I3CON*nection*

industrialised integrated intelligent construction

WP1 Validation of I3CON work with stakeholder requirements

By Lidewij Kemp, draaijer + partners and Tarek Hassan, Loughborough University.

"The current building industry is too supply driven."

This statement was heard in the interviews for Workpackage 1 (WP1 - Stakeholders requirements) with key stakeholders in the industry. The main goal of the workpackage is to achieve insight into the requirements of stakeholders and validate the work developed in I3CON against these requirements. The values that represent the stakeholder requirements can additionally be used in general to assure building projects are more demand driven. All views of the approximately 70 key stakeholders of various organisations throughout Europe that were interviewed can be categorised in 6 main values (see figure 1) to be considered in building projects in general and in the I3CON developments in specific. In the continuation of the work in WP1, the stakeholder values, and the more specific requirements which go with these values, are used to assess the work in I3CON in other workpackages against the stakeholder values.

Description of the 6 values
These values represent performance criteria which when applied to buildings result in sustainable high performance buildings. Each of the values is described below.

Environmental Management
Environmental management involves all environmental aspects in relation to buildings, such as energy usage and – efficiency, focus on climate changes (and solutions to solve this), usage of materials (in relation to availability of resources) and ecology (e.g. the quality of areas in which a building stands through usage of green areas (creating park like environment). The environmental performance must be looked at in a broad perspective and also in relation to financial aspects (investment vs. operational costs).

Comfort
The comfort (performance) level of buildings and spaces relates to: the internal environment (temperature/ air quality/ etc.), the design (e.g. comfort level of furniture),

Figure 1: Main values based on stakeholder requirements

user-friendliness of buildings (easy to use = comfortable).
It also involves the impacts of the internal environment on the end users, such as productivity of end users, which mainly applies to office buildings: an uncomfortable indoor environment in the office could influence the productivity of workers in that office. Another example is comfort in hospitals: studies have been made ('healing environment') of the influence of indoor climate + design in hospitals and how it influences patients in their recovery process.

Life Cycle Costing
The financial aspects of buildings are currently mostly considered only on capital investment basis. It is important to consider buildings for their total life cycle and the accompanying costs. Some measures (e.g. for energy saving) can lead to higher initial costs, but will save costs during the use of buildings. For example, having solar panels might require a higher investment, but they result in saving energy or even producing more energy than a building needs during its operation leading to lower running costs. Therefore the total life cycle of buildings must be considered.

Customer orientation
The construction industry is currently mainly supply driven. Focus should be more on the customer and their needs.

Primarily this means defining the requirements based on the (future) use of the building (demand), instead of supply driven (what technologies are available). An analysis of the current and future developments in an organisation is the basis of the housing strategy, e.g. increase or decrease in employees influences the decision on the flexibility level of buildings. Customer orientation also implies that the users must have insight in what they can choose, for instance having a catalogue (as is developed in I3CON) with which an "à la carte" building can be created, based on the customers preferences. Furthermore, it is important to 'educate' the customers on what they can demand. So not only the choices should be offered, but also insight on the financial and technical consequences of their choices, or the level of sustainability.

Flexibility
The level of flexibility of a building is important in relation to the changing use of buildings, or change of users, who may have different demands. The higher the uncertainty about what the demands will be in e.g. 10 years, the more profit owners will have if buildings or spaces are flexible. There are several ways of creating flexibility in buildings: creating adaptability; having a building that can easily be changed when needed; provisions for future expansions: for instance designing building systems that have a higher capacity than needed, because of potential change in use; designing the dimensions for the floor height so that it can be used for any type of function (office/ residential/ etc.). This leads to lower costs of adapting a building when the demand changes.

Building process
All the values described above can be seen as a way to create added value for the users/ owners/ clients.

The traditional way of managing projects in the construction industry is to focus on construction time, -costs, etc. But a new way of organizing the building process is needed to create extra value. This item of the building process is one that crosses through all of the 5 themes described above. For instance: reasoning from the total life cycle of buildings, can result in that it is useful to involve financial organisations (that own and maintain buildings) in the design phase of a project: this knowledge about the operation phase is considered in the design. Also, customer orientation might lead to involving end users in the design of buildings, through use of catalogues with which they can design their own house.

Further use of the value framework in I3CON

Currently the workpackage focuses on assessing the developments in I3CON on the stakeholder main values through peer reviews of the work done in the technical workpackages. In addition the stakeholders views in WP1 will be used for a workshop that is planned in the next I3CON Conference to validate the compliance of I3CON results with the stakeholders requirements.

2nd International Conference on Industrialised, Integrated, Intelligent Construction

By Ana Iglesias EMVS and Miguel Segarra, DRAGADOS

On behalf of the Integrated Project I3CON (26 partners across Europe) we would like to invite you to the 2nd International Conference on Industrialised, Integrated, Intelligent Construction.

This 2nd International Conference is organised by EMVS (Spain) with the collaboration of DRAGADOS (Spain). The conference aims at bringing together professionals in the construction sector to analyse current and future developments along the building lifecycle leading to a more sustainable way of doing construction.

I3CON already organised a highly successful first international conference at the University of Loughborough (UK) with a focus set on the academy. The conference attracted a high number of delegates from more than 16 countries and generated interest in a number of leading-edge areas, resulting in a varied programme of paper sessions and workshops associated with relevant projects in the area and the ECTP (European Construction Technology Platform).

In the forthcoming 2nd Conference, I3CON project results and outstanding invited speakers from across Europe are intertwined in a stimulating conference programme that showcases a wide range of research and current fer-de-lance practices in sustainable industrialised construction, throwing light into the future practice of the European construction industry. The conference features a varied range of top interest themes like:

- Design and simulation tools supported by lifecycle building information modelling.
- Implementations of advanced construction components (Electrochromic glazing, Multi-Service Trunking System1, use of façade-integrated Phase Change materials)
- Intelligent building systems integration, control and use of building information for maintenance applications.
- Standards and optimization.
- Energy efficiency of buildings.

The event will take place on 9th June, 2010 at Centro Cultural Eduardo Úrculo, Plaza de Donoso, 5, Madrid (Spain). It is a facility of the Municipality of Madrid located in the northern part of the city. The centre is a new 12.000 sqm building including many services such as exhibition hall, conference room for over 400 people.

Up-to-date information about the conference and a full programme will be available soon at http://www.I3CON.org

Ana Iglesias   Miguel Segarra

Parallel Activities

- The event will be complemented with a parallel I3CON results poster session and other industry technology demonstration activities related to I3CON that will be on display on the exhibition hall area.
- A parallel event, the "Hogar Digital" demonstrator (Digital Home) promoted by the ASIMELEC – ITC association, in collaboration with the Madrid City Council and the Science & Innovation Ministry and co-financed by the European Regional Development Fund (ERDF), is being exhibited at the Eduardo Úrculo Centre from January 2010. The event features a digital home that is open to visitors.

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[1] The Multi-Service Trunking System is an experimental vertical and horizontal installations module integrating different types of building services (water, gas, electricity, etc.) in a single element.

WP4.4 Benchmarking construction products and systems: Measuring embedded carbon - the next indicator of sustainability.

By David Churcher, BSRIA

David Churcher

In recent years the main emphasis in reducing the carbon impact of buildings has been in reducing the energy used during occupation. This has been tackled in a number of different ways – improving the insulation in buildings to reduce heat loss or the need for cooling in hot weather, installing plant and equipment that uses energy more efficiently, rethinking the design of HVAC systems to use passive measures instead of mechanical systems.

Operational energy use for office buildings on a university campus has been benchmarked by Imperial College at 110-350 kWh/m^2 Treated Floor Area/year[2]. This covers heating, cooling, lighting, small power and ancillary building systems. Approximate figures for embedded energy in office buildings has been estimated at 1100-3300kWh/m^2 (based on figures of 4-12 GJ/m^2 quoted at an industry conference in 2004[3]).

Hence to a first approximation, embedded energy is equivalent to 10 years of operating energy. As pressure continues to reduce operating energy then this multiple is likely to increase, and it will become more important to understand and then to reduce the embedded energy and CO_2 emissions associated with manufacture and installation.

The difficulty with calculating specific figures for embedded energy and CO_2 emissions is sourcing appropriate data. Ideally each component manufacturer would be able to quote the embedded energy and the CO_2 emissions associated with each of their products. Contractors could then combine these figures with other those for building materials and the construction processes to give an overall figure for embedded energy or CO_2 emissions. In the benchmarking exercise in I3CON Work Package 4, we have used an elemental approach

to calculate the carbon emissions in two different external cladding products. We have specifically not considered the CO_2 emissions associated with transportation or installation since these are so site specific.

The methodology we applied is as follows:

1. Identify the principal materials used in the cladding system, for example aluminium, glass, concrete

2. Identify the quantities of each material used in a sample area of cladding (in our benchmarking this was an area of wall 7.2m long and 7.6m high). These quantities start from drawings or specifications for the system to calculate volumes of each raw material. From this the mass of each material is calculated.

3. Use the Inventory of Carbon and Energy[4] developed by Bath University in the UK to establish an appropriate figure for embedded carbon per kg for each material.

4. Multiply the weight of each material by the CO_2 emission factors to give CO_2 emissions for each material.
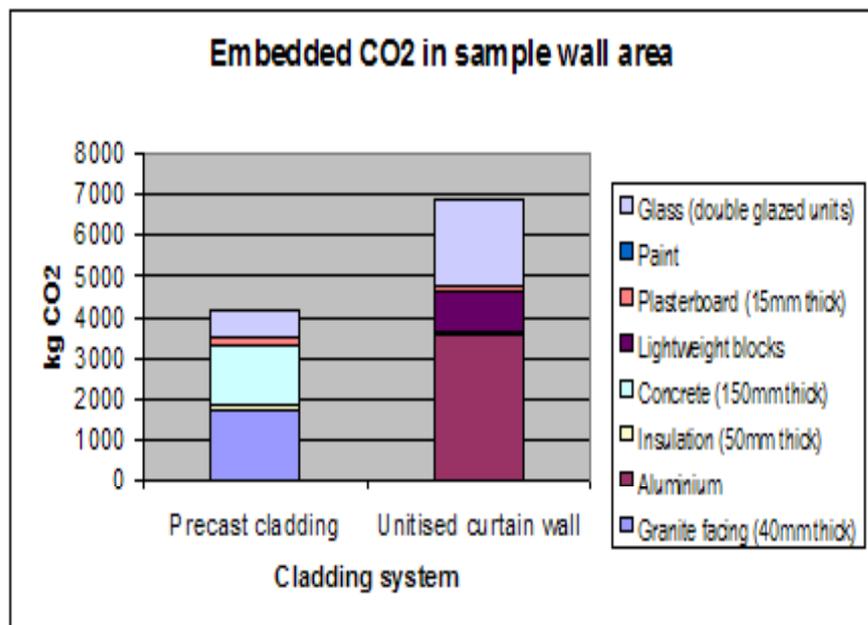
5. Sum the separate CO_2 emission figures to give an overall total, and divide this by the elevation area of the cladding to give a unit figure of CO_2 emission/$m2$ wall area.

Although in this case we are primarily interested in the overall total for each cladding system, this approach does enable us to see the relative CO_2 emissions for the different materials in the two cladding systems. This is shown in the chart below.

The conclusion of this analysis is that at a product level, the precast concrete cladding had a much lower level of CO_2 emissions over a typical façade detail, and that this is primarily because the aluminium in the unitised curtain walling has such a high level of CO_2 emissions.

Embedded CO_2 in sample wall area

[2] http://www3.imperial.ac.uk/pls/portallive/docs/1/4595923.pdf (page 6)
[3] http://www.cibse.org/pdfs/9%20David%20Arnold.pdf (page 15)
[4] http://www.bath.ac.uk/mech-eng/sert/embodied/ (requires submission of email address to download the latest version)

WP6.3 Ambient User Interfaces to Mobile Tools for Accessing Building Management Systems

By Artur Krukowski, Intracom S. A. Telecom Solutions (ICOM)

Artur Krukowski

I3CON proposes employing Mobile Terminals for providing a diverse set of building operational services. Considering the nature of the work of the operational services personnel, communication of building related information is expected to employ highly intuitive and natural user interfaces resulting in minimal interaction overhead. Such interfaces are to exploit a variety of modalities, including visual and audible in addition to context & location-awareness. In this regards Intracom implemented multimodal interfaces to building data accessible via building service gateway (BSG) for use by the operation services personnel via narrowband (text, data) and broadband (voice, video, images etc) services, enabling voice/speech/video interactions and user profiling. Parallel to this a Generic Object Browser (GOB) was developed for accessing dynamic real time objects from Building Automation Systems as well as static building data objects from the BIM databases. In order to enable context and ambient awareness for mobile application Intracom has developed an RFID-based wireless positioning system allowing tracking the position of the service-person inside the building and using this information for displaying data relevant to this location and the operation context. Multimodal User Interface (MMUI) was envisaged to facilitate interaction of operation service personnel (OSP) with the Generic Object Browser (GOB) who accesses static building data and dynamic data from sensor networks. A main goal was to integrate speech recognition and synthesis engine into the GUI of the application and in this way greatly facilitate and enrich the user interaction with the application. Latest generation of speech recognition systems designed for

mobile platforms provided user independent and open vocabulary recognition as well as dynamic vocabulary creation, making them well-suited for this task.

By building upon standard GUI model, utilising the paradigm of observer and command patterns, it was possible to extend the functionality of user interface components to provide auditory information to the user as well as react to the user commands. For this task we plan to use a third-party speech engine that provides an API, and integrate it with the rest of the application and GUI logic. We also looked into novel research on automatically generated graphical user interfaces, where look and feel of the interface is adapted to either the user's reduced dexterity, due for example to the use of glows, or reduced visibility due to bad light conditions. User modalities considered included:

Graphical User Interface (GUI) – standard means of controlling the mobile terminal with touch screens for controlling an application and displaying the relevant information with hardware/on-screen keyboard used as a text input device.

Hardware Buttons – built in physical buttons configured to access most commonly used GOB features.

Audio User Interface (AUI) – employing Loquendo Automatic Speech Recognition (ASR) engine for issuing audio commands and Text-to-Speech (TTS) synthesis for communicating information to the user. AUI is used in scenarios where the user's visual attention has to be directed elsewhere (moving, attending to other tasks) or the hands-free operation is required/preferred.

**RFID Positioning**- Intracom wireless positioning system developed for positioning users
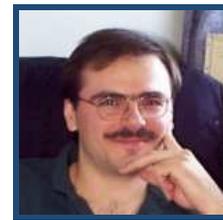
against active RFID tags deployed strategically in the building in addition to passive (short-range) RFID tags attached to components stored in the Building Management System (BMS). This information is used not only to display user's position on the map, but more importantly allows automatic access and pre-fetching of relevant local information from the BSM relevant to users' location and context of their operation. The use of active 2.4GHz RFID allows precise positioning inside buildings at performance similar to Wi-Fi-based systems, however at a considerably lower cost than their Wi-Fi alternatives.

Hands-free operation – in addition to Audio User Interface and RFID/context program adaptation Intracom has replaced standard mouse, keyboard and/or touch screen with head-on display and free-air (gyro) manipulator allowing maximum comfort of service operation.

A mobile system is composed of the PDA device running MS Mobile 6.1 operating system accessing via WEB services relevant building information, such as: environmental data from Wireless Sensor Networks developed by Thales Communications UK, BIM data server from LONIX and dynamic data from the Building System Manager (BSM) provided by VTT. Hands-free operation was achieved by employing monocular display SV-6 from Micro-Optical mountable on standard glasses and air-free 3D gyro mice. This was enhanced by Multimodal User Interfaces integrating Loquendo ASR for voice controls, TTS for alerts and messages and context-awareness, Location-Awareness and proximity detection for access to most important information.
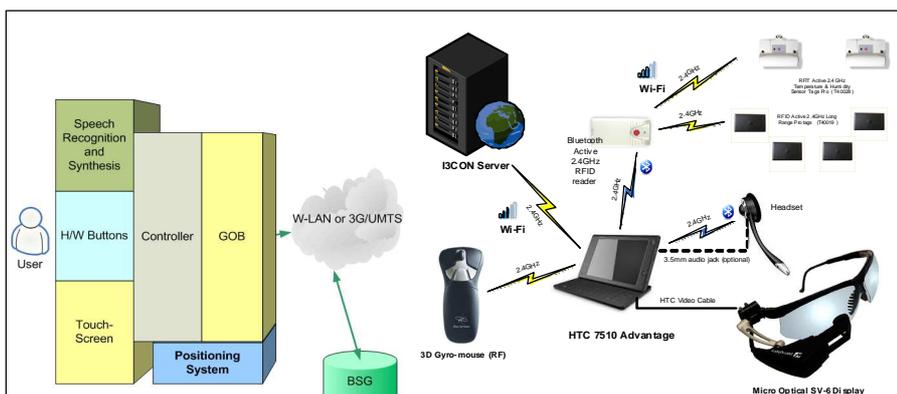
Forthcoming Events

Date	Title	Format	Location
16th March 2010	Innovation for Developers, designers and constructors	Expo	Sandton Convention Centre, Johannesburg RSA
16th March 2010	Mostra Convegno	Expo	Fiera Int di Milano, Italy
13th April 2010	International Building Fair	Fair / Expo	Brno, Czech Republic
13th April 2010	Building Holland	Exhibition	RAI, Amsterdam
13th April 2010	Building SEEBBE	Expo	Fairground, Belgrade
19th April 2010	Industrial Automation	Expo	Deutsche Messe, Hannover
22nd April 2010	Architecture, Building and Construction Design	Expo	Sydney Convention and Exhibition Centre.
10-13 May 2010	CIB World Congress	Conference	Salford Quays, Salford, Manchester, UK
25th May 2010	Green building, innovative building and engineering products	Expo/Conference	ADNEC, Abu Dhabi
27th May 2010	CAMEX, Nat'l. Exhibition of Construction and Installation	Exhibition	Constanta, Romania
1st June 2010	11th International Show of Construction Equipment and Technologies	Expo	Crocus Expo IEC, Moscow
9th June 2010	2nd International I3CON Conference	Conference	Madrid, Spain
8th June 2010	Renewable Energy	Expo	RAI Amsterdam
8th June 2010	Drives and Controls 2010	Exhibition	NEC Birmingham, UK
17th June 2010	Energy Exhibition and Trade Fair	Fair / Expo	Wiesbaden, Germany
9th July 2010	Building and Renovation Show	Expo	Melbourne, Australia

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