Quick feedback from the meeting of

C.I.B. W102 "Information and knowledge management in building 2002",

Held on June 17 and 18, at the Faculty of Civil Engineering, Department of Construction Management, University of Belgrade.

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Words of welcome

The meeting was opened by Dr. Dragan Domazet, Minister of Science, technologies and development, Republic of Serbia, Dean Branislav Coric, vice dean Zoran Radic and Professor Zivojin Prascevic were present. In his welcoming remarks, Dr. Domazet situated information and knowledge management at the center of the processes of technical innovation and economic development. The rapid development of information technology and its adoption in every day life – particularly by the younger generations – called for a new understanding of how information is to be found, communicated, used and converted so that it can be used for responsible decisions and actions.

Performance-based building

The main part of the meeting was devoted to discussing the impact of performance-based building on information, and on the key role of information in the practical adoption of the performance concept. The coordinator opened the discussion by a short presentation of the performance approach.

The performance approach can be caricatured by the phrase: “The end justifies the means”. In other words:

- the buyers (in the case of building: the clients or their professional advisers) state clearly what is wanted – but only in terms of the required qualities: the performance *criteria*,[1]
- the vendors (in the case of building: the suppliers or contractors) show what they can provide – describing it in terms its performance *characteristics* rather than in terms of what it is actually like.[2]

The performance approach has been variously discussed for several decades – but with only infrequent applications. Most designers – architects and engineers - will claim that they *tacitly* consider performance at a certain stage of their designing process, that is to say when passing from an analysis of user requirements to a strategic selection of how to build. Some, when faced with a novel set of requirements, *explicitly* use performance descriptions to obtain particular features of their projects. And performance codes have been adopted in several countries.

An interesting early practical application of performance contracting is the California Schools Construction Systems Development (S.C.S.D.) project, dating from the mid-sixties. In that project, the aim of which was to significantly improve the quality of school buildings, an aggregated market was used to leverage technical innovation by manufacturers in the four key domains of structure, ceiling/lighting, partitions and heating-venting-air conditioning. A rigorously prepared set of performance specifications was used as the basis for an inter-manufacturer competition for the design of subsystems in each of these four domains. An equally rigorous organizational design framework obliged the competing manufacturers to provide inter-subsystem compatibility (e.g. structure-with-partitions, structure-with-HVAV, etc.).

Quality schools were indeed built, and for many years thereafter, compatible sub-systems[3] were available in the USA and Canada for concise specification, using the consecrated formulation of “Brand ‘X’ of equivalent”.

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1 Sometimes a partial physical description of what is wanted is also provided; this is often called a 'footprint'.

2 Today, more often than not, the physical description is provided – leaving the performance caractéristiques up for guess-work.

3 These 'compatible subsystems could be specified therafter using the consecrated form: "brand 'X' or equivalent", which is mandatory in North America (since the competitors – winners or losers on price –

"PeBBu"

Today, the CIB[4] – International Council for Research and Innovation in Building and Construction – through its CIB Development Foundation, is mandated by the European Union (in the interests of value-for-money) to examine the scope for a broad adoption of the performance approach, to evaluate the state-of-the-art and to develop networks to favor the exchange of information and knowledge about performance-based building. This is called “PeBBu”; one of its nine domains of focus is “information and Documentation” – which obviously concern members of CIB W102. The deliverable of the PeBBu project is the information and knowledge network about performance-based building; not performance-based building itself, which requires radical – and indeed long-term - changes in the processes and procedures of designing, manufacturing, building and managing.

A changing flow of information

The performance approach has been taken up in countries where a national model specification exists, such as the Nordic countries, the Netherlands, Australia and New Zealand, among others.[5]

In the Netherlands, the STABU (Standards for Building) has been working on transforming its ‘prefabricated’ standard specifications to use the language of performance. From this work, it has been recognized that one can have a performance description at any one of a number of levels; generally, the higher the level, the more difficult this description will be, and conversely.

It is also evident that there is an intrinsic problem in describing an object (e.g. a window) without naming it (i.e. describing it by its required performance criteria, that is to say, in abstract terms). Indeed, it has been found necessary to produce a lexicon to describe building objects in normalized abstract terms; otherwise, it is impossible to compare products with their performance descriptions. In parallel, the “deemed to satisfy” specification is still being used as a way of circumventing the problems inherent in the performance approach.

It is important to stress that at the end of the designing and building process, the design professional retains full responsibility for ensuring that his/her project appropriately integrates the chosen *physical* parts (components, materials, systems); the abstractions of the performance approach correspond to a phase of this process, albeit a critical phase. In other words, instead of integrating these objects in terms of what they are (e.g. window, door, wall panel), the design professional [whether he or she is working

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provided subsystems which met the same technical performance criteria and were, therefore, 'equivalent'.

4 Conseil international du bâtiment pour la recherche, l’étude et la documentation; until recently, its English name was : International Council for Building Research, Studies and Documentation.

5 The International Construction Information Society – ICIS – is also involved.

for the 'buyer' (client) or the 'vendor' (manufacturer or contractor)] must now integrate the corresponding performances (e.g. thermal, visual, mechanical, durability, etc.).

In the Nordic countries, for example, structural design has been based on the performance approach for decades; suitable explicit (i.e. documented) knowledge is available in that sector. However, there is less experience with the architectural design phase, even though there is a trend to develop standardized building components with standardized performance descriptions, obeying standardized design ‘rules’ leading to open industrialization. In parallel, there is a trend to decentralizing the systems of information.

Of course, a distinction has to be made between measurable and immeasurable performances. Measurement and testing are at the center or the performance approach; they are used to verify that the performance *characteristics* of the products on offer are equivalent to (or better than) the performance *criteria* of the buyer, i.e. the client. One way of proceeding with this ‘measurable/immeasurable’ problem is to provide information based on experience rather that (or as a complement to) research results, including information about failures (which are offer instructive even if difficult to find out about for liability reasons).

The tools of information technology (IT) may help structure the performance-related information, particularly when it is destined for the practitioner. For example, summary information can be backed-up by detailed supporting information, accessible through hyperlinks.

The structure of information

In a performance context, one must recognize the distinction between performance *criteria*-related information, which is external to any product, and performance *characteristics*-related information, which is ‘internal’ to a product and its intrinsic properties. Though these may be regarded as the two faces of the same coin, it is necessary to consider functional descriptions separately from a description of properties; indeed, there is a one-to-'n' relationship between functional requirements and properties.

The performance approach is probably appropriate under certain conditions (e.g. for specific markets or to meet special requirements). It is necessary to be able to judge where the performance approach is most appropriate and to adopt performance-related information strategies there. Indeed, one can generalize and suggest that the ‘switch’ to the performance approach (and, thus, to performance documents) is appropriate when a ‘switch’ in technique is desirable or necessary for some practical reason or other.

Searching for information

In this regard, searching for performance-related information poses question of search procedures. Can one search for information on the basis of performance criteria or performance characteristics?

In terms of procedures, the answer is 'yes'; no particularly new reference-base strategies are required.

However, in terms of using the performance criteria/characteristics as search keys, the answer is not so evident. Indeed, it is virtually 'no' as long as performance-related information remains as scarce as it is today throughout the building industry.

A related question stems from scenarios for the future organization of the building process. Is there going to be a trend to greater integration – the so-called European paradigm. Or, alternatively, is there going to be hyper-specialization and fragmentation – the so-called North American paradigm).

In the first scenario, there will be major firms, capable of supporting broad-coverage in-house information management services. In the second scenario, the small hyper-specialized firms, strongly linked to the Internet, can manage the information requirements of their focused domains of expertise.

Flowing from these divergent views about the future scenarios are predictably different sets of information requirements, particularly regarding the risks associated with innovation and the reliability of information about these risks, notably in a performance context.[6]

Information-related barriers to the performance approach

Christl McMillan and Tony Conder have prepared a preliminary report after the 2001 meeting of W102. It highlighted possible barriers to the introduction of the performance approach, and was based specifically to experience with introducing performance codes. These barriers are *external* to the industry or *specific to 'niche groups'*.

The *external barriers* are:

- economic: The state of the economy, sources of funding, business cycles and current levels of return on construction investment;
- social: The 'sophistication' of the industry, people's expectations and occupational hierarchies;
- political: Political will, clarity of purpose, strength of lobby groups and 'hidden' influences;

6 Of course, performance-based codes are designed to limit these risks to a certain extent.

- geographic: Local climatic variations, distribution of resources, access to information (including travel to training centers);
- cultural: Preferences for architectural styles and/or techniques, different expectations and needs, language/jargon and history/resistance-t-change.

Niche-related barriers depend on the view points of the various participants in the building process. Influential niche groups include:

- legislators/code writers,
- manufacturers/suppliers,
- designers,
- administrators/control agencies,
- contractors and specialty contractors,
- owners and users.

From experience in New Zealand, these various levels of barriers (including barriers inherent in the building industry as a whole) require different types of communication:

- mass,
- targeted,
- one-to-one.

These types of communication fall broadly under the title of 'education' (about performance and performance codes); the importance – and complexity – of 'educational communication' must not be under estimated, and budgets must allow for it.

Information transfer to SMEs

At the request of the members of W102 who met in Australia and New Zealand in 2001 and who discussed the question of the transfer of knowledge and information to SMEs, Branka Dimitrijevic attended the first meeting of CIB's new task group, TG47[7] "Innovation Brokerage in Construction".

Papers presented at that meeting, held in Manchester (U.K.) on November 1 and 2, 2001, emphasized the role of brokers in facilitating innovation at its more advanced stage (i.e. between research and advanced practice). This focus – on examples from the field of the larger and more complex projects, whether in building or civil engineering – is likely to implicate the larger firms, (though many of the so-called 'larger firms' in the building sector actually fall into the definition of SME's).

From the discussions held in Melbourne and Auckland in 2001, W102's interest is specifically in technology watch and technology transfer to SME's, associated with accompanying information retrieval and dissemination problems.

7 TQ47 was set up after TG35 "Innovation in Construction" had completed and published its work.

The work of TG47 clearly overlaps with this aspect of the work of W102 – but with differing, and complementary, emphases. The coordinator of W102 is asked to contact the coordinator of TG47, Prof. Graham Winch.

A conceptual analysis of the process of knowledge creation

Dr. Andrea Stracuzzi (University of Pisa) presented preliminary findings of a research project exploring the organization of knowledge in a 'learning organization'. How do enterprises learn from their environments and how do they train operators to develop strategies of control and decision-making.

Knowledge is different from information and knowledge is important in the context of decision-making. For information to become knowledge requires perception/reception and decoding/understanding. Knowledge, it is well known, can be explicit or tacit. Tacit knowledge can be

- embodied (physical/physiological),
- 'embrained' (specific to the psychology of an individual),
- encultured (linked to its socio-cultural context).

Tacit knowledge is, therefore, difficult to extract, and knowledge management implies acting on (or working with) people in order to capture the tacit knowledge without which a firm cannot progress.

With the advent of information technology, the characteristics of tacit knowledge and its management become especially important, since in any computer system, information is considered to be a 'definable object'; can tacit knowledge become 'definable'?

Improving education in the field of construction management

Professors Svetlana Vukovic and Milan Trivunic presented the programs of the Department of Civil Engineering, University of Novi Sad. Their programs place emphasis on project and construction management, where there appears to be a lack of local expertise to match the high levels of technical competency.

Special mid-career courses provide information on the organization of the building and construction processes, their management and their information needs.

Construction technology selection using a rough sets case based reasoning model

Dr. Goran Cirovic and Mr. Zoran Cekic showed how knowledge about constructibility could be a significant roadblock in the processes of construction and manufacturing. This knowledge is required 'up front' at the design stage, if subsequent costly and/or time-consuming modifications are to be avoided.

A procedure is proposed for tackling this problem, based on case-based reasoning applied to a construction knowledge base. Rough sets theory enables a robust and more efficient knowledge base to be prepared and exploited, using information technology tools and protocols. Experience gained on the construction site becomes available for shortening and improving the building design and production process.

Internet in construction – procedure for establishing collections of relevant web links

Dr. Zoran Djordjevic and Mr. Milos Kovacevic, after demonstrating that the Internet is relatively little used by construction firms, also showed that there are few construction-industry-oriented portals and collections of web links.

Using existing algorithms for automated classification of web sites, supported by the knowledge possessed by construction experts, a strategy has been devised to design and produce an acquisition system which is able to identify relevant web pages and which is also able to process them so that they are made available to the user in an appropriate way.

The proposed system includes a page repository, a filtering and classifying mechanism and an 'administrative interface'.

The objective of the system is to provide the industry with a tool specifically designed to ease the localization of, and access to, relevant information. This strategy aims at circumventing the all-too-familiar problems of (a) the overload of information and consequent loss of pertinence and (b) the unreliability of information and the associated risks in using it.

Next meetings

Dr. Branka Dimitrijevic, University of Strathclyde, Scotland invites members of W102, to the 2003 meeting, to be held in mid-June 2003 (the actual date will be established soon). Branka Dimitrijevic assured members that the University possesses all the facilities needed for a meeting, and could provide a convivial setting for all events.

The 2004 meeting will be hosted by Dr. Costas Katsanis at Ryerson University, Toronto, to fit in with the 2004 CIB triennial congress, also being held in Toronto.

The possibility of an informal meeting of W102, jointly with W55 (economics), W65 (management), W70 (facilities management) and W89 (education) is being explored. It would take place in Cuba, in 2004, presumably at about the same time.

Closing the meeting

Everybody expressed their thanks to the organizers of the meeting; it was convivial and effective, and a friendly atmosphere prevailed, enabling the various subjects to be explored and discussed constructively.

The coordinator will establish on-line mechanisms so that participants can exchange information on an on-going basis. In this way, everyone can follow developments in the field of information in building, including the impact of performance-based building.