



PROJECT DOCUMENTATION AND INFORMATION FLOW

An Information Paper for International Construction Information Society (ICIS)

Background

This information paper addresses the complexity of the whole construction industry as it pertains to construction information and how it is identified and organized. This is a process that our industry has not addressed in a total context - at least for the whole industry - or even for to some parts of it.

This paper focuses on:

- people (information generators),
- information resources (from a variety of sources),
- the flow of the construction process,
- the documentation it generates along the way,
- the questions, decisions, and solutions derived from construction information, and
- the project specific documentation generated from each of these aspects and activities.

A time frame for all these events is from sunrise (facility creation) to sunset (demolition and recycling of the facility).

Project documentation means all forms of documentation for any facility or project types:

- it identifies project specific information required to accomplish all processes and resulting documentation;
- it demonstrates how project information needs to be rationalized to easily flow from one process to the next; and
- it identifies a need to rationalize the classification and organization of all relevant information.

Activities usually associate with a multiplicity of resources and involve a variety of players:

- it includes many differing forms of construction information;
- this includes demands for classifying and organizing construction information;
- it affects imposition of regulations on documentation; and
- it recognizes external influences affecting construction documentation.

Our industry has traditionally focussed on organizing segments of construction information, one portion and one discipline at a time. We must focus on all aspects of information collection, record keeping, and to consider restructuring that information not only for bid and contract purposes but also to expedite the process of continuing facility management.

This paper will explore and summarize, in a broad conceptual aspect, the need for developing a more global strategy to this issue. The need for recognizing and assessing the experiences of others and their requisite knowledge of a project as it develops is paramount.

Definitions

Construction industry: An economic industry comprised of resources and activities combined to produce a functional facility or space.

Construction information: Resource data and generated documents used as a factoring nucleus to produce a result.

Players (participants/actors): People including investors, proprietors, lessors, designers, managers and facilitators, contractors, subcontractors, suppliers, and facility users.

Project: A constructed facility which may be a building enclosure, open airport, road, bridge, site development, industrial complex, or utility infrastructure.

Resources: A combination of people functioning as players, materials, produced products, and background supporting data or directive documents.

Classification (according to ISO Report TR 14177): A set of concepts arranged systematically according to the chosen characteristics or criteria.

Special Terms

Defined in the ISO Report TR 14177, the terms identified in this Issues Paper are:

FACILITY: A physical structure or installation, including related site works, serving one or more main purposes.

SPACE: An area or volume bounded actually or theoretically.

ELEMENT: A physical part and system of a facility with a characteristic function (e.g., enclosing, furnishing, or servicing building spaces), defined without regard to the type of technical solution or the method or form of construction.

[Although *elements* are defined without regard to the way they are constructed, once they have been designed and detailed they become real and can be considered as *designed elements*.]

DESIGNED ELEMENTS: The complete physical facility divided according to characteristic functions.

[The same complete physical facility can be divided into *work sections*.]

WORK SECTION: A physical part or portion of a facility, viewed as the result of particular skills and techniques applied to particular construction products and/or elements during the construction (production) phase.

[The term *work section* is used somewhat uniformly by Europeans and effectively means the same in North America as a "specification section". One type of *work section* may be included in several *designed elements*. Similarly, one *designed element* may include several types of *work sections*. The *work sections* give the *elements* their detailed design and material content.]

Changing Times

The construction industry of the late 1990s requires us to recognize:

- changes in the industry,
- changing people and materials,
- changing contracting methods,
- advent of newer contract forms which change and shift professional and legal responsibilities,
- changes to document preparation throughout the whole creation, design, and construction process,
- broadened traditional perspectives including civil, industrial, and other engineering disciplines, and
- the development of appropriate classification tables to suit these criteria.

Most important, we must recognize the changes in the rules occurring in the industry. We have but three real choices:

- stay with what we have and be left behind certain segments of the industry;
- wait for others (maybe even government) to make these changes for us, then learn and adapt accordingly; or
- we can initiate, create, and implement the changes required to address the future as best we can and provide leadership for others to follow.

Realizations by ICIS member organizations from an early meeting in 1989 to a more formal ICIS organization in 1994, were that a greater degree of harmonization of classifying information was necessary and possible. It appeared then that agreement on classifying principles could be achieved as a first step.

Where Are We?

Facility owners (facility creators and managers) now insist on having access to ALL information collected during a developing project process and to have that information at hand during the life of a facility. They want to have ready access to all data that was used to prompt decisions, the options that were considered, records of the options and decisions, and information on the background to those decisions. They want to use that information in an attempt to better manage their facilities and as an asset for future owners.

There has never been a greater need for rationalizing the creation and production of construction documents in the industry. The increase in international trade of construction products and diversification of localized consultant and contracting services makes internationally and nationally accepted principles for document production and preparation very important if not crucial.

The increasing attention being given to the management and use of facilities, including operation and maintenance, has increased the need for classification systems which may be used harmoniously throughout the total construction process, from inception to demolition. The preparation of specifications and cost planning is but a small part of those activities, albeit an important part. Classification of these processes and the information generated is critical to both industry efficiency and facility record keeping.

Need for Classifying

Element-oriented cost classification tables presently proliferate the European and Asian industries and to a lesser extent, North America. Work section classification systems are somewhat less prominent in

Europe and Asia but more prominent in North America, though a recognizable shift has been occurring very recently in most (construction focussed) areas of the world.

Appropriate and standardized classification of concepts, design processes, facilities, spaces, bidding and contracting methods, realty information, and related activities is rare - anywhere. A necessary and natural outgrowth of a relationship between diverse construction documents, is the need to conceive and develop a more global "unified" approach to address all construction information and applications - under one universal approach - that is logical and simple to apply.

Recognizing the natural flow of information on a project has not been a natural process. Information sharing between the parties throughout the complete facility creation process is nearly non-existent - except in scattered hard copy documents. Mistakes are made and corrected. Mistakes are often repeated because the players change as a project develops - the process transitions from one stage to the next. Mistakes and oversights are also made because of memory lapses by the players. On overview, the process is chaotic and unorganized from the perspective of capturing information, recording it, and having it conveniently available.

Owners and facility managers require information to conceptualize then bid, contract, and construct a facility - then to continue to operate and maintain it - efficiently. As time progresses and a facility function changes, effective and efficient methods of altering or expanding a facility is required. Accumulated information gathered during the construction process must be kept, catalogued, and available for efficient changes to the construction work. Information development and record keeping must be made more efficient.

Information systems must organize and manage data from many different sources for use within differing applications such as drawing systems, CAD techniques, specification systems, product information systems, and cost information systems. These data and document production relationships must be structured in such a way that the stored information is consistent and reliable within and between the different systems. Consequently, linked and harmonized classification tables and systems are imperative.

Why the Concern?

We need effective, consistent, and continuing communicating and archiving tools. Some major factors are:

- The dramatic increase in international trade of construction products, international exchange of consultant and management services, and international construction funding and management services mandates the need for communication using universally common and accepted principles.
- The increasing need for efficient management of the use and utility of buildings and facilities including operation and maintenance has increased the need for classification system(s) which may be used by all members of disciplines within the construction industry, from inception to demolition.
- The increasing importance of construction information and the sharing of knowledge as we move quickly towards an electronic based information society is critical. Effective use and sharing of electronic information requires a common language and organizational structure for classified and coded systems with clearly defined rules.

Work section classification tables are in evidence in some ICIS constituent member organizations. Each organization has developed and imposed its own system in its own domain. There is now a need to

recognize ICIS member existing systems, new processes, new contracting methods, changes in technology, and construction products from other than local sources.

The focus of any global classification system for the construction industry should at least include the subjects of:

- property assessment and acquisition
- codes and regulations affecting the intended facility
- laws and ordinances - including subjects such as accommodating handicapped or disabled persons
- environmental considerations
- facility concept and design processes
- buildings and related facilities
- architecture, interior design, and landscaping
- facility environment utilities (HVAC, plumbing, fire protection, electrical)
- life safety and facility protection requirements
- civil engineering
- industrial engineering
- process engineering
- utilities (source and distribution)
- renovation and rehabilitation of existing work
- facility costing and budgeting
- facility maintenance and management
- facility service contracts
- temporary facilities and work
- other activities reasonably identifiable as being part of the construction industry and
- project specific research, correspondence, reports, written communications between the parties involved, and changes occurring during the transforming processes

Other secondary but also important considerations are:

- the relationship of each of the above to the advancement of "time",
- the role and participation of various special interest parties,
- the requirement to create a classification system that addresses both master and project specific applications, and
- the need to present and archive information and decision-making for audit trail purposes.

All of the above considerations must be recognized for their role or influence on the formulation of a global classification system. Yet another influence is the recognition that buildings and facilities (the built environment) transition through several distinct phases:

- notion of a requirement
 - needs analysis
 - realty considerations
 - budget (and cost) criteria
- creation phase
 - schematic design
 - document development
 - bid and contract award
- production phase
 - construction

- commissioning
- use phase
 - operation and maintenance
 - equipment replacement and upgrading
 - interior changes and renovations
 - change of occupancy
- out-of-use
 - the demolition phase

The "use" portion above may also involve renovation and then operation and maintenance again. This cycle will repeat until the facility is demolished or rendered unusable.

Classifying Construction Product Information

The basic concepts and principles which would comprise a portion of a global classification system includes certain classes of divergent construction product information. Broadly categorized they are:

- general and special purpose buildings and facilities,
- constituent products (materials, components, and assemblies),
- plant, temporary facilities, and non-constituent products,
- associated management and administration,
- associated attributes (quality, suitability, appearance),
- associated codes, standards, and regulatory constraints.

Classifying Construction Specifications

The principles associated with specifying products and systems also comprise a portion of a global classification system. Principally they are:

- *facilities*,
- *spaces*,
- *elements*, and
- products or materials.

At present, the North American *MasterFormat* purports to address specifications, costing, and construction product information but does not deal with these related but dissimilar functions well. *MasterFormat* would need to be extensively re-scoped and rearranged to specifically address specifications only. The result would be a classification system that may not resemble the present document. Whether *MasterFormat* or its replacement should address both *work sections* and *element* specifying remains to be examined further.

With specifications as part of a global classification system, specifications and drawings are really accumulated knowledge systems - not just bidding or contractual documents. They represent an information gathering and decision process. That information must be preserved for other uses at a later date, perhaps by other parties. Information gathering and decision processing should not be included in formal construction documents, but there is a need to record decisions, selections, and options for future reference. The need to store and efficiently retrieve this information must be recognized and addressed in a composite global classification system.

Classifying Construction Budget and Cost Information

The principles associated with budgeting projects and cost estimating systems comprise yet another portion of a global classification system. Principally, they are:

- project budgeting and financial planning,
- buildings and facilities by function,
- spaces formed by enclosures,
- basic building and facility *elements*,
- product sections (*work sections*),
- environmental and safety costs,
- cash flow forecasting, and
- cost control and management.

Most classification tables for *elements* in their present form, primarily address "buildings". *Element* classifying must change in form so that it accommodates an integration with *work section* classifying and expands its present scope beyond "buildings".

Classifying Other Subjects

A single classification system or harmonized multiple systems should address a broad range of other related but distinct subject areas. In a current needs sense and broadly expressed, they are:

- regulatory requirements or measures,
- facility design criteria,
- legal documents,
- facility purpose information,
- several categories of specification documents,
- budget and cost systems,
- construction product classifications, and
- drawings in many forms for differing purposes.

Discussion - Information Flow

A "total concept" for document creation during the various stages of design and construction development would include:

- a compilation of several approaches for creating and managing project information,
- establishing criteria,
- considering alternatives and options, and
- decisions being made.

The concept of one document flowing into the creation of the next is unique to the industry - unique in the sense that documents are usually produced sequentially - without a broader view to a consolidated strategy for total document information creation. Consider a singular strategy:

- to functionally dovetail informational document types with each other;
- to complement each other in purpose and usage with a similar interface;
- to present information at a point in time and in a manner to influence and encourage decision making;
- to follow a natural work flow of document creation - reusing the decisions already made - expanding on those decisions the a greater level of detail; and

- to offer an efficient method for users to effectively produce industry acceptable documents in a form to which the industry is accustomed.

As new people in the industry join into the project stream, they can be readily informed as to the questions and issues addressed and the decisions made thus far. Their review might include assessment of options and decisions made. Then they are much better equipped to offer their contribution, within a consistent process, more efficiently.

Structured Classifying

Our industry must address the need to accommodate product information classification and develop a comprehensive approach to classifying product information evaluation criteria, contextual technical assistance, and cost/value planning information and processes.

A recent ISO research paper identified three distinct approaches to classifying construction information:

- classify by function (performance criteria and expectation statements)
- classify by object (system, assembly, part, component, product, material, or ingredient)
- classify by location (on project property, within a facility, part of a superstructure)

Each of these approaches do not necessarily share the same philosophy, though they can be related to each other by certain common word linkages. Development and decomposition of each approach suggests unique scenarios for developing usable classification tables. To achieve this approach, we would require a common word (subject or object) list from which to derive differing approaches.

In a very simplistic way, perhaps an approach to classifying subjects and to organizing and developing the content of usable *work sections* might suggest:

- by function - suggests a good basis for a "project prospectus" (with little if any regard to a technical solution - or an object's material composition)
- by object - suggests a good basis for an "outline" or short-form text:
 - by object - in a broad context (example: system or assembly) for an outline specification
 - by object - in a narrower context (example: components and products) for short-form and long-form specifications

A variable here is that industry practitioners may still wish to specify and construct a complete and functioning component or system as an operating assembly with distinct functional criteria.

- by location - will be indigenous in each of the above approaches but only in descriptive or explanatory statements within a specification document's text.

An Example of This Approach

The following simple example (using concrete) illustrates how each of the three approaches stand alone as well as relate to each other:

- the left column addresses an element (without a design solution)
- the second column addresses a variety of elements (with a partial or conceptual design solution)
- the third and fourth columns address the actual materials, resources, and activity of constructing the complete element with details and contractual requirements

Project Prospectus	Outline Form Specification	Short-Form Specification	Longer-form Specification
Substructure Superstructure Enclosure criteria	Foundation (concrete) Frame (structural steel) Principal products	Cast-in-place concrete Concrete slabs-on-grade Precast concrete Concrete repair	Concrete Materials and Methods Concrete Forms and Accessories Concrete Reinforcement Cast-in-place Concrete Cementitious Decks Precast Concrete Concrete Finishing Grouting Concrete Restoration Concrete Cleaning

- In the left column, several *elements* are expressed as a design concern - constructing a substructure and superstructure.
- In the second column, concrete is addressed as a product (a *designed element*) in somewhat more detail but still expressed in its differing forms.
- In the third column, concrete is addressed within a category of concrete products expressed in some detail and in several differing methods of creation (site-cast and precast).
- In the fourth column, concrete is addressed as a variety of concrete products expressed in even more detail and in differing forms (site-cast, precast, and post-tensioned).

This simple example identifies that harmony and flow is necessary between project information documents, each created for each successive stage in a facility's design development.

Wayne Watson, RSW, FCSC, CCS, FCSI, Vice-President of Digicon Information Inc., a construction software development and construction information marketing firm.

Digicon Information Inc.

Camrose
4514 - 47 Street
Camrose Alberta Canada T4V 1J1
Telephone: 403-672-8525
Toll-Free (Western Canada): 800-610-SPEC
Facsimile: 403-672-9882
E-mail: w2@digicon.ab.ca

Calgary
125 Covington Bay, N.E.
Calgary Alberta Canada T3K 4A9
Telephone: 1-403-226-3272
Facsimile: 1-403-226-3272
E-mail: david@digicon.ab.ca

Copyright 1977/1998 - All Rights Reserved: CmSPEC©, MiniSPEC™, OutlineSPEC©, MasterPP©, and MacroSUITE© are products of Digicon Information Inc., Camrose AB Canada. RenoSPEC© is a product of Renovation Systems Associates, Dallas TX USA.