



**AALBORG UNIVERSITY**  
DENMARK

**Aalborg Universitet**

## **Revaluing Construction 2007 - Crossing Boundaries**

*Lessons Learned and Perspectives for Construction*

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# **Meeting Report**

**Revaluing Construction 2007**

**CROSSING BOUNDARIES**

**Lessons Learned and Perspectives for Construction**

**9-10 October 2007  
Copenhagen - Malmö**

# Revaluing Construction – Crossing Boundaries

Lessons learned and perspectives for construction



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# Introduction

## Construction is facing great challenges

Globalisation brings new pressures but also new opportunities; clients have rising expectations; and buildings become more complex. How can the industry rise to these challenges? How can it become more efficient and productive, more attuned to customer expectations and more able to take advantage of new technological and business opportunities? In short, how can it create more value for all stakeholders? These are the issues that the third international Revaluing Construction conference addressed in October 2007 in Copenhagen/Malmö.

## Previous Revaluing Construction conferences

The first Revaluing Construction conference took place in Manchester, UK in February 2003. It was the first conference to bring together leaders of construction reform programmes from around the world. The conference attracted some 125 people and was organised by the University of Manchester Institute of Science and Technology (UMIST). Under the title "Revaluing Construction – the International Agenda" it focused on three interrelated themes:

- Change through construction reform programmes.
- The restructuring of business and project processes.
- The concept of value.

The second Revaluing Construction conference took place in Rotterdam, the Netherlands in March 2005. The conference attracted some 225 people from 19 countries. It was organised by the Foundation for Building Research (SBR) with financial support from PSIBouw – the Dutch construction reform programme initiated by government and the industry. Under the title "Revaluing Construction 2005 – the Challenge for Change in Construction" it dealt with issues of change in the industry:

- Radical change is on the agenda. But how can it be achieved?
- How can a traditional industry like construction be transformed to an efficient, technologically advanced and valued contributor to a modern economy?
- How does one achieve lasting change in an industry with so many small enterprises and specialist groups?

The two previous conferences as well as Revaluing Construction 2007 – Crossing Boundaries form part of the broader revaluing construction initiative by CIB which supports initiatives for change and improvement in construction (<http://www.revaluingconstruction.scpm.salford.ac.uk/>).

## Why 'Crossing Boundaries'?

Satisfying future client and social needs and maximising value for all stakeholders will require construction to be innovative with respect to its or-

organisational structures and its products and to use resources wherever they may be found. Traditional boundaries – within project organisations, between product functions and imposed by geography – are breaking down. Revaluing Construction 2007 looked at the implications for construction and even questioned whether ‘construction’ as we know it will continue into the future.

The conference was organised as a mix of plenary sessions and three parallel sessions along with a visit to Malmö. The parallel sessions were complemented by plenary sessions in which prominent speakers from the industry, and expert observers, discussed the conference themes and looked to the future. The parallel sessions centred on the following themes:

- Crossing geographical boundaries: how construction firms operate in and learn from other countries.
- Crossing organisational boundaries: overcoming traditional divisions to enhance project performance.
- Crossing product boundaries: how new technological developments and changing client requirements are transforming the nature of construction operations and output.

## The programme

Revaluing Construction 2007 – Crossing Boundaries was attended by some 200 delegates including 5 journalists from different trade magazines. A little more than half of the participants came from the organising countries Denmark and Sweden. The other half came from the rest of the world. In round figures, the delegates included 45 Europeans, 15 Asian/Australians, 15 Africans and 10 North Americans. Looking at the affiliation of the delegates, it is clear that the conference was successful in attracting a well-balanced mix of delegates from industry, government and academia:

- Industry: 100
- Government and reform programmes: 25
- Academia: 60

The conference brought together the experience and understanding of nearly fifty international speakers, mostly from business but also from government and research bodies, to bear on the issues of change and performance improvement in construction. Its aim was to help everyone who attended to understand the changes that are happening internationally, so that they are better able to lead and guide their firms or other organisations in the future. The conference enabled the participants to learn from the experience and the insights of their colleagues in the industry who are facing similar challenges. Below the programme of the conference is presented.

<b>Tuesday 9 October</b>	
<b>08.00-08.30</b>	<b>Registration and coffee</b>
<b>08.30-08.40</b>	<b>Welcome</b> Lone Møller Sørensen, Director, Danish Building Research Institute - Aalborg University, Denmark
<b>08.40-09.10</b>	<b>Revaluing Construction - the double challenge of looking inward and outward</b> Peter Barrett, CIB President and Pro Vice-Chancellor, University of Salford, United Kingdom
<b>09.10-09.30</b>	<b>Opening of the conference</b> Michael Dithmer, Permanent Secretary, Ministry of Business and Economic Affairs, Denmark
<b>09.30-10.30</b>	<b>Keynote presentation:</b> <b>Solutions without boundaries - lessons from the clean-up of the Rocky Flats nuclear facility, and other successful projects</b> Nancy Tuor, Vice Chair, CH2M HILL, USA
<b>10.30-11.00</b>	<b>Coffee</b>

<b>11.00-12.30</b>	<b>First parallel sessions</b>		
	<b>Crossing geographical boundaries:</b> <b>Value through globalisation - company strategies and operations</b>	<b>Crossing organisational boundaries:</b> <b>Successful project teams - the client as leader and integrator</b>	<b>Crossing product boundaries:</b> <b>From short-term delivery to life-time services</b>
	<b>Achieving success in China - the experience of a UK construction management company</b> Chengde Chen, Chairman, Sino-Infrastructure Partnership, PR China <b>Successful expansion of overseas business in India and Dubai – experience of a Hong Kong contractor</b> Jackson Cheong, Vice President, China State Construction Engineering, Hong Kong SAR, PR China <b>The Federation MultiComplex - how does a foreign contractor achieve success in Moscow?</b> Karl Almstead, Vice President, Turner Construction, USA	<b>Partnering in the Nordic countries</b> Jacob Norvig Larsen, Senior Researcher, Danish Building Research Institute - Aalborg University, Denmark  <b>Achieving world class teams through a focus on safety</b> Steve Bowers, President, Global Safety Management Consultants, USA  <b>Creating a successful contractual framework for partnering - in the UK and Arabian Gulf</b> David Mosey, Partner and Head of Projects and Construction, Trowers and Hamblins, United Kingdom	<b>A European approach to whole life costs and performance</b> John Connaughton, Director, Davis Langdon Consultancy, United Kingdom  <b>Strategies to improve adaptability in office buildings</b> Siri Hunnes Blakstad, Professor, Norwegian University of Science and Technology, Norway
<b>12.30-13.30</b>	<b>Standing lunch buffet</b>		
<b>13.30-15.00</b>	<b>Second parallel sessions</b>		
	<b>Crossing geographical boundaries:</b> <b>Taking advantage of international resources</b>	<b>Crossing organisational boundaries:</b> <b>Promoting integration through virtual construction</b>	<b>Crossing product boundaries:</b> <b>Moving towards zero-defects: getting it right - the first time!</b>
	<b>Using international skills - a UK contractor's experience of the European labour market</b> Stephen Quant, Human Resources Director, Skanska Rashleigh Weatherfoil Ltd, United Kingdom <b>Success factors in international joint ventures</b> Christian Brockmann, Professor, University of Applied Sciences Bremen, Germany  <b>European PPP road projects from a lenders perspective</b> Christian Kummert, Managing Director, DEPFA BANK plc, Ireland	<b>Constructing Swire's One Island East Tower with the aid of new collaborative technologies</b> Martin Riese, Director, Gehry Technologies Asia, Hong Kong SAR, PR China  <b>How European contractors are using virtual construction</b> Wilfred van Woudenberg, Chairman, <b>ENCORD</b> Virtual Construction Platform, The Netherlands  <b>Revaluating Facilities Management through the Sydney Opera House exemplar project</b> Peter Scuderi, Chief Operating Officer, Cooperative Research Centre for Construction Innovation, Australia	<b>Reforming the building industry: The Norwegian Building Cost Programme</b> Egil Skavang, Chief Executive Officer, The Building Cost Programme, Norway  <b>Modular systems: Raising quality through industrialised production of housing</b> Anders Larsson, Chief Executive Officer, Open House, Sweden  <b>Supplier management as a key element of performance</b> Markus Neumann, Manager, Purchasing Strategy and Cost Management, Volkswagen AG, Germany
<b>15.00-18.00</b>	<b>Transport to Malmö and technical tours</b>		
	<b>Housing tour</b> - guided walk through the Bo01 Exhibition area at Malmö seafront, passing the latest developed area, finishing with a visit at the Turning Torso.	<b>Civil engineering tour</b> – guided walk that will start with a visit at the Turning Torso and finish at the old Western Station, one of the offices of the City Tunnel under construction.	
<b>18.00-22.00</b>	<b>Conference dinner in Malmö City Hall</b> hosted by Anders Rubin, Deputy Mayor, City of Malmö, Sweden		
<b>22.00-23.00</b>	<b>Return to Copenhagen Marriott Hotel</b>		

<b>Wednesday 10 October</b>			
<b>09.00-10.30</b>	<b>Third parallel sessions</b>		
	<b>Crossing geographical boundaries:</b> <b>Land development in an international marketplace</b>	<b>Crossing organisational boundaries:</b> <b>Construction reform programmes</b>	<b>Crossing product boundaries:</b> <b>Designing for people - user-driven innovation</b>
	<b>Transforming an industrial area into an internationally competitive urban landscape</b> Lars Holten Petersen, Vice President, Carlsberg Properties, Denmark <b>Constructing Coega – an integrated deep water port and economic zone for world markets</b> Pepi Silinga, Chief Executive Officer, Coega Development Corporation, South Africa <b>Investment in infrastructure in Shanghai and its impact on the construction sector</b> Bai Yun, Chief Engineer, Shanghai Urban Construction Group, PR China	<b>Reforming the Dutch construction sector: Lessons from PSIBouw</b> Henk van der Horst, Chief Executive Officer, PSIBouw, The Netherlands <b>From reflection to emergence - lessons from South Africa</b> Ronnie Khoza, Chief Executive Officer, Construction Industry Development Board, South Africa <b>Crossroads of change: Hong Kong's response to the 'Construction for Excellence' Report</b> Andrew Baldwin, Formerly Dean, The Hong Kong Polytechnic University, Hong Kong SAR, PR China	<b>Working with people - participatory design-tools</b> Tina Saaby, Partner, WITRAZ architects, Denmark <b>ACCOR – an example of client/user driving innovation</b> Frédéric Bougrain, Researcher, Centre Scientifique et Technique du Bâtiment, France <b>Optimising design with client and user inputs - experience of using the Design Quality Indicators</b> William Hawkins, Policy and Operations Manager - Design Quality, Construction Industry Council, United Kingdom
<b>10.30-11.00</b>	<b>Coffee</b>		
<b>11.00-12.00</b>	<b>Keynote presentation:</b> <b>International collaboration: Experiences from the Elephant House in Copenhagen ZOO</b> Armstrong Yakubu, Partner, Foster + Partners, United Kingdom and Haakon Løe, Director, Ramboll, Denmark		
<b>12.00-13.00</b>	<b>Standing lunch buffet</b>		
<b>13.00-14.30</b>	<b>Fourth parallel sessions</b>		
	<b>Crossing geographical boundaries:</b> <b>International performance metrics</b>	<b>Crossing organisational boundaries:</b> <b>Spectacular projects - a source of inspiration and innovation</b>	<b>Crossing product boundaries:</b> <b>Emerging technologies - redefining the product</b>
	<b>Comparing European construction industries - lessons and issues</b> Bernard Williams, Consultant, Bernard Williams Associates, United Kingdom <b>Ten years of benchmarking American engineering and construction firms</b> Stephen R. Thomas, Associate Director, Construction Industry Institute, USA <b>Measuring productivity amongst Norwegian contractors</b> Thorbjørn Ingvaldsen, Senior Researcher, SINTEF, Norway	<b>Delivering the London Tunnels for High Speed 1, the Channel Tunnel Rail Link</b> Ian Blight, Project Director, Halcrow, United Kingdom <b>Creating world-class stadia - making the impossible happen through innovative design and financing</b> Frits Scheublin, Director, BAM Engineering, The Netherlands <b>Highlights from Henning Larsen Architects' international portfolio</b> Louis Becker, Architect, Director and Partner, Henning Larsen Architects, Denmark	<b>The integrated building envelope - lessons learned from a development project</b> Mikkel Kragh, Associate, Arup, United Kingdom <b>Redefining healthcare infrastructure: integrating services and the built environment</b> James Barlow, Professor, Imperial College London, United Kingdom <b>Measuring performance and value in manufactured housing</b> Pekka Huovila, Chief Research Scientist, VTT Technical Research Centre of Finland, Finland
<b>14.30-15.00</b>	<b>Coffee</b>		

<b>15.00-15.45</b>	<b>Keynote presentation:</b> <b>Construction: An industry in transition</b> Fred Moavenzadeh, James Mason Crafts Professor and Director, Massachusetts Institute of Technology, USA
<b>15.45-16.30</b>	<b>Panel discussion:</b> <b>Redefining the boundaries - are we seeing 'the death of construction' as we know it?</b> Chair: Henrik L. Bang. Panellists: Sven Landelius, Frits Scheublin, Peter Scuderi, Jackson Cheong and Fred Moavenzadeh
<b>16.30-17.00</b>	<b>Closing observations and thanks</b> Lone Møller Sørensen, Director, Danish Building Research Institute, Denmark and Wim Bakens, Secretary General, CIB, The Netherlands
<b>17.00-18.00</b>	<b>Reception</b>

# Summaries of the conference sessions

## Sessions on Tuesday October 9

### Opening session

The three opening presentations set out the scope and focus of the conference: revaluing construction and crossing boundaries.

Professor Peter Barrett, University of Salford, introduced the, deliberately, rather vague concept of "revaluing construction". Although there has been a long and interesting history in construction research of "looking in" on the industry to make the processes more efficient, the revaluing construction initiative has joined to this the idea of "looking out" in order better to understand the role and contribution of construction within the broader society in which it operates. Central to this is a shift in viewpoint from 'the construction industry' to 'the BE sector' (built environment). One way of expressing future directions is through the five 'E's'. Construction has in general moved past the basic criterion of *efficacy*. However, we clearly need more *efficient* construction processes, but these must be orientated to *effectively* meeting client and user needs. Given the centrality of built environments to economic success and positive human experience there will always be an *ethical* dimension to consider, but ultimately we must strive for built solutions that *elegantly* resolve all of these, often conflicting, aspirations. The 'infinity model', introduced in the presentation, is a contribution to how both looking outwards and inwards can be linked to support progress in this direction.

The second presentation by Permanent Secretary Michael Dithmer, Danish Ministry of Economic and Business Affairs, on Denmark and the Danish construction industry in a globalised world. Aiming at a Denmark with strong social cohesion and competitive strength, the Danish government has initiated a globalisation strategy with four main elements: world top-level education, strong and innovative research, more high-growth start-ups and renewal and innovation. In this respect, the construction industry is facing three important challenges in a globalised world: 1. Energy efficiency and climate change. 2. Productivity and innovation. 3. Open markets, common standards and consumer protection.

Vice Chair Nancy Tuor, CH2M Hill, USA, shared the lessons learned from the clean-up of the heavily contaminated Rocky Flats nuclear facility. In 2000, DOE and Kaiser-Hill (KH) signed a first-of-its-kind incentive fee contract to complete the safe, accelerated cleanup by December 2006, at a cost of \$3.96 billion. KH's mission was to ship hundreds of thousands of cubic metres of radioactive materials, demolish nuclear and non-nuclear facilities, clean-up contaminated soils and groundwater, preparing the site for transformation into a national wildlife refuge. Throughout the project, DOE and KH remained committed to meeting or beating the 2006 closure date while ensuring full compliance with safety, health, and environmental regulations. The Rocky Flats team completed the cleanup in October 2005 (14 months ahead of schedule) at a cost of \$3.443 billion (more than \$550 million under cost). KH succeeded by utilising a wide variety of project management tools to help accomplish this job. Constantly pushing and crossing numerous boundaries during the project paved the way to make the impossible possible. The lessons learned include:

- Safety must be the foundation.
- Incentive-based contracts work.
- Structure bonuses to incentivise the accomplishment of contract goals.
- Disciplined, relentless project management pays.
- Invest in a robust project controls system.
- Benchmark against best in class in other industries.

### **CROSSING GEOGRAPHICAL BOUNDARIES: Value through globalisation: company strategies and operations**

The session provided three perspectives on the policies and approaches required when construction firms operated in countries with different and unfamiliar cultures and traditions. These came from the experience of:

- SIP – a partnership between UK and Chinese interests which managed the construction of facilities for 'Western' firms investing in China.
- China State Construction Engineering (Hong Kong) Ltd which had expanded its operation to Dubai and India.
- Turner Construction, based in the USA, which was managing the construction of a large commercial complex in Moscow.

The speakers all emphasised that a fundamental factor in success was in the development of a partnership with local interests which respected their inputs and understanding. This required individuals to demonstrate appropriate attitudes and behaviours, with expatriate staff being willing to work with local staff as equals, while at the same time seeking in collaboration with local staff to introduce ways of working which had been shown to be effective in previous projects. The outcome of this approach was the development of trust among all parties and a commitment to joint aims – the fusion of 'families' as Chengde Chen, Chairman, Sino-Infrastructure Partnership (SIP), PR China, expressed it.

Experience showed that many procedures and practices could be transferred to other countries but clearly some – for example those relating to personnel issues – needed to be adapted to local expectations and legal structures. Jackson Cheong, Vice President, China State Construction Engineering, Hong Kong SAR, PR China, illustrated the challenges of 'exporting' management systems from the Hong Kong contractor to its overseas business in India and Dubai.

Training had been a significant element in the success of SIP in integrating UK and Chinese practices; Chinese staff had been trained in accordance with UK professional engineering requirements standards and in international business (e.g. contract) procedures. Overseas firms could bring specific expertise to projects (e.g. Russia had no technical standards for very high-rise structures) but while these provided an entry point to certain markets, there needed also to be appropriate training of local staff, argued Karl Almstead, Vice President, Turner Construction, USA, based on his experience from the Federation MultiComplex in Moscow.

### **CROSSING ORGANISATIONAL BOUNDARIES: Successful project teams – the client as leader and integrator**

The three presentations in this session illustrated how the construction client can take the lead to form successful teams in projects of different types.

Senior researcher Jacob Norvig Larsen, Danish Building Research Institute, Aalborg University, presented a study about partnering in the Nordic countries. While partnering was originally introduced in the US and UK as a means to avoid conflict and costly arbitration, partnering in the Nordic countries is promoted as a way to increase user value, shorten building time and diminish defects. Nevertheless, there are distinct differences in the way partnering is implemented in the different Nordic countries. Larsen provided an overview of different partnering models, analysed their strength and

weaknesses and discussed future prospects for partnering in the Nordic building industry.

World class teams could be achieved through a focus on safety, argued CEO Steve Bowers, Global Safety Management Consultants. He presented how the companies that attract great employees have a competitive advantage – a safety advantage. If your loved ones had a choice to work either for a company with an average safety record, or one with an excellent safety record – whom would you choose for them? Bowers discussed the advantages that a world class safety programme brings to both the company and its employees. The material will discuss the dividends that safety pays as well as how world class safety adds to the bottom line.

Partner David Mosey, Trowers and Hamlins, presented a model for creating a successful contractual framework for partnering – in the UK and Arabian Gulf. Based on experience with the widely-used partnering contract PPC2000, developed by the author, the presentation illustrated through the UK and Middle East case studies the ways in which such a contract describes and supports the successful planning, design and construction of any project. It explained how partnering has been successful both in the UK and the Arabian Gulf in establishing successful teams, ensuring buildability and affordability of designs, meeting deadlines at each stage of a project and saving both time and money.

### **CROSSING PRODUCT BOUNDARIES: From short-term delivery to life-time services**

The two presentations in this session focused on initiatives and strategies to turn the attention of the construction industry from short-term delivery to life-time services. The third presentation was unfortunately cancelled at short notice.

Director and partner John Connaughton, Davis Langdon Consultancy, presented the results of a project studying 11 European countries commissioned by the European Commission. The project aimed at establishing a common conceptual and methodological framework for life cycle costing and performance in the European Union (LCC). A core process for undertaking LCC has been identified. Among the challenges encountered are lack of standards, large variations as to discount rates used and lack of historical data. Further, the study has identified important links to sustainability.

Professor Siri Hunnes Blakstad, Norwegian University of Science and Technology, centred on the challenge of time with regards to workspace in buildings. A Norwegian project with emphasis on knowledge and learning in organisations (KUNNE) formed the basis for the presentation. It was stated that demand changes are frequent, and consequently the life cycle of buildings needs to be considered as well as the changing relationship of users with buildings. It is important to study buildings in use to get a better understanding of the value creation of users and the need for adaptability. Instead of just focusing on traditional technical and functional lifespans it is necessary to consider others such as social and cultural lifespans. From an understanding of the dynamics of the organisational life cycle different strategies for adaptability can be considered – in the design and construction process – in building use – in finance and contracts and physically. From an understanding of the dynamics of the organisational life cycle, strategies for adaptability at four different levels have proved helpful: 1. Building concept. 2. Main structure of the building. 3. The general floor layout – 'the footprint'. 4. Work spaces and 'settings'.

### **CROSSING GEOGRAPHICAL BOUNDARIES: Taking advantage of international resources**

In this session the three presentations focused on aspects of making use of a migrating workforce, management skills and know-how in international joint ventures and finance.

In the first presentation, Stephen Quant, Human Resource Director at Skanska Rashleigh Weatherfoil, the UK, informed the audience about why and to what extent migrant workforce have made an impact in the UK construction sector. Two sets of laws have created a system where main contractors have virtual no craftsmen employed and sub-contract all work. The sub-contractors in turn perform themselves, sub-contract further or use agency supplied workers. The second part of the presentation showed how the origins of migrant workers from different countries have varied over time. The first ones came from Ireland, followed by commonwealth migrants. In the 1990's specialised workers from Europe dominated and was followed by eastern Europe workers per 1st of May 2004, followed by even more after. There are both positive and negative effects of the continuous flow of migrant workers. On the positive side is that it has allowed a rapid expansion of economy, filled skill gaps, contributed to tax revenue, limited wage inflation and provided skilled workforce in many areas. On the negative side is that communications may be difficult, health and safety issues are abandoned, some abuse of unskilled, industrial relation issues and assimilation issues.

Professor Christian Brockmann, University of Applied Sciences in Bremen, Germany presented his work on success factors in international joint ventures (IJV). IJVs are characterised by that they are multi-organisational, multinational, in construction often formed to build megaprojects, and partners complement each other (i.e. they have different core competences). This in turn results in that IJVs are structurally incoherent, yet they must perform like an orchestra. Through the development of a model mapping the different important aspects of successful IJVs Professor Brockman has been able to draw the conclusion that success factor research cannot produce elegant formulas, just interrelated cognitive maps that are products of sense making processes and that complexity cannot be reduced to simplicity. Further, management solutions cannot be found outside the group of practitioners and research in management can only clarify, elucidate and evaluate practices (non-normative). Management research must be applied, using the cognitive maps and language of practitioners.

The role of financial institutions was described by Christian Kummert, Managing Director, DEPFA BANK, Ireland. With the rise in use of different models of Public Private Partnerships (PPPs) banks have become more involved in projects and especially in risk management of projects. From the perspective of the banks, they want to work with:

- Experienced contractors.
- Buffer in construction schedule (working shifts, winter break, etc.).
- Completion buffer (Construction Contract versus Concession Agreement).
- Joint and several liability of turnkey contractors' completion guarantee by contractors/sponsors.
- Liability caps of contractor.
- Liquidated damages for delays in completion.
- Advance payment bond.
- Retention.
- Performance bond.
- Warranty periods.
- Direct agreement with turnkey consortium.

Of the three different payment forms – full toll, shadow toll and availability payment – the bank prefer availability payment as the risk are much lesser than in the other two.

### **CROSSING ORGANISATIONAL BOUNDARIES: Promoting integration through virtual construction**

The three presentations in this session illustrated the potential of applying virtual construction as a mean to cross organisational boundaries in different regions of the world.

In the first presentation, Martin Riese reported on the experience with one of the most substantial implementations of a Building Information Model (BIM) on One Island East Tower in Hong Kong with the goal to save at least 10% in the cost of construction by enhancing efficiency and reducing waste across the entire process. All participants of the initial phase of the process had worked together in creating a single 3D BIM, and the contractor had later on assumed full responsibility of the BIM model during construction phase. The demonstrated value by applying BIM models will await the completion of the One Island East Tower. However, so far the conclusion is that there is a huge potential value by a global adaptation, but a successful implementation will require a strong client demanding application of BIM models and cooperation.

From ENCORD's virtual construction platform, it was underlined how European contractors see virtual construction as a future mean to enable contractors and partners to cross the organisational boundaries and improve best practices and innovation. However, BIM is still in the developing phases with constantly 5-6 different models merging. Therefore, the European contractors are working on getting experience with the models and sharing these within the ENCORD virtual construction platform. The conclusion is that there is a need for practical, target oriented development of BIM in order for BIM to provide huge value for construction.

From Australia, Peter Scuderi presented the project Sydney Opera House, where industry, government and research through a partnership are developing innovative strategies covering BIM, services procurement and performance benchmarking. The preliminary conclusion on the project is that the application of BIM provides a means to improve Facility Management performance through a better alignment of services and performance objectives.

The presentations illustrated that BIM has a huge potential value for construction, but in order to be successful further target oriented development and strong demands from clients is required as well as international standards for BIM allowing for international competition.

### **CROSSING PRODUCT BOUNDARIES: Moving towards zero-defects: Getting it right - the first time!**

The three presentations in this session addressed various ways forward in order to reduce defects in construction. The presentations spanned a construction reform programme, a building manufacturer and a leading car manufacturer.

CEO Egil Skavang informed that the three focus areas of the Norwegian Building Cost Programme are improved customer competence, increased productivity, and improved leadership and individual responsibility. The programme is industry-led with a budget of approx. 10 million Euros. Three central activities/projects in the programme focus on reducing defects in construction, introducing building information models and training female leaders. Although conclusions can only be preliminary, the lessons learned so far are that boundaries are being pushed by the programme: Collaboration is working, and a change of attitude is beginning to grow in the industry. But it is a long-term process, and implementation is crucial and hard.

CEO Anders Larsson of Open House Production, Sweden, discussed raising quality through industrialised manufacturing of housing. Open House Production produces a modular system for industrialised manufacturing of housing units characterised by good design, function and quality. Open House Production is a Swedish company owned by Norwegian housing association OBOS. From the beginning in 2002 Open House Production has produced approx. 1.200 units. The presentation showed that the company has taken control of the complete process by directly employing designers, technical staff, factory workers and site workers. A high level of quality is reached through a carefully controlled process and well defined products –

resulting in repetition – which allows for continuous improvement. A central “group for improvement” handles through an intranet-based facility incoming faults and subsequent correction in an orderly fashion. The building concept is being continually developed with regards to system and products. Knowing customer wishes and demands is crucial for further development. There are clear limits for variations to the concepts as the company creates a niche for itself – but with plenty of room for others in the market.

Markus Neumann, Volkswagen AG, Germany, introduced supplier management as the new key element of performance improvement among car manufacturers. The purchasing strategies of the Volkswagen Group (VW) were presented with special emphasis on supplier management. The activities in the elaborate sourcing process of the VW group were outlined: Request-for-quotes – Quotation – Negotiation – Preparation of Recommendation – Final Presentation and Nomination – Readiness. The current trends are:

- Increasing cost of components and materials.
- Reduction in the number of suppliers.
- Increasing supplier innovation.

Supplier management has three main focus areas – quality, innovation and cost – and the strategic partnerships entered into reflect varying emphases on these. Strategic partnerships usually have a firm element of differentiation strategy (customer value) rather than pure cost reducing strategy. Group methodologies are strictly applied and complement the buying power of the group.

## Sessions on Wednesday October 10

### **CROSSING GEOGRAPHICAL BOUNDARIES: Land development in an international market place**

The three presentations described various aspects and strategies for large urban developments from three different parts of the world, Denmark, South Africa and China.

CEO Lars Holten Pedersen, Carlsberg Properties, Denmark started off with presenting the strategy of Carlsberg of turning one of their large breweries in central Copenhagen into a vibrant and pulsating city centre in a contemporary setting, respecting history and at the same time reaching for the future. Carlsberg has decided on a strategy of involving both the public and the City of Copenhagen which have resulted in a broad support for their work both from people in general and from politicians. The main reasons for the broad support are:

- The openness from the company about the project as well as the good will around the Carlsberg brand.
- The promises made regarding the vision and the democratic and open international ideas competition.
- The will to dialogue and the open processes so far.
- The innovative element (creating a new city).
- The need to revitalize Copenhagen.
- Carlsberg's courage in prioritizing and demanding, as well as having a clear opinion in the vision.

The second presentation by CEO Pepi Silinga, Coega Development Corporation, South Africa, dealt with the construction of a deep water port, Coega IDZ & Port of Ngqura, and its surrounding infrastructure. Their vision is “to be the preferred investment destination”. To reach the high goals of the project the company had to develop core competencies in the areas of insight-

driven investment promotion, planning, resourcing and delivery of complex mega-infrastructure projects, provision of human capital solutions, delivery of priority public sector infrastructure projects and leveraging the IDZ as a green-field investment destination, to provide innovative and customised (e.g. turnkey) solutions to investors. So far they have succeeded, a number of international companies have invested in the area.

In China, construction is booming in many places. Bai Yun, Chief Engineer, Shanghai Urban Construction Group, PR China described the case of infrastructure in Shanghai and its impact on the construction sector. Over the last twenty years the total investment in fixed assets has increased 140 times and the ownership has gone from mainly state owned to a much more level proportion of ownerships. Ongoing projects, the MRT projects in Shanghai, and future projects, the Shanghai EXPO 2010 area and the Shanghai Yangshan deep water harbour, were described. These different large infrastructure projects have had and have important impacts on the development of the construction sector in the area, for example there have been an increase in small private companies (specialized contractors and equipment suppliers) and larger state-owned contractors have had to merge. A lot of new technologies have been adopted for example Shanghai Shentong Metro Co. Ltd uses remote monitoring system to improve management efficiency and to reduce the associated risks. SCTAC in cooperation with Tongji University developed a digital system for Shanghai geotechnical information. Some important issues for the future were also presented such as rapid development of the city brings environmental problems, insufficient maintenance in infrastructure results in durability problems, there is inadequate consideration for energy saving and there is also inadequate planning for underground space.

### **CROSSING ORGANISATIONAL BOUNDARIES: Construction reform programmes**

This session provided three perspectives on construction reform programmes and lessons learned on drivers to reform. The reform programmes included:

- PSIBouw – reforming the Dutch construction sector presented by CEO Henk van der Horst, PSIBouw, The Netherlands.
- CIDB (Construction Industry Development Board) moving from a period of reflection to emergence as argued by CEO Ronnie Khoza, CIDB, South Africa.
- The responses to the Tang Report – Construction for Excellence in Hong Kong analysed by Formerly Dean, Andrew Baldwin, The Hong Kong Polytechnic University, Hong Kong SAR, PR China.

The speakers all emphasised that a fundamental factor for change and success is a burning platform. In all countries the construction industry is faced with demand for increased value for end user and society as well as sustainable profit for the construction industry. This was the basis for establishment of construction reform programmes with clear goals and focus areas for development. The reform programmes had similar focus areas for development like value and quality for end-user and society, professional workforce, improved knowledge infrastructure, safer and environmental focused industry and sustainable profit for the construction industry.

A common focus for the reform programmes was also that they were based on cooperation between all the stakeholders of the construction industry and with a strong government commitment. The programmes were all aiming at creating a culture change and in repair of thrust among the parties involved. This was essential in the process of renewing of a fragmented sector characterized by a hard price-driven competition.

The timeframe for the programmes are all between 3-6 years. However in view of the timeframe for a construction project combined with the need for a

culture change in the sector, all programmes considered this a too short a period for developing the sector, because this hardly leaves any time for evaluation on the individual projects and as well as evaluation across projects. These evaluations are essential in order to generalise the knowledge being create and dissemination of new knowledge to the whole construction industry.

Further the experience from Hong Kong illustrates that the pace of change in a local market might be highly influenced when changes in the local market to a large extend is set by the competitive forces in the global construction market.

### **CROSSING PRODUCT BOUNDARIES: Designing for people – user-driven innovation**

The three presentations addressed various methods and tools to involve the users in design or stimulate the role of users as innovators.

Tina Saaby, Partner, WITRAZ architects, Denmark showed how user participation can take place as part of design of urban spaces and housing areas. User participation can take place at three levels: Passive (inform), creative (involve) and active (decide). 15 examples of tools that have been tried and tested were discussed: Fieldwork, interviews, observations of participants, information/communication, workshops, campaigns, study trips, competitions, events, exhibitions, votes, games, full scale models, clarifying values and sketch board. The applicability of different tools in relation to the different levels of user participation was discussed. It was concluded that such tools are essential for future development with a human touch – and can be applied broadly in various subsectors of the built environment.

Frédéric Bougrain, Researcher, CSTB, France presented a case study of the ACCOR hotel chain (concepts such as Formule 1, Suitehotel and All Seasons) with special focus on the opportunities of construction clients for driving innovation through co-production. The hotel group has a specialised innovation and design department and dedicated teams for concept development. Key issues in concept development are customer value, user functionalities, maintenance and operations, energy and water costs and prefabrication. It was concluded that the public sector as clients and users have a great potential for pursuing value-enhancing innovation strategies.

William Hawkings, Policy and Operations Manager – Design Quality, Construction Industry Council, United Kingdom presented evidence on how to optimise design with client and user inputs from use of design quality indicators (DQI) in more than 800 projects. Numerous quality criteria are used in construction, but for DQI the Roman architect Vitruvius' classic dimensions have been translated into three concepts: Functionality, impact and build quality. The starting point for a DQI evaluation is the project mission in which the aspirations for the project are stated. Hence, ideally DQI workshops are held in relation to both project briefing and the building in-use. Both the demand and supply side are represented in the process. DQI scores are presented as a basis for discussions at the building in-use workshop and the conclusions feed back into the strategic decision making of the demand side.

### **KEYNOTE PRESENTATION: International collaboration: Experiences from the Elephant House in Copenhagen Zoo**

Armstrong Yakubu and Haakon Løe started the presentation by addressing the client's perspective, and how the authors understood the project as engineers and architects. Crossing organisational boundaries, collaboration technologies became fundamental. In the process, the collaborators tackled how to get the job done; working from London and Copenhagen offices, and a combination of proximity and working at a distance was a central part of the collaboration arrangements.

Getting the right start involved getting to know elephants and international research was done into the social patterns of elephants and travelling to zoos, transferring this knowledge into architecture and construction.

The presenters discussed the successes and the areas of the project with room for improvement. The Zoo was careful about the choice of team, and the key success factor was appointing an international team with creative competence in culture building and architecture.

### **CROSSING GEOGRAPHICAL BOUNDARIES: International Performance Metrics**

The three presentations in this session illustrated how the systematic collection and analysis of performance data could illuminate and influence practice at different levels: project, firm and national industry. The presentations illustrated how data from projects, and at national level, could be used to provide evidence of the business benefits of different working practices.

In the first presentation, CEO Bernard Williams, BWA summarised the work carried out and the conclusions of a study which had sought to compare the effectiveness with which national construction industries in the EU used labour and other resources. This had been accomplished through examination of previous comparative studies and by analysis of data on building costs and labour wage rates, supplemented by interviews with managers experienced in the different countries. The results were indicative, but consistent, and the principal conclusion was that the use of industrialised methods of construction led to higher overall efficiency in the construction process. The differences at national level across the EU were significant and pointed to the potential for substantial efficiency gains – perhaps equivalent to 2% of European GDP.

Associate Director Stephen Thomas, Construction Industry Institute, USA, reviewed the experience of the Construction Industry Institute in the USA which had facilitated benchmarking amongst its members for more than ten years. He emphasised the importance of clarity in objectives and data definitions, in order that all participants should be fully aware of their responsibilities and the expected outputs. There was evidence that CII benchmarking had influenced the adoption of good project practices, for example, in the substantial drop in the accident rate amongst participating firms as compared with the rest of the industry. Benchmarking was now becoming sector-specific, with schemes tailored for the construction of pharmaceutical research and manufacturing facilities, for example.

A five-year long Norwegian research project into construction productivity, reported by Senior Researcher Thorbjørn Ingvaldsen, SINTEF, Norway, had concentrated on one type of building project, the construction of residential apartment blocks, to bring out the differences in performance attributable to management and organisational practices. Data had been collected from over 120 projects and some 14 factors had been found to influence productivity. When corrected for factors outside the control of the management of the site or firm (such as the characteristics of the site), a difference of 2:1 had been found between the highest and least productive sites. The analyses had shown managers the potential for improvement.

### **CROSSING ORGANISATIONAL BOUNDARIES: Spectacular projects – a source of inspiration and innovation**

The two presentations in this session illustrate how spectacular projects can act as a source of inspiration and innovation in construction. The third presentation was however cancelled due to technical problems.

Project Director Ian Blight, Halcrow, United Kingdom, presented the experiences from delivering the London Tunnels for High Speed 1 (HS1), the Channel Tunnel Rail Link. HS1 will be Britain's first major new railway for over a century – a high-speed line running for 109 km (68 miles) between St Pancras station in London and the Channel Tunnel where it will connect with

the growing European high-speed rail network. The new line has been built in two sections. Section 1 further from London opened on schedule in October 2003 while Section 2, the approach to London, began in July 2001 and will open on 14 November 2007. The 'Area 200 Alliance' was formed when all four Contracts, together with Rail Link Engineering and the Client, effectively became one Contract; it represented a major change in traditional contractual relationships. The Alliance was dedicated to delivering this major piece of civil infrastructure in a spirit of cooperation and without contractual conflict. It was a huge success.

Director Frits Scheublin, BAM Engineering, The Netherlands, presented a major breakthrough in creating world-class stadiums by making the impossible happen through innovative design and financing. Exploitation of football stadiums is an almost impossible task. A major league team plays only once a week. Half of the matches they play in the stadiums of opposite clubs. In the summer the competition stops. As a result such a team plays only 18 matches on their own grounds. If a club is very successful they may also play some matches in the European football league. Together with an incidental tournament and some friendly matches an average stadium is never used more than 25 times a year. The size of a football stadium must be sufficient to host a national champion and its supporters. But most teams are not world famous and therefore most matches in the league are played with a far from overcrowded stadium. The most successful solutions were found in multi-functionality. Stadiums may also be used for pop-concerts, Davis Cup tennis, political rallies, travelling preachers etc. The technical problem is the grass needs daylight and fresh air. And the public at most of the mentioned events would stand on the grass and damage the grass beyond repair if it were not covered with wooden sheets. Covering 10000 m<sup>2</sup> of grass takes a full day of hard work. Uncovering takes another day. After 3 days the covers have to be removed. Otherwise the grass will get yellow and it cannot recover from that.

The client promised a design and build contract if BAM could solve the exploitation problems and present the client for a technical solution with a feasibility study. BAM realised that the only solution was in a quick covering and uncovering of the field or alternatively the complete removal of the field out of the stadium. The contractor chose the latter. The pitch had to be removed, but how? BAM studied a floating pitch, a pitch on wheels, and a pitch on jacks to lift it high above the underground. Finally it was decided to choose a sliding pitch. The technology to slide heavy loads came from the ship building industry, where ships are built in sections. These sections are sledded together for assembly. The only problem was that the pitch weighted 12000 tons. About twice the maximum load ever sledded before. The client accepted the proposal and the contractor got the contract. A year later the contractor even got its second contract for the same, meanwhile properly patented, system.

### **CROSSING PRODUCT BOUNDARIES: Emerging technologies – redefining the product**

The three speakers in this session presented three very different attempts to redefine the construction product by using new emerging technologies – fibre-reinforced polymers, integration of services and product and industrialised production improving performance and value management.

The first speaker for this session, Mikkel Kragh, Associate, Environmental Physics, Ove Arup and Partners, London, United Kingdom, talked about the opportunities by using fibre-reinforced polymer as a curtain wall. The product is a good example of redefining a product. It has already been used in bridges, off-shore structures and transportation.

Professor James Barlow, Professor of Technology and Innovation Management, Imperial College London, UK discussed the importance of redefining the health care infrastructure. The presentation was based on interesting

on-going research programme performed under the management of Ha-CIRIC, Health and Care Infrastructure Research and Innovation Centre. He argued that, there are significant challenges in planning and delivering a built infrastructure to meet the emerging health and social care needs. These relate to the complex dynamics linking change in care services, technologies and built infrastructures. If the pace of change may be speeding up, he asked if this mean we need more flexibility in how we think about care system infrastructure as well as how it is delivered. Consequently, the built environment industries will need to be innovative to respond to future opportunities in this sector, innovative in planning and design, innovative in construction approaches, and innovative in offering new services to healthcare providers.

The third speaker, Pekka Huovila, Chief Research Scientist, VTT Technical Research Centre of Finland, approached the question of how to measure, compare and evaluate the performance and value of industrialised housing. The presentation was based on the experience of an ongoing 4-year project ManuBuild running until March 2009 on Open Building Manufacturing within the EU Sixth Framework Programme. Performance metrics describes community perceived values, performance indicators and assessment methods to be used in a new business model. It covers the different viewpoints of the community, main stakeholders and the customer in particular. They include process indicators, product indicators and organisational indicators. A long list of 53 value indicators has been collected in the development project ManuBuild, and a shortlist of 12 has been selected. These are now being tested and linked to a new business model developed in the project.

### **FINAL PLENARY SESSION: Redefining the boundaries – are we seeing 'the death of construction' as we know it?**

The closing session of the conference addressed global trends and their implications for construction.

The final keynote speaker Fred Moavenzadeh, James Mason Crafts Professor and Director, Massachusetts Institute of Technology argued that construction is an industry in transition. He highlighted the changes taking place on both the demand side and the supply side of construction. Changes on the demand side include new trade patterns, realignment of economic blocs, financial innovations, environmental challenges and new types of work to be undertaken. Moavenzadeh argued that the changes on the supply side include globalisation, manpower and technological changes.

In the following panel discussion, the panellists debated how the boundaries of construction are being redefined and whether we are seeing the 'death of construction' as we know it as an industry today. The panellists generally acknowledged that new perceptions of the industry are coming into play, and new players are entering the industry. But consensus did not prevail as to whether this implied 'the death of the construction industry' as such. For some, like Sven Landelius, the chairman of the Swedish Construction Clients Association, the need for faster and more far-reaching change of the industry was advocated strongly. For others like Jackson Cheung, Vice President of China State Construction Engineering, a more incremental perspective of change in the industry was put forth. Reciting a metaphor by Mao, Cheung argued 'that you cross a river in small steps, because you don't know how deep it is'.

In her final remarks, Lone Møller Sørensen, Director of the Danish Building Research Institute, highlighted five issues:

- Putting the user/client in the driving seat.
- The issue of improving the efficiency of the industry.
- Construction as the framework and foundation for life.
- The importance of proper management: sell, develop, deliver.
- The implications of crossing boundaries.

In his closing words, Wim Bakens, Secretary General of CIB, emphasised three areas to be addressed by a construction or rather built environment industry in transition. 1. The people issue. 2. Technology, more specifically Building Information Models. 3. The re-organisation of the industry.

# Redefining the boundaries of construction

Peter Barrett, Professor and Vice-Chancellor at University of Salford, introduced the deliberately rather vague concept of 'revaluing construction'. The concept in itself is an attempt to cross boundaries by expanding our usual conception to encompass not only the construction industry as such, but to expand our notion into the broader concept of the 'built environment' industry. Not only our perception of construction is being challenged, but also the conditions for construction are changing. Despite the perception of construction as a home market industry, the construction industry like all other industries need to face the challenges of a globalising world to stay competitive as highlighted by Permanent Secretary Michael Dithmer, Danish Ministry of Economic and Business Affairs. In response, Vice-Chair Nancy Tuor, CH2M Hill argued that one way of staying competitive is to develop solutions without boundaries by making a sustained effort to question all taken-for-granted assumptions about construction and management. With this appeal, Tuor elegantly set the scene for the conference themes scrutinising our understanding of current boundaries of construction.

## Crossing geographical boundaries

The first theme of the conference explored the challenge of globalisation.

The conference addressed four crossings of geographical boundaries:

- Value through globalisation – company strategies and operations.
- Taking advantage of international resources.
- Land development in an international marketplace.
- International performance metrics.

First, how do companies deal with the associated challenges of globalisation to provide enhanced value to their clients? The speakers identified three characteristics of company strategies as significant when globalising: 1. Development of a partnership with local interests, which mutually respect the inputs and understanding of each partner. 2. Contractors going global provide management services rather than labour force. 3. Contractors follow their clients going global.

Second, how does construction take advantage of internationally mobile labour and capital? Migration of workforce has both positive and negative impacts like allowing for a rapid economic expansion, limited wage inflation, hampered communication etc. When it comes to the flow of capital, financial institutions are increasingly becoming involved in construction projects, particularly regarding risk management. More generally, taking advantage of international resources in international joint ventures is highly challenging, but research in mapping success factors can not produce elegant formulas for achieving success, just interrelated cognitive maps that are products of sense-making processes.

Third, examples of major urban developments from three different parts of the world described various strategies for attracting international investors etc. The Danish example of Carlsberg is characterised by a double-sided strategy of thinking globally and gaining local support through the involvement of the general public and the municipality in an open process. In the South African example of Coega, the core strategy is to succeed by acquiring and developing core competencies in a large number of areas, not just

construction. The Chinese case of Shanghai showed how the sheer size of investments and the complexity of the construction activities are reshaping the client/supplier relations e.g. by privatisation, amalgamation of state-owned contractors and development of intelligent network-based models.

Fourth, what makes a construction firm or a whole industry competitive nationally and internationally? A pilot study for the European Commission indicated that the use of industrialised methods of construction, investment in R&D, well trained and well paid site workforce and certain characteristics of the procurement process lead to higher overall efficiency in the construction process on a national scale. Turning our attention to the individual firm, the Construction Industry Institute provided evidence that benchmarking had influenced the adoption of good project practices in the US. Similarly, the five-year productivity study in Norway has provided evidence that project management is the single most important factor explaining differences in productivity among contractors. Thus, this session illustrated how the systematic collection and analysis of performance data could illuminate, influence and improve practice at different levels: project, firm and national industry.

## Crossing organisational boundaries

The second theme of the conference explored the challenge of overcoming traditional organisational divisions to enhance project performance. The conference addressed four crossings of organisational boundaries:

- Successful project teams – the client as leader and integrator.
- Promoting integration through virtual construction.
- Construction reform programs.
- Spectacular projects – a source of inspiration and innovation.

The first session focused on how clients and their project managers can generate a successful project culture through their leadership and commitment to integration of objectives and operations. The delegates were reminded that the drivers of successful project teams may be found in less obvious places like health and safety. Further, the two presentations on partnering gave insights into the various rationales driving the search and solutions for successful project teams in different contexts. While partnering was originally introduced in the US and the UK as a means to avoid conflict and costly arbitration, partnering in the Nordic countries is promoted as a way to increase user value, shorten building time and diminish defects. Thus, the 'recipe' for developing successful project teams may be highly dependent on the local context.

The second session addressed how integration across organisational boundaries can be achieved through the use of virtual construction. This session explored how new digital technologies and tools facilitate and may even require reorganisation of the construction process in order to exploit their full potential. While the three speakers shared optimism regarding the potential of building information models (BIM), they were also concerned about the difficulties and challenges facing construction in fully realising this potential. In particular, they stressed the need for practical, target-oriented development of building information models and the need for a strong client demanding the use of BIM.

The third session focused on results and lessons learned from three construction reform programs: the Dutch reform program PSIBouw, the Construction Industry Development Board (cidb) of South Africa, and the Tang report 'Construction for Excellence' in Hong Kong. The reform programs share a number of focus areas like value and quality for end user and society, professional workforce, improved knowledge infrastructure, safer and

environmental focused industry and sustainable profit for the construction industry. A common driver for change applied in the reform programs is cooperation between all the stakeholders of the construction industry and with a strong government commitment. A common strategy for change is greater integration and improved communication across the supply chain. Despite some differences among the construction reform programs, the many similarities with respect to drivers of change, focus areas and objectives are striking.

The fourth session explored the role of spectacular projects as a source of inspiration and innovation of construction outputs and processes. The two examples of spectacular projects included an organisational innovation and a product innovation. The successful delivery of the London Tunnels for High Speed 1, the Channel Tunnel Rail Link, in a spirit of cooperation and without contractual conflicts has become an exemplar to follow in UK construction when it comes to forming alliances. An example of a spectacular project stimulating product innovation was the development of a system to ensure multi-functionality of a football stadium. The innovative solution has now been patented, and it is being used in other stadiums. Summing up, although the spectacular projects account for only a small share of the overall market these projects can have profound and far-reaching impacts.

## Crossing product boundaries

The third conference theme explored the challenge of how new technological developments and changing client requirements are transforming the nature of construction operations and output. The conference addressed four crossings of product and technology boundaries:

- From short-term delivery to life-term services.
- Moving towards zero-defects: getting it right – the first time.
- Designing for people – user-driven innovation.
- Emerging technologies – redefining the product.

The first session addressed the time perspective – moving from short-term delivery of construction products to life-term services. The session explored what these changes mean for design and operations in relation to lifecycle costing and adaptability. Commissioned by the European Commission, a common conceptual and methodological framework for life cycle costing and performance in the European Union has been established. Frequent demand changes highlight the need to consider not only the life cycle of buildings but also the changing relationship between users and buildings. From an understanding of the dynamics of the organisational life cycle, strategies for adaptability at four different levels were presented: 1. Building concept. 2. Main structure of the building. 3. The general floor layout – 'the footprint'. 4. Work spaces and 'settings'.

The second session spanned various strategies to reduce defects in construction by getting it right – the first time. The Norwegian Building Cost Programme has supported a number of development projects to improve industry performance e.g. through benchmarking and the use of ICT. Another strategy is industrialised manufacturing of housing through control of the complete process, repetition by well defined products, continuous improvement initiatives and customer surveys. Among car manufacturers, supplier management is the new key strategy for performance improvement. Usually, Volkswagen AG builds strategic partnerships with selected suppliers to focus on customer value through a differentiation strategy rather than a pure cost reduction strategy.

The third session considered how users can play a role in design and innovation, and how that may be used to create buildings and environments

that add value. The Danish example showed how 15 different tools can be applied to have users participate at three different levels: Passive (inform), creative (involve) and active (decide). The French example of the ACCOR hotel chain illustrated how construction clients can drive innovation through co-production of new hotel concepts like Formule 1, Suite Hotels and All Seasons. The British example presented evidence from more than 800 projects on how design can be optimised with inputs from clients and users from the use of design quality indicators (DQI) on functionality, impact and build quality.

The fourth session gave three examples of very different attempts to redefine the traditional construction product by using new emerging technologies. The first example showed how the emerging technology of fibre-reinforced polymers can be applied to develop new construction products with improved product characteristics. The second example from the health care sector analysed how the health care infrastructure can be redefined by taking into account the complex dynamics linking change in care services, health technologies and built infrastructures. The third example focused on emerging management technologies to measure, compare and evaluate the performance and value of products and services. Within the development project ManuBuild, performance metrics have been developed to describe community perceived values, performance indicators and assessment methods to be used in a new business model.

## Perspectives for construction

The conference gave a comprehensive coverage of how boundaries are being crossed in numerous ways around the globe and the implications hereof.

Firstly, the construction industry or rather the 'built environment' industry is being reshaped by globalisation and at the same time advancing globalisation by its very own actions, strategies etc. To turn a much popular slogan upside down: Construction thinks local but acts de facto global (maybe without even realising it). Clearly both our analytical and empirical perceptions of construction, as we know it, are being challenged by the numerous crossings of geographical boundaries taken for granted hitherto.

Secondly, our attention has been turned towards the various ways in which integration across organisational boundaries may be one of the most powerful means to improve project performance whether by technological, organisational or inspirational means.

Thirdly, our traditional perception of construction products is in various ways being challenged by integration across product boundaries. The speakers at the conference pointed at (some of) the trends that will probably influence the future development of construction products and services.