THEORETICAL CONSTRUCTS FOR IS-CAPABILITY IN AEC

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SUMMARY

The purpose of this paper is to develop a conceptual framework and to explore the possible types of Information System (IS)-capability models especially in the Architecture, Engineering and Construction (AEC) environment. Based on current literature, capability is considered from the perspectives of individual, organisation, and the skill to utilise IS innovations. The different perspectives explain the challenge of improving the IS-capability. Individual capabilities need to be studied when considering intelligence, knowledge formation and capability leading to action. The viewpoints of organisation give insights into decision-making and the implementation of an improvement project. The organisation is examined from the administrative, social, knowledge management, activity and economic assessment viewpoints. Knowledge management was found to be very important when considering IS capabilities. IS-capability can be simplified into organisation, economic development, and technical dimensions. These dimensions have equal importance as IS-innovations are utilised. Organisation needs to be committed, project has to be feasible, and the technical solution needs to be mature to enable employees to utilise them. Finally, it is considered desirable to undertake further research into the area of end user utilization of IS-capability, particularly within the AEC culture.

INTRODUCTION

Future historians will certainly look back to the end of the 20th century as an era of information. This was the time when information was everywhere. Why is it that almost everyone still seems to agree that information is important, that we need it, and that more of it is better? Common sense, however, asks how can we avoid the flow of unnecessary information. One answer is that information on its own is not enough. Instead, information has to be transformed into knowledge. Where does the knowledge come from and how do we cope with, control or manage this knowledge? Knowledge management can be approached from three different directions: firstly from organisational cognition and intelligence; secondly from organisational development and strategy; and thirdly from the organisational information systems and information processing direction (Tuomi 1999). This study makes use of the organisational cognition and intelligence direction as it aims to develop theoretical constructs for IS-capability in AEC. This study concentrates on three areas: firstly how individuals are co-operating and learning; secondly process capabilities and organisations; and thirdly what is IS-capability in AEC.

The relations between intelligence, knowledge, capability and action are shown in figure 1. It says in short that intelligence generates knowledge structures that underlie capabilities that manifest themselves in selective action.

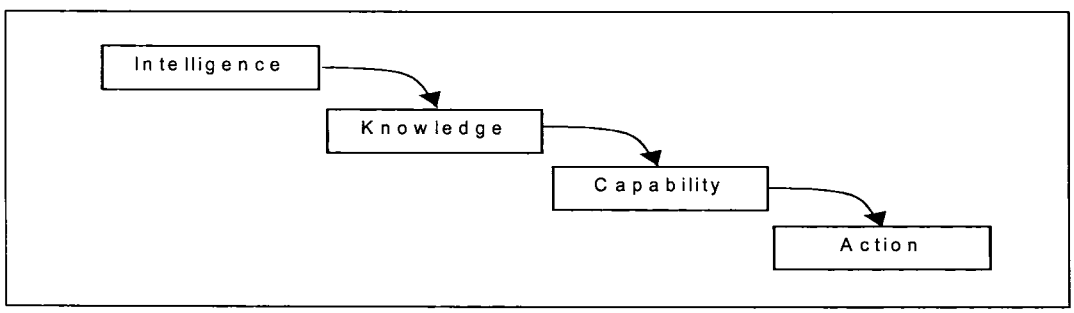

Figure 1 Intelligence as a generator for selective action (Tuomi 1999, p. 122).

PROCESS CAPABILITIES AND THE INDIVIDUAL

During recent years, researchers have been studying learning organisations. The subject that learns is human but not in isolation. The subject is a human-in-society. This means that in practise individuals can use training, experience, habit formations, skill acquisition of the environment and society as sources of knowledge and develop his/her own capabilities more rapidly than he/she could do alone through experience, conceptual thinking and imagination. Interaction of intelligent individuals will result in the development of knowledge that may form the basis of capability ultimately manifesting itself in action.

The study of human knowledge is as old as human history itself and has been central to the study of philosophy and epistemology since the Greek period. When considering intelligence, knowledge formation and capability leading to action, from the perspective of the individual as a learning organism, a theoretical investigation of the development of individual capabilities will be presented. Initially, definition of some terms should be undertaken.

Intelligence is considered an innate aptitude to understand. The Platonist model theorised that it was natural to the human intellect, always engaged as it is in determining under what former headings it shall catalogue any new object. Piaget purported that the child constructs, during the course of development, an individual understanding of the real world and said that, "...intelligence is interactionist in essence" (Turner 1984 pp. 7), however, this Piagetian model ignored the influence of social aspects on cognitive development. Bergson stated "...that the young child understands immediately things that the animal will never understand, and that in this sense intelligence, like instinct, is an inherited function, therefore an innate one" (Bergson 1960 pp. 155). Comparative psychologists purport "...that the more an animal is intelligent, the more it tends to reflect on the actions by which it makes use of things, and thus to approximate to man" (Bergson 1960 pp.197). Knowledge is taken to mean comprehension of a subject whilst capability is taken to be the ability or competence in a subject and finally action is taken as a deed or motion. The Piagetian model linked knowledge to development and stated that for an individual "to know" required the construction of a cognitive structure (Turner 1984). Knowledge is considered to be a competitive resource by Nonaka and Takeuchi, who purport that knowledge creation generates competitive advantage (Nonaka & Takeuchi, 1995 pp. 6). The three characteristics of knowledge creation elucidated by Nonaka and Takeuchi are: firstly, to express the inexpressible; secondly, to disseminate knowledge; and thirdly, that new knowledge is born in the midst of ambiguity and redundancy (Nonaka & Takeuchi, 1995 pp. 12).

One commonly accepted definition of learning is a relatively persistent change in an individual's possible behaviour due to experience. Historically behaviourist-learning models have focused on associative or classical and instrumental or operant learning theories. It is purported by classical conditioning theorists, such as Pavlov, that people are conditioned to respond. Instrumental operant learning theorists, such as Skinner, purported that people learn by trial and error, and that our behaviour is moulded by reward and punishment. Activity theorists, such as Vygotsky, purport that activity theory is a thoroughgoing object relations theory and that the transformation of interpersonal experience into intrapersonal thought processes is the root of all that is specifically human in human psychology. Vygotsky reportedly said "What the child does with an adult today, she will do on her own tomorrow" (Engeström, et. al. 1990 pp. 413). The cultural theory of human nature, within the framework of activity theory, came to prominence during the 1980's under the banner of cultural psychology and is defined as that branch of inquiry that delves into the contextual behaviour of psychological processes (Engeström, et. al. 1990 pp. 87). The inclusion of the interaction between the individual and society provided the impetus for further research into the way individuals learn in society. Social learning theorists, such as Albert Bandura, emphasized internal mental states, such as expectancies, and considered vicarious learning and modelling to be important to the learning process. Foster claimed that cultural reproduction and the transmission of knowledge is related to order, control, stability and change in society, these being the fundamental problems in sociology (Foster 1981 pp. 340). "...teaching children individually need not only accelerate cultural pluralism; it can also strengthen respect for disciplined thought and inquiry and sensitiveness to humane values, and these should act as a counterpoise to social division" (Bassett 1978 pp. 270). A comparison could be drawn between society as a whole and the work environment or more specifically the work environment within the AEC culture. Learning may be driven by either traditional means or by the experience of the individual in society. "Educators may wish to assist individuals to assess for

themselves how they are using their cognitive processes at any one time so as to plan what their next move should be. By these means learners can become involved in the process of their own learning" (Turner 1984 pp.155). Innovative learning theorists, in their view of knowledge creation, emphasise the importance of critical questioning and rejection of the accepted wisdom as a triggering action to innovative learning (Engeström, et. al. 1990 pp. 397) More recently learning theories have emphasized the role of cognitive processes in learning. Zeus and Skiffington assert that our learning process is influenced not only by environment but also by mental events, mental representations, our beliefs, expectations, emotions and intentions (Zeus & Skiffington, 2000). Constructivist learning principles or narrative therapy is seen as a problem-dissolving system and a means of rewriting a person's story and biography and utilises both the traditional learning techniques and interaction of the learner in society. It purports that the learner is always an active organism, not just responding to stimuli but engaging with them in an attempt to make sense of their world and in so doing generate knowledge internally, not just from external sources. Since the most recent learning theories emphasize the role of cognitive processes in the learning process and include mental events, mental representations, people's beliefs, expectations, emotions and intentions as influencing factors to change it is considered that learning is a manner of acquiring knowledge, utilising the cognitive approach. Accordingly, it is considered that a cognitive intervention approach would involve application of the latest learning theories. These theories should be learner focused and emphasize learner ownership, to maximise the acquisition of knowledge generally and in particular within the work environment. Cognitive intervention in the form of solution focused therapy, or coaching, is said by Zeus & Skiffington (2000) to be essentially a conversation; it is about learning, a process more about asking the right questions than providing answers. Being a coach is about change and transformation. It is about fostering human beings' ability to grow, to alter maladaptive behaviours and to generate new, adaptive and successful actions. Coaching is about facilitating the person's ability to reinvent themselves, – creating new stories, new identities and new futures. It recognises that the self is not a fixed entity, but is fluid and always in a state of becoming. Coaching is a process, where the process is equally important when compared to the ultimate goal.

The learner is always seen as an active organism, not just responding to stimuli, but seeking them out and engaging and grappling with them in order to make sense of the world. Knowledge is generated internally, not just from external sources. Barnard maintained that knowledge consists of two parts, firstly, logical, linguistic content and secondly, behavioural, non-linguistic content (Nonaka & Takeuchi, 1995 pp. 36-37). Nonaka emphasises that new knowledge always starts with the individual and is transformed into organisational knowledge (Nonaka & Takeuchi, 1995 pp. 13). The difficulty may lie in individual's ability to generalise newly acquired knowledge in relation to the more broad ideals of society. This should be the focus of future research. That is, investigators must examine the IS capability models being utilised by end users, particularly in the AEC culture together with how the solution-focused approach utilised at an individual level can be applied in the workplace and particularly within the AEC culture.

PROCESS CAPABILITIES AND THE ORGANISATION

Sarshar (et al. 1999) pointed out that information technology (IT) and other enablers need to fit within a business context of process improvement. They developed a framework of Standardised Process Improvement for Construction Enterprises (SPICE) to support the construction companies in improving their processes. The aim of SPICE is to reveal the maturity level of the process in the construction company and describe the next maturity level. SPICE describes the major process characteristics of an organisation at each maturity level, without prescribing the means for getting there. The key processes need to be demonstrated with the five process-capability features:

(1) Commitment to perform – this typically involves establishing organisational policies. Some require organisational sponsors or leaders.
(2) Ability to perform – this describes the preconditions (adequate resources, appropriate organisational structure and training) that must exist to implement the process completely.
(3) Activities performed – describes the activities, roles and procedures necessary to implement processes. It typically involves establishing plans and procedures, performing the work, tracking it, and taking corrective actions
(4) Analysis and evaluations – describes the basic evaluation practises that are necessary to determine the status of a process. In other words controlling and improving the process.

(5) Verifying implementation – this verifies that the activities are performed as planned. (Sarshar et al 1999b, p. 382)

Process capability features in SPICE (Sarshar et al.1999, p. 382)	**Features in TIMI-barometer** (Enkovaara et al. 1998)	**Views in Organisations**	**Individual capability** (e.g. Knowles 1980, Otala 1993, Venkula 1988, Peltonen et al. 1994)	**Knowledge capital** (Tuomi 1999)
Commitment to perform - organisational policies - sponsors or leaders	IT-Management - commitment - IT strategies - IT as a success factor	Administrative - Commitment and control - design of strategy and structure - effective distribution of labour - information processing	Commitment to perform - own responsibility - manager's support	
Ability to perform - resources - organisational structure - training	IT skills Motivation Infrastructure Used software Structured information - paper format or digital format or meta data	Social - communication and collaboration - power - trust - institutions - organisational culture Economical - resources - network of value creation and transaction	Competence -knowledge tacit/focal/explicit -understanding -technical skill -communication skills & contacts to experts -attitude -values –interest Situation in the personal life	Human capital - competence - attitude - intellectual agility Structural capital - internal structure - renewal capability - external structure
Activities performed - establishing plans and procedures - work performance - tracking work - corrective actions as necessary	Processes - core processes - quality - customer view - IT in processes - Effect of IT	Activity - business process - work process - task co-ordination and scheduling	Experiences of mistakes and success Learning capacity - personal capacity - orientation type of personality - meaningfulness of the situation - energy and methods	
Analysis and evaluations - evaluation of the status of the process - controlling and improving the processes	Evaluated benefits - customer satisfaction - time - quality - cost - co-operation - motivation	Economical assessments - business system - company in competition - network of value creation and transaction - global environment		
Verifying implementation - are activities performed as processes describe - review of management - quality assurance			Ability to verify the success	

Table 1 Features in capability studies. (Naaranoja 2001)

Table 1 compares the features of process capability of SPICE to those of IT capability in TIMI barometer and individual capabilities and views in organisation. The study shows that in the main approaches the organisational views are found. The main views are administrative, social, economical, activity, and economical assessment. The TIMI features were created to assess the maturity of the IT utilisation in the company.

We can distinguish several foci and levels of analysis in organisational analysis. When focal actor is the owner, the organisation is seen as an economic entity that exists to make profit. When the focal actor is top management we discuss decision-making, goal setting, command and control structures, information flows, and organisational renewal. When the focal actor is a collective of workers, organisational processes, division of labour, co-ordination of activities, communication networks, institutions, commitments and culture look prominent. When discussing the organisation as such, the organisational structure, cybernetic input-output models, and interorganisational models emerge as natural issues that need to be studied. Rosenböjer (1998) studied development of ability and willingness to organise resource mixes for productive actions in three levels: the firm, relationship and network. He found financial, physical, human, technological, reputation and organisational resources in this development. Although, his study focused on distribution in the fine paper sector in the United Kingdom, the idea of analysing capability development in levels is usable. In addition, the importance of reputation needs to be remembered as process is improved.

Within organisation, we have several perspectives in knowledge. Firstly, knowledge can be seen as an accumulated *resource* that underlies capabilities. Knowledge makes some types of performance possible. The accumulated possibilities for action we can call competencies (Tuomi 1999, p. 294). Secondly, knowledge can be viewed as a structure that *constrains* activity, and that makes some actions effective. Thirdly, knowledge can be viewed as a *product*. As a product, knowledge can change existing constraints for actions, and lead to development. In the extant literature on knowledge management, the focus has been often on the resource perspective. However, at the same time the knowledge has also been viewed as a product. Therefore, it has been assumed that a design or a document can be valuable as such, without considering the activity in which this value is realised. Often two types of knowledge resources have been distinguished: human capital and structural capital. The idea has been, for example, that human competencies " walk out every night" and whereas structural capital "stays in the company. In economical terms it has been considered that human capital can only be rented, whereas structural capital can be owned by the company (Tuomi 1999).

The analysis presented in table 1 emphasise the importance of studying the capabilities in order to understand how the capabilities of an organisation influence on those of an individual. It is also important to study how the human capital can be "saved" in the organisation by IS that recreates the knowledge. The features of capability are complex but we can simplify them in four different dimensions: commitment, ability to perform, the processes of the activity, and ability to evaluate the activity. It is most important to learn from the past projects. This can mean, for example, saving the assessment results of the process in the project databank in order to remember the lessons learned.

IS-CAPABILITY

Naaranoja (2001) traced IS-capability from the features of SPICE, TIMI, and views in organisations, individual capabilities, and knowledge capital. IS-capabilities in FM are proposed to have three main dimensions (table 2):

- economic development
- organisation
- technical.

This view is believed to help in assessing quickly the capabilities of the company and its co-operators in AEC network. The dimensions are not independent since the information system may help the organisation to improve its other capabilities. Economic development affects the possibilities to improve information systems. However, the dimensions may be studied in separation.

The economic development aspect is understood here in a rather broad way. The scope is: how well the economical aspects like the strategies support the use of innovations. The financial and other resources are an important factor. It is important to be able to fit IT within a business context of

IS-CAPABILITY IN A COMPANY	
ECONOMIC DEVELOPMENT	
Processes	Quality of processes Evaluation of processes Improvement plans and priorities
Strategies	Business strategy (where and why) IS-strategy (what is required) IT-strategy (how can it be delivered)
Economical situation	Ability to invest Ability to carry the risks
Customers and Suppliers	Requirements of the customers Types of customers Collaboration with suppliers
ORGANISATION	
Knowledge capital	Human capital - competence - attitude - intellectual agility Structural capital - internal structure - renewal capability - external structure
Commitment	Institutional factors - attitude of the business field - attitudes in the human network Administrative factors - communication and collaboration - power/trust - institutions /organisational culture
TECHNICAL	
Current IS infrastructure	Age of computers, local network, Email, Internet, shared databases, windows environment, etc.
Current IS software	Used software: bookkeeping integrated or not with operative and/or service tools ?
Current data structure	Form of data paper documents/digital /shared databases used by staff; customers; collaborators
Benefits and costs of the current IS	Does IS help to make good decisions? Efficiency Effectiveness Performance
Ability to assess: possibilities and risks of IS-innovations	Improvement capabilities Is it possible to make a big technology jump?

Table 2 IS-capability in a company.

process improvement. Based on these factors the company needs to be able to create a priority list how IS can be improved.

The capability of the organisation is related to features like commitment and ability to perform (compare process capability). Commitment to perform can be described by *administrative and institutional factors*. Administrative means here the ability of the organisation to distribute labour to the development task given and commitment and control habits of the organisation. Institutional factors are communication and collaboration skills, power, trust, institutional factors and organisational culture. *Knowledge capital* describes the ability to perform a feature in the organisation. Knowledge capital is the sum of human and structural capital. Human capital is the sum of competence, attitude and intellectual agility. Structural capital is the sum of internal structure, renewal capability and external structure (Tuomi 1999).

The technical aspect aims to describe which kind of factors enables the use of IT-innovation in a company. There is studied what kind of benefits are gained in organisations nowadays by using IS, for example, how does IS improve decision-making. Experiences help the company to specify what is needed and how the new IT should work. Especially, the ability to tell the software vendors the needs and wishes of the company are important when selecting a new system.

Evidence is found that the level of domination of these dimensions varies in organisations affecting the IS-utilisation. For instance, if the organisation dimension of IS-capability dominates the utilisation, the benefits of IS may remain moderate though the organisation tests and uses several different kinds of IS. If the organisation stresses the benefits of the IS-innovation and do not ensure the utilisation skills of the organisation, the managers may have difficulties with the motivation of their employees. This type of challenge can be seen as the employees have difficulties to find time to learn to use the IS. The companies do not measure IS benefits, although companies say that they distinctly benefit from the IS-utilisation. The technical dimension of the IS capability cannot dominate either the utilisation since nobody can fully know the possibilities, since the IS develop so fast. The companies also assert it difficult to follow the technical development and keep their systems updated. (Naaranoja 2001)

The needs of the company have to give direction to the IS-strategy. However, it is important to gather the technical capability by utilising IT and studying IS-possibilities. Though IT-skilled individuals have an important role, it is even more important that all the employees want to learn from each other and skilled people are utilised to a maximum in this process. The question is not who is better but how to hasten the learning and create a positive attitude towards ongoing change.

CONCLUSIONS

This theoretical paper describes IS-capabilities of individuals and organisations in general and in particular within the AEC environment. The paper points out that the capability development should happen at the individual, company and network level. It is considered that organisations operating within the AEC environment would benefit by initially determining precisely what the requirements to support their processes are. One methodology that could possibly be utilised to achieve this objective is to prompt organisations to write a story about what is considered to be an ideal IS.

IS capability dimensions (economic development, organisation, and technical dimensions) need to be improved even-handed since the optimal benefits of IS require knowledge of the business, capable organisation, and sound IS. If one of the dimensions is dominating the development project the results of the pilot may be successful but the wider community may, however, have difficulties in utilising the results.

It is considered that the focus of future research should be in studying:

- individual's ability to generalise newly acquired knowledge in relation to the more broad ideals of society, in general, and the AEC culture, in particular.
- organisation's ability to select the IS tools that become economically feasible and that the individuals are motivated to utilise.
- what different types of IS-capabilities in AEC may exist and their connections with the success of utilisation of IS.
- what kind of variation is likely to be present in different kinds of facility management (FM) companies.
- the linkage between the formation of IS-implementation teams and implementation success. For example, what role the team plays in the economic development dimension of IS-capability. How is the project team formed? Is the project team able to affect the overall capability? How do they affect it?

If the research was undertaken in these areas it is anticipated that IS capability would have increased potential for improvement providing further potential for increasing individual job satisfaction and ultimately leading to increases in productivity, especially within the AEC environment

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Welcome to Information on the W78 Conference

The W78 conferences provide a general forum for all those involved with Information Technology in Construction to address the following objectives.

- To foster, encourage and promote research and development in the application of integrated IT throughout the life-cycle of the design, construction and occupancy of buildings and related facilities
- To proactively encourage the use of IT in Construction through the demonstration of capabilities developed in collaborative research projects
- To organise international cooperation in such activities and to promote the communication of these activities and their results

Latest Conference News

(16 April 2003)

Prof. Mary Lou Maher has kindly agreed to be the Friday morning keynote presenter (replacing Jerry Laiserin). Mary Lou will address the 'Bridging the Distance' theme drawing on her extensive experience of collaborative environments as well as highlighting the work being undertaken in Australia within the CRC consortium.

(12 April 2003)

There are two unfortunate pieces of news for the W78 conference.

1. Keynote speaker Jerry Laiserin has had to withdraw from the W78 conference. Jerry was due to attend the CAAD Futures and CAADRIA conferences following W78 and as these two conferences have been postponed due to SARS Jerry is not able to get to W78
2. The University of Auckland has required the W78 conference to request all attendees from SARS infected countries to not attend the conference. This has impacted on 10 people from Hong Kong and Singapore. The conference now has 52 delegates attending from 20 countries.

NZ and SARS (16 April 2003)

Several people have asked what is happening in NZ in relation to the SARS outbreak. I think your governments' and the WHO are providing a lot of guidance for travellers in Asia. The situation in NZ at the current time is as follows:

- NZ does not have any cases of SARS
- NZ has not restricted entry of people from any country due to SARS
- NZ does not quarantine people coming from affected countries
- NZ does not test people entering the country for SARS
- NZ health officials will isolate people who have SARS symptoms and there is screening for symptoms through nurses at NZ's international airports and prior to departure in SARS affected countries

See: http://www.moh.govt.nz/sars for NZ's official news on this topic.

Schedule (Timetable)

CIB W78 2003 - Printed Papers

PPT	Paper Title	Authors
	A Computer Model for Selecting Equipment for Earthmoving Operations Using Queuing Theory	Sabah Alkass, Khalil El-Moslmani and Mohamed AlHussein
PPT	A Comparative Study: With Insight into the Use of IT in Local Architectural Practices	Azza A. Arif and Aly H. Karam
	An Integrated Environment for Life Cycle Costing in Construction	Nick Bakis, Mike Kagiouglou, Ghassan Aouad, Dalanthi Amaratunga, Mohammed Kishk and Assem Al-Hajj
PPT	Two Decades of Research Developments in Building Design	Claude Bedard and Hugues Rivard
PPT	Re-Engineering of Objects in Constructional Drawings	Volker Berkhahn and Christian Esch
	Development of an Agent-Based Workbench Supporting Collaborative Structural Design	Jochen Bilek and Dietrich Hartmann
	Usability Testing of Hand Held Computing on a Construction Site	Sarah Bowden, Antony Thorpe and Andrew Baldwin
PPT	Creating a Benchmarking Service to Measure ICT Uptake for the Australian Construction Industry	Graham Brewer, Thayaparan Gajendran, Judith McCann and Swee Eng Chen
	The Use of Web-based Tools to Support a Contractual Claim in Arbitration or Litigation	Philip Chan
PPT	Time-Cost Relationship for Residential Construction in Texas	Ifte Choudhury and Siva Shankar Rajan
PPT	Next Generation Knowledge Management Systems for the Construction Industry	Per Christiansson
	Classification of Construction Information with Fuzzy Attributes	Ozer Ciftcioglu
	An Industrial Evaluation of the Virtual Construction Site (VIRCON) Tools	Nashwan Dawood, Eknarin Sriprasert, Zaki Mallasi and Darren Scott
	'Healer, Heal Thyself!': Information Management in an Architecture Faculty	Andreas Dieckmann, Peter Russell and Thomas Stachelhaus
PPT	An IT Infrastructure for Long Term Research & Development at the CRC for Construction Innovation	Robin Drogemuller, Keith Hampson and Kwok-Keung Yum
PPT	Design as Problem Handling - Outline of a Framework	Anders Ekholm
	Customer Relationships Management in AEC Sector	Kerem Ercoskun and Alaattin Kanoglu
	Development of a Procedure to Evaluate the Air Leakage Distribution from Fan Pressurization Test - Validation of Three Airflow Models	Fariborz Haghighat
	Applying Web Services Within the AEC Industry: Enabling Semantic Searching and Information Exchange Through the Digital Linking of the Knowledge Base	David Harrison, Michael Donn and Henry Skates
PPT	IT Directions - 20 Years' Experience and Future Activities for CIB W78	Rob Howard
PPT	Product Family Modelling in the Construction Industry	Kaj A. Jorgensen
	Visual Product Chronology as a Solution for Accessing Building Product Model Data	Kalle Kahkonen and Jarkko Leinonen
PPT	Conceptual Framework for Live Capture and Reuse of Project Knowledge	John M. Kamara, Chimay J. Anumba, Patricia M. Carrillo and Nasreddine Bouchlaghem
	Scheduling for High-Rise Building Construction Using Simulation Techniques	Arthur W.T. Leung and C.M. Tam
	A Framework for Evaluating IT Benefits in Construction Companies	Yan Li and Shou Qing Wang
PPT	An Agent Approach to Data Sharing in Virtual Worlds and CAD	Mary Lou Maher, Pak-San Liew and John S. Gero
	A Generic Inclusion of Space Strategies with Activity Execution Patterns in 4D Tools	Zaki Mallasi and Nash Dawood
	Middleware-based Modelling and Simulation of Geotechnical Structures	Udo F. Meissner and Jochen Ruben
	Network-based Co-operation Processes for Fire Protection Planning	Udo F. Meissner, Uwe Rueppel, Steffen Greb and Mirko Theiss
	An Agent-based Approach to Dam Monitoring	Ingo Mittrup, Kay Smarsly, Dietrich Hartmann and Volker Bettzieche
PPT	Development of the PM-Supporting Tool in Japanese Building Construction Market: Improvement of an Application Software for Scheduling	Ryusuke Mizuno, Shuzo Furusaka, Takashi Kaneta, Takayori Takamoto and Chikashi Yoshida
	Design Critique Inside a Multi-Player Game Engine	Jules Moloney, Robert Amor, Jay Furness and Benjamin Moores

PPT	Theoretical Constructs for IS-Capability in AEC	Marja Naaranoja and Paul Clarke
	Aedilitia website triggers the construction sector about EC requirements	Elisabetta Oliveri, Marco Padula, Rossella Scaioli and Gloria Pescarolo
PPT	Management of information flows during construction projects	Benoit Otjacques, Pierre Post and Fernand Feltz
	Data Rich Digital Architectural Environments: Managing Rich Information Flows in Architectural Practices of Australia	Nghia Pham and Anthony Dawson
	Information Technology-Enabled Knowledge Sharing in Multinational Strategic Alliances: Media Richness - Task Relevance Fit	Martin Sexton, Bingunath Ingirige and Martin Betts
	A Group Support System to Improve Value Management Workshops in Hong Kong	Qiping Shen and Jacky K.H. Chung
PPT	A Framework for a Collaborative Design Review System Utilizing the Unreal Tournament (UT) Game Development Tool	Mohd.Fairuz Shiratuddin and Walid Thabet
	Prophet: A Contextual Information System Framework	Vipul Singhvi and Michael Terk
	COSEE: Component State Network Centric Model for Verifying Temporal and Spatial Consistency in Project Schedules	Yuanbin Song and David K.H. Chua
PPT	Properties for Fire Engineering Design in New Zealand and the IFC Building Product Model	Michael Spearpoint
	Genetic Algorithms for Multi-Constraint Scheduling: An Application for the Construction Industry	Eknarin Sriprasert and Nashwan Dawood
	A Software Tool for IT Project Selection (PROSEL)	Rodney Stewart and Sherif Mohamed
	Sustainable Development of Construction Small and Medium Enterprises (SMEs): IT Impediments Focus	Rodney Stewart, Christopher Miller, Sherif Mohamed and Gary Packham
	Outline of a system for sensor-driven, high-resolution building models	Georg Suter, Ardeshir Mahdavi and Robert Ries
	State-of-the-Art Internet Technology in Singapore's Construction Industry	Chan Swee-Lean and Leung Nga-Na
	Legal Challenges & Strategies in e-Procurement in Construction	Seng Kiong Ting and Hwee Yi Wong
	Works Project Information Standards for the Hong Kong Construction Industry	T.C. Tse, K.D. Wong and K.W. Wong
PPT	LCADesign: An integrated approach to automatic eco-efficiency assessment of commercial buildings	S.N. Tucker, M.D. Ambrose, D.R. Johnston, P.W. Newton, S. Seo and D.G. Jones
	Graduate Level Construction Informatics Curriculum: A Proposal to Meet the Bologna Structure	Ziga Turk and Davor Delic
	Mapping the W78 Papers onto the Construction Informatics Topic Map	Ziga Turk and Tomo Cerovsek
PPT	Clarity in the usage of the terms ontology, taxonomy and classification	Reinout van Rees
	Generalised Model Subset Definition Schema	Matthias Weise, Peter Katranuschkov and Raimar J. Scherer
PPT	VR modeling in Built & Environment - Some experiences and directions in site operations	Stefan Woksepp and Odd Tullberg
	Web Services for Crime Deterrent Design Knowledge	Song Wu, Angela Lee, Ghassan Aouad and Charlie Fu
PPT	An IFC-based Product Model for RC or PC Slab Bridges	Nobuyoshi Yabuki and Tomoaki Shitani
	A Knowledge Classification Scheme for Constructable Designs	Yi Qing Yang, Sui Pheng Low, Shou Qing Wang and Bee Hua Goh
	Adaptations of QFD for Constructable Designs within a Concurrent Construction Environment: An Information Modeling Approach	Yi Qing Yang, Shou Qing Wang, Sui Pheng Low and Bee Hua Goh
PPT	W78 Commission meeting	Martin Betts
PPT	Workshop: Computer Supported Collaborative Work	Stephen Egan

Contact Information

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The 20th CIB W78 Conference on Information Technology in Construction

Waiheke Island, Auckland, New Zealand, 23-25 April 2003

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

CIB W78 2003 - Attendees

Name	Affiliation	Country
Michael Ambrose	CSIRO	Australia
Robert Amor	University of Auckland	New Zealand
Penny Barry	University of Auckland	New Zealand
Claude Bédard	Concordia University	Canada
Volker Berkhahn	University of Hannover	Germany
Martin Betts	The University of Salford	UK
Edmond Chan	University of Auckland	New Zealand
Ifte Choudhury	Texas A&M	USA
Per Christiansson	Aalborg University	Denmark
Paul Clarke	University of Technology Sydney	Australia
Gustav Coetzee	Boutek/CSIR	South Africa
Kathryn Davies	UNITEC Institute of Technology	New Zealand
Nash Dawood	University of Teesside	UK
Tony Dawson	Deakin University	Australia
Andreas Dieckmann	Aachen University	Germany
Robin Drogemuller	CSIRO	Australia
Stephen Egan	CSIRO	Australia
Anders Ekholm	Lund Institute of Technology	Sweden
John Grundy	University of Auckland	New Zealand
David Harrison	Victoria University of Wellington	New Zealand
Kate Henderson	UNITEC Institute of Technology	New Zealand
Rob Howard	Construction Communications	UK
Claire Hyde	University of Salford	UK
Kaj Jørgensen	Aalborg University	Denmark
John Kamara	University of Newcastle upon Tyne	UK
Aly Karam	University of the Witwatersrand	South Africa
Han Soo Kim	Sejong University	South Korea
Young Suk Kim	Inha University	South Korea
Angela Lee	University of Salford	UK
Junbok Lee	Hongik University	South Korea
Yuhua Luo	University of Balearic Islands	Spain
Mary Lou Maher	University of Sydney	Australia
Udo Meissner	Darmstadt University of Technology	Germany
Ryusuke Mizuno	Kozo Keikaku Engineering Inc.	Japan
Jules Moloney	University of Auckland	New Zealand
Marja Naaranoja	Vaasa University	Finland
Benoît Otjacques	Centre de Recherche Public	Luxembourg
Sapri Pamulu	Victoria University of Technology	Australia
Nghia Pham	Deakin University	Australia
Hugues Rivard	Concordia University	Canada
Steven Shaw	CSIRO	Australia
Harijono Sigit	Institute of Technology Sepuluh Nopember	Indonesia
Michael Spearpoint	University of Canterbury	New Zealand
Rodney Stewart	Griffith University	Australia
Walid Thabet	Virginia Tech	USA
Reinout van Rees	Technical University Delft	The Netherlands
Stefan Woksepp	Structural Mechanics, Chalmers	Sweden
Nobu Yabuki	Muroran Institute of Technology	Japan
Kwok Yum	CSIRO	Australia

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Welcome to Information on the W78 Conference

The 2003 W78 conference has been and gone. We had a very successful conference with 50 delegates from around the world. This site provides residual information about the conference including:

- Electronic copies of all papers printed in the proceedings
  - Where copies of the presentation were provided by the author these are also available to view
- Photos of events at the conference and from the post conference tour
- Information on the scientific committee, the timetable, and the attendees

All enquiries should initially be directed to Robert Amor (trebor@cs.auckland.ac.nz).

For questions or comments relating to the operation of this web site, please contact Ulrich Guenther.