually switched from descriptive and deemed to satisfy codes and norms to more performance based, even if in detailed regulations and specifically standards quite many examples of the former still remains.

The European Construction Products Directive, CPD, was adopted in the beginning of the 1990’ies.

About authorities, regulations and rules

Boverket, The National Board of Housing, Building and Planning (www.boverket.se) is the Swedish government agency for planning, the management of land and water resources, urban development, building and housing.

The regulations most pertinent to the PeBBu Domain 1 field issued by Boverket are

• the Building Regulations BBR stating mandatory provisions and general recommendations relating to BFS 2000:22


• the Design Regulations BKR

Mandatory provisions and general recommendations up to BFS 1999:46 The Design Regulations (BKR) of the Swedish Board of Housing, Building and Planning, contains mandatory provisions and general recommendations pursuant to the Planning and Building Act (1987:10), PBL, the Act on Technical Requirements for Construction Works etc (1994:847) and the Decree on Technical Requirements for Construction Works etc (1994:1215).

Banverket, (www.banverket.se) is the governmental authority responsible for the railway system in Sweden.

This means following and pursuing the development within railway traffic system, supporting the parliament and the government on relating issues, responsibility for operation and management, co-ordination of the local, regional and inter-regional railway traffic, and support of research and development within the area.

Vägverket, Swedish National Road Administration, SNRA

The SNRA (www.vv.se) is the national authority assigned the overall sectoral responsibility for the entire road transport system. The SNRA is also responsible for drawing up and applying road transport regulations. In addition, the SNRA is responsible for the planning, construction, operation and maintenance of the state roads.
This sector responsibility involves representing the State at a national level in issues relating to the environmental impact of the road transport system, road traffic safety, accessibility, level of service, efficiency and contributions to regional balance, as well as in issues relating to intelligent transport systems, vehicles, public transport, modifications for the disabled, commercial traffic in addition to applied research, development and demonstration activities within the road transport system.

About standards and standardisation

**SIS**, Swedish Standards Institute ([www.sis.se](http://www.sis.se)) develops Swedish and international standards and consists of three main areas. The largest area is SIS, Swedish Standards Institute.

The two other SIS areas are SIS Förlag AB, a full-service publishing house that publishes and sells standards and other publications, and SIS Forum AB, which provides education and consultation in interpreting and implementing standards. Both companies are wholly-owned subsidiaries of SIS.

European harmonised standards are mandatory adopted and used on the Swedish market as in all EU countries. International standards can be voluntary used but when adopted as Swedish standards (SS/ISO) these are mandatory to governmental agencies such as Banverket and Vägverket.

SIS has since several years an established mirror committee (SIS TK 209 Recycling and Service Life Planning) to the ongoing standardisation within ISO TC59/SC14 Design Life, and significant Swedish competence input has been made to this ISO work.

About information and support services to the building and construction sector

**Svensk Byggtjänst**, Swedish Building Information Centre ([www.byggtjanst.se](http://www.byggtjanst.se)) is a company supporting the construction sector with knowledge and information mainly via the channels described below

- **Bygginfo** – verbal information on news and transition in the sector given by informateurs to stakeholders on the market. News and information services via the internet and company customised education.
- **AMA** – The sectors own reference work being used at establishing construction and installation descriptions including administrative regulations to procurement and carrying through of construction works.
- **REDA** – construction description forms connecting to AMA by which construction guides can be established
- **Bygginfodatabas** – a database giving guidance on information about regulations and codes
- **Aff** – a support for efficient and quality assured procurement of facility management services
- **BSAB** – the sector-common system used for structuring information in the construction and facility management process

About the Factor Method

The Factor Method is yet not commonly known or used in the Swedish construction sector.

The first two parts of ISO 15686, part 1 providing guidance to designers in the service life planning process and describing the Factor Method and part 2 accounting for the service life prediction procedures, will be adopted as Swedish standard (SS/ISO) as soon a Swedish translation has been performed. ISO 15686 part 3,
“Performance audits and reviews”, released as full international standard 2002-08, will be adopted as SS/ISO in its English version.

Information campaigns and educational programmes on the SS/ISO standards are presently being programmed in co-operative efforts by SIS and universities (see also below).

**About Reference Service Life data**

Reference Service Life data is, as in most countries, not commonly easily available. Information and data are scattered. However, there is a slowly increasing awareness in the materials and products producing industry about market benefits related to being able to declare the service life of products.

Descriptive information setting a basis for reference service life data of products can be found in e.g. the AMA system described above, and direct life data declared as maintenance intervals – based on experience – is issued in commercial facility management handbooks.

**About Research and Development**

Sweden is an exception from most other countries in the world as the overwhelming part of the public funded R&D is carried out within the university system. Only about 8 % of the public funded R&D is performed by institutes (the comparison figure for Germany is close to 50 %). Hence public funded R&D in Sweden is closely connected to academic education both at under- and post-graduate level.

Sweden has by tradition had a strong research environment related to building and construction technologies, materials, building physics etc. General cuts in funding to building research over the recent decade has put these R&D areas under pressure, but they still are focus areas at some universities and a few R&D institutes.

The main arguments and the driving forces governing R&D in these domains are today connected to environmental concerns, resource conservation and optimisation, and the like.

As for building materials research there is trend towards a system thinking in the R&D; “Materials and system engineering” might be a governing heading.

Durability, service life, sustainability, sustainable construction are dominant key words.

**About education and training**

As stated in the brief description of R&D above, an increasing interest is paid to the issues of durability, service life, sustainability and sustainable construction.

Most, not to say all, courses in relevant subject areas bring these issues to the attention of the student.

In connection to the release of the ISO 15686 standards as SS/ISO an education and training campaign is being planned.