

# Open Building: An Architectural Management Paradigm for Hospital Architecture

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## Abstract

This paper discusses a significant and innovative medical facility in Bern, Switzerland. The 50,000 square meter project – the INO - was managed by the Canton Bern Building Department under the leadership of Giorgio Macchi, Chief Architect. The client and the management team recognized - when the decision was made to build a major addition - that complex buildings such as this only become "whole" over time. They had come to realize, after many conventionally procured buildings, that inevitably the program of functions changes to meet new medical procedures, new regulations, and new market and insurance conditions. Recognizing these dynamics led to a decision to adopt an entirely new process for procuring the facility, and with it a concept of distributed design management. A competition was held to select a design and construction firm for each of three distinct "levels". The primary level is intended to last 100 years and is expected to provide capacity for a changing mix of functions. The secondary level is intended to be useful for 20+ years, and the tertiary level for 5-10 years.

The approach taken in this project deals in a new way with problems of facilities change, and the concomitant management of distributed design and construction responsibilities. As such, it represents a good example of "open building" theory and practice, an approach to facilities design and construction that is conventional in the office and shopping center markets and increasingly in multi-family residential construction worldwide. The INO project is the first known project to apply these principles of architectural management in health care architecture. It therefore sets a new standard for adaptable medical facilities, offering an alternative paradigm to meeting critical needs in the field of health care architecture. The results of this innovation are being carefully studied with the objective of drawing lessons for US practice.

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## Background

In the past three decades (Prins et al 1993; Brand 1994; Templemans Plat 1995; Kendall October 1999, Venturi and Scott Brown, 2004), facility managers and clients of commercial and office buildings in many countries have come to understand that dynamic societies require agile architecture. Two alternatives face clients with dynamic requirements:

1. Scrap and build practices – design and construction according to presumably “fixed” programmatic requirements, resulting in facilities requiring expensive renovation when uses change and entangled systems must be upgraded, or premature demolition when economical upgrading is impossible.
2. Stock maintenance practices – design and construction according to analysis of both current requirements and provision for unknown future uses and technical upgrading. This is called “open building” among some practitioners internationally.

There is new evidence that “stock maintenance” practices are being applied with increasing frequency to the medical facilities. A sharp departure from conventional functionalist thinking and architectural management practices is increasingly recognized as a prerequisite to deliver sustainable built facilities of the scale, quality and capacity called for in the medical campus of tomorrow. Designers, facility managers and medical facility administrators are slowly adopting new ways of working. The evidence of this is ubiquitous, but not easy to name or recognize from the perspective of the management thinking in which we have been trained to operate.

This paper reports on a project that may be among the first in the world to apply “open building” management principles to the design of a large medical complex. But before introducing the project, it is useful to review a number of principles and problems facing health care architecture.

## Basic Principles of the Behavior of Complex Environments

The “open building” strategy for architectural management, discussed in this paper, has its roots in the way ordinary built environments behave. An example helps to illustrate the point.

Most cities have developed, spread out, declined, renewed in parts, refocused their sense of place and have become multi-nucleated. In all of this, the city is an example of a fine-grained “living fabric”. Not surprisingly, no one party – private or public - controls the whole. Only a few owners – universities, medical centers, large corporate organizations, and governmental units being the most prominent – are large-scale, but even in these cases, control is hierarchically structured within them.

Most cities and towns are representative of hierarchical organization. The city owns and maintains the streets and the city utilities, and mandates and enforces building regulations and zoning ordinances. Individual families and companies own individual lots on which they construct buildings. Some of the buildings are occupied by tenants who independently fit-out their own spaces to meet their preferences. There are systemic principles at work, even if they are not appreciated or are largely invisible at any given time.

This living fabric regenerates itself naturally and regularly, if unevenly. There is a certain order to the process. Parts can be replaced without excessively disturbing other parts. That is, buildings can be demolished and replaced by others without disturbing adjacent buildings or the street network. This is possible because all parties involved follow accepted conventions or rules, in which it is in everyone’s interest to expand their own territory as far as possible, express their own values and use personal resources conservatively in doing so, while avoiding conflict. In a healthy living fabric there are no winners or losers, but rather a dynamic balance in time.

There is a definite hierarchy at work that helps us manage change. The larger framework of streets sets the context for the properties on which individual buildings are constructed. We have experiences that show us that if the street network adjusts, the buildings situated in the spaces between the streets are affected. But the buildings can adjust without impacting the street network.

### **Lessons for Hospital Facilities Clients**

This hierarchical structuring helps us to manage complexity. It also allows distribution of responsibility with minimal fuss and conflict. Some of the buildings we appreciate most – those most suited to agile regeneration - were, not surprisingly, organized in congruence with this hierarchical structuring. Constructed in the 19<sup>th</sup> century in the pre-functionalist or pre-Modernist period (Brand 1994, Venturi 2004), these are among the buildings that are being saved and renewed today and used as models for new work.

The reason they are being adapted is not first of all because of their style, although now we seem to want to preserve these historic buildings because the public, clients – and many professionals – doubt the current profession's capability to deliver better buildings. Built by one party and one architect one hundred years ago, they are now being adapted by other architects for new uses.

These buildings are models of the kind of buildings hospital administrators are increasingly expecting from their architects and engineering consultants. Not only do they fit into a coherent urban pattern, they are simple to build and offer spaces of remarkable quality, as well as spatial and technical capacity. Most important, they are not tightly integrated with programs of use – they are not defined “functionally”. They are “open” buildings, sustainable in the large sense because they can accommodate change.

### **The Insel Hospital and the INO Addition**

Figure 1: Part of the Insel University Hospital Campus in Bern



One such departure from the norm was the decision to construct a large 50,000 sq meter medical facility on the Insel teaching hospital campus in Bern, Switzerland, part of which can be seen in Figure 1. As with all medical facilities, this project was planned under tight budgetary, regulatory and environmental constraints. The story of this project is worth recounting since it represents the decision of a large client and its facility planners to alter the management methods it had been using for decades, in order to obtain a new facility to meet the future with more assurance. (Building Futures Institute 2002).

The Insel Hospital is a hospital for intensive care, emergency and surgery. For several years, the facilities planning group of the Canton Bern building department, responsible for this major primary health care facility, tried to fix a program of uses so that a design team could produce construction documents for a major addition, called the INO. Each year, a series of events occurred that prevented them from fixing the program: new medical procedures were introduced, a new head of surgery was hired with new staffing,

space and equipment requirements, a change in the market for services occurred, new regulations were introduced, the pediatric facility was scheduled to be expanded, and so on.

As a result of these continual changes, the facilities group found it impossible to get the addition they needed. To solve the problem, they decided to adopt an entirely new planning and management process, recommended by Mr. Urs Hettich, then architect and Director of the Canton Bern Building Department. The client's demand for long-term utility value in the addition to their facility defined the most important aspect of the new design and decision process: the ability to assure optimized adaptability in the face of changes in technical, social or political circumstances.

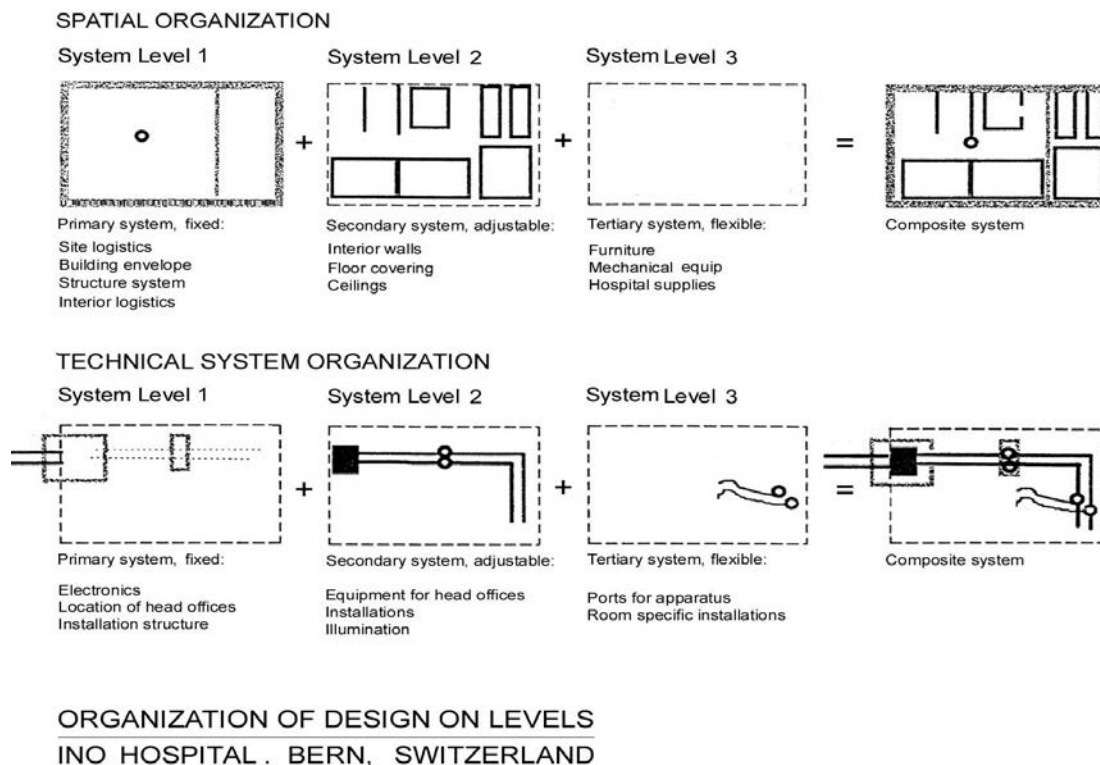
The traditional idea of delivering health care facilities up to now has been that it is easier and more economical to optimize a construction project by comprehending the "whole" with all its interdependencies. But in very complex buildings like hospitals, the hospital administration had learned that it is never possible to do so - that such facilities are too dynamic and can not be planned and built as if they are somehow "programmatically static". Rather, the "whole" will come into existence over time, in an incremental way. This means that large and complex buildings are never finished. In recognition of these realities, the project was split into three systems organized and conceived according to their expected life spans:

**Primary system (nearly 100 years)**

**Secondary system and (nearly 20 years)**

**Tertiary system (nearly 5 -10 years)**

The following diagram (Figure 2) explains the basic approach to managing this complexity.



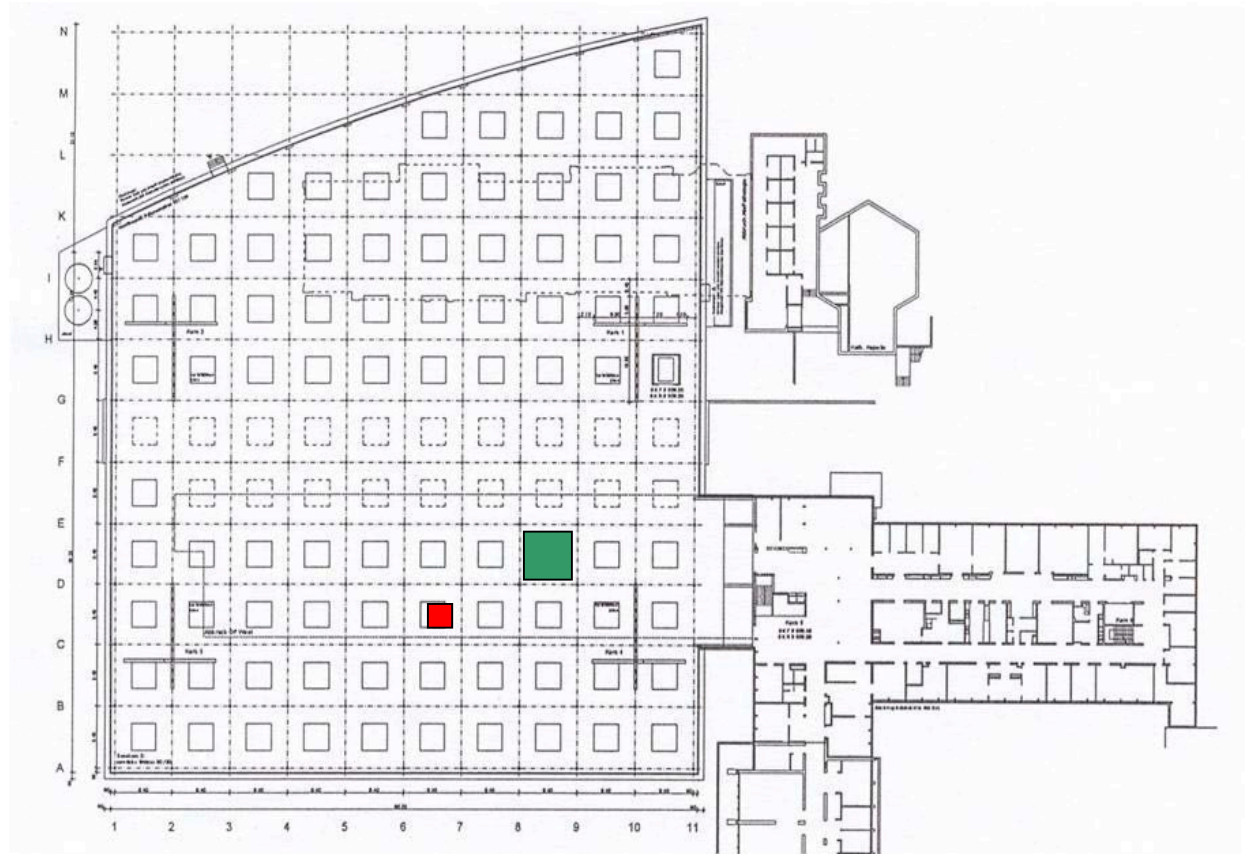
The primary system (see below) determines the structure of the hospital and gives conditions for the development of the following systems. The interfaces are exactly defined, but the independence of lower level (secondary and tertiary) systems is as large as possible, in both technical and management terms.

## The Jury Process

### Primary System

After an international publication and call for entries in 1997, ten architecture teams were selected for the competition of the primary system. One of the criteria for this invitation was that the design team had never designed a major hospital project. The presentation requirements for the primary system were very open for the competitors except for the gross building area. A declaration of cost/capacity calculations and ecology/energy analysis were required. But layout scenarios were not required for the primary system. In addition, the competitors did not receive space-planning templates. Some projects proposed for the primary system were totally empty; some showed spatial arrangements of departments and spaces. It was up to the competitors to show the quality of their “open building”. According to the project manager, it was not a problem for the jury to abstract and to compare. The Canton Bern building department used layout scenarios of the expected surgery theatres in the jury examination process.

Figure 3: Plan of a typical floor of the Primary System, showing 8.4m x 8.4m structural grid. The primary System architect was Peter Kamm and Kundig, Architects. This firm had designed one of the pioneering residential open building projects in Zug, Switzerland in 1973.



Fixed mechanical systems risers are placed in each quadrant. Fixed vertical circulation points are also located as part of the primary system. One of the planning innovations of the primary system shown in Figure 2 is the placement of 3.6m square “punch-through” opportunities (red square) in each structural bay (green square). Each of these (red) squares is a portion of the 20cm thick concrete slab without reinforcing. This offers the possibility of vertical penetrations at any location in the floor plate for vertical circulation, mechanical systems, or light shafts (see Figure 3)



Figure 4: Building Section showing one possible distribution of vertical light shafts

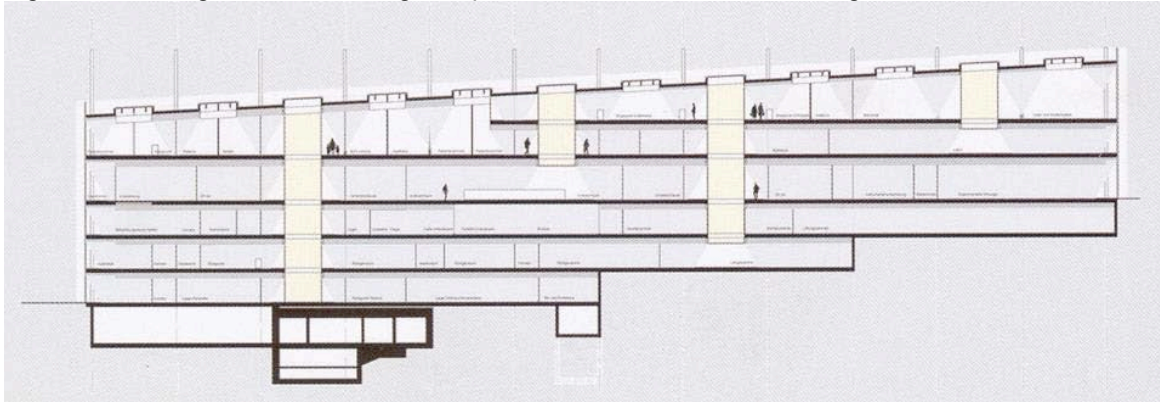


Figure 5: Phase One of Primary System



Figure 6: West façade showing double skin



Figure 7: Interior view of the top floor of the empty Primary System, showing skylights, openings for light-wells to the floor below (on right of picture) and pre-cast columns with four sleeves at the base of each column for possible vertical drainage piping. Also visible is the inner layer of the double skin envelope showing operable wooden windows.



## Secondary System

For the secondary system the project managers demanded solutions for distribution of mechanical services and layout scenarios as well, showing typical patient paths. The competitors for the secondary system were required to be experts in hospital design. They each received a documentation of the primary system and the layout templates of the existing hospital. Submissions were required of firms submitting proposals for the secondary system to demonstrate - with drawings - how, for example, its proposed fit-out system could be deployed according to a range of programmatic scenarios within the given base building (already under construction).

Figure 8: One floor plan of the Secondary System, designed by Itten and Brechtbuehl, the winning team

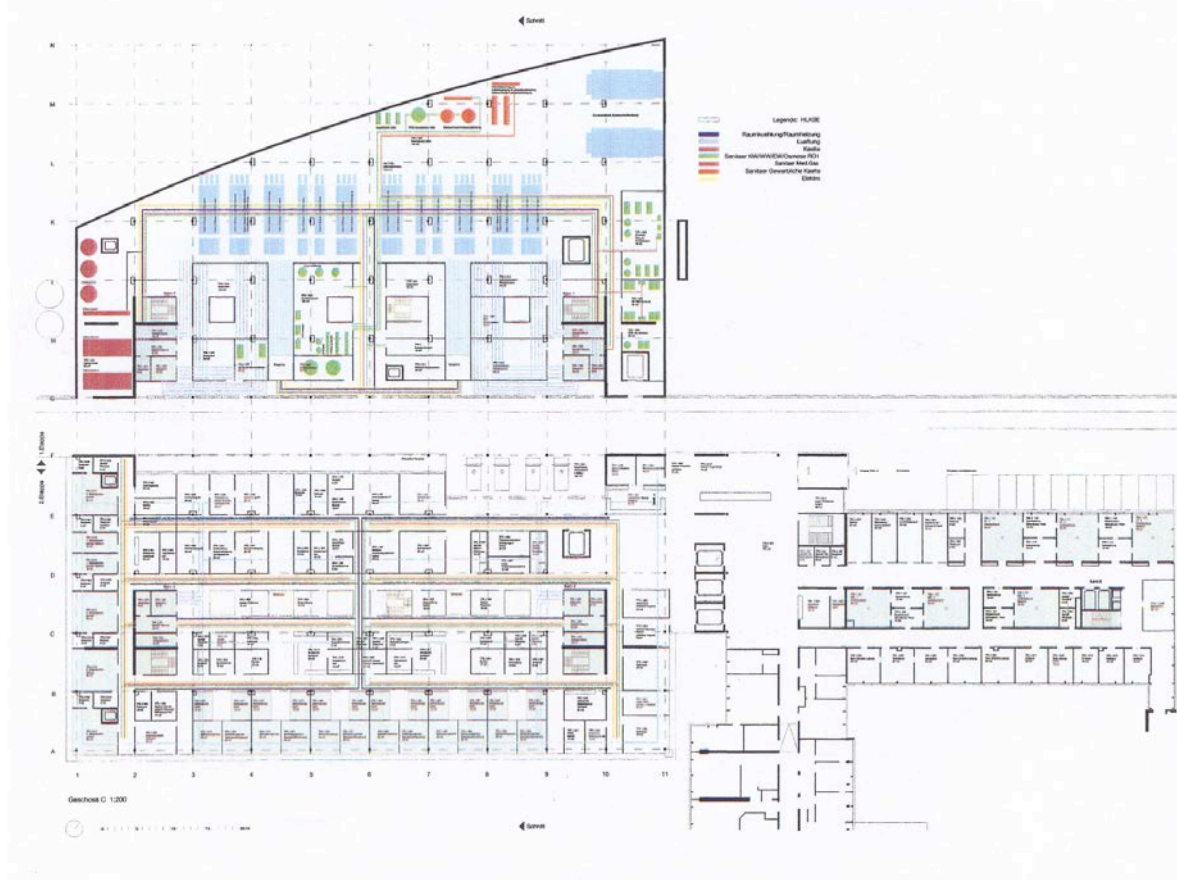
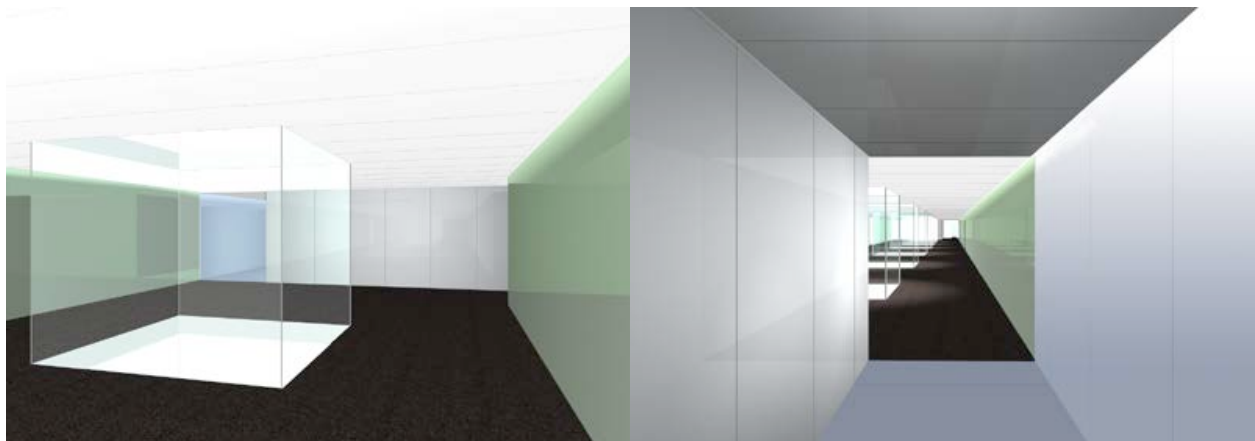


Figure 9: Interior perspectives of light-well lit corridors, part of the Secondary System design





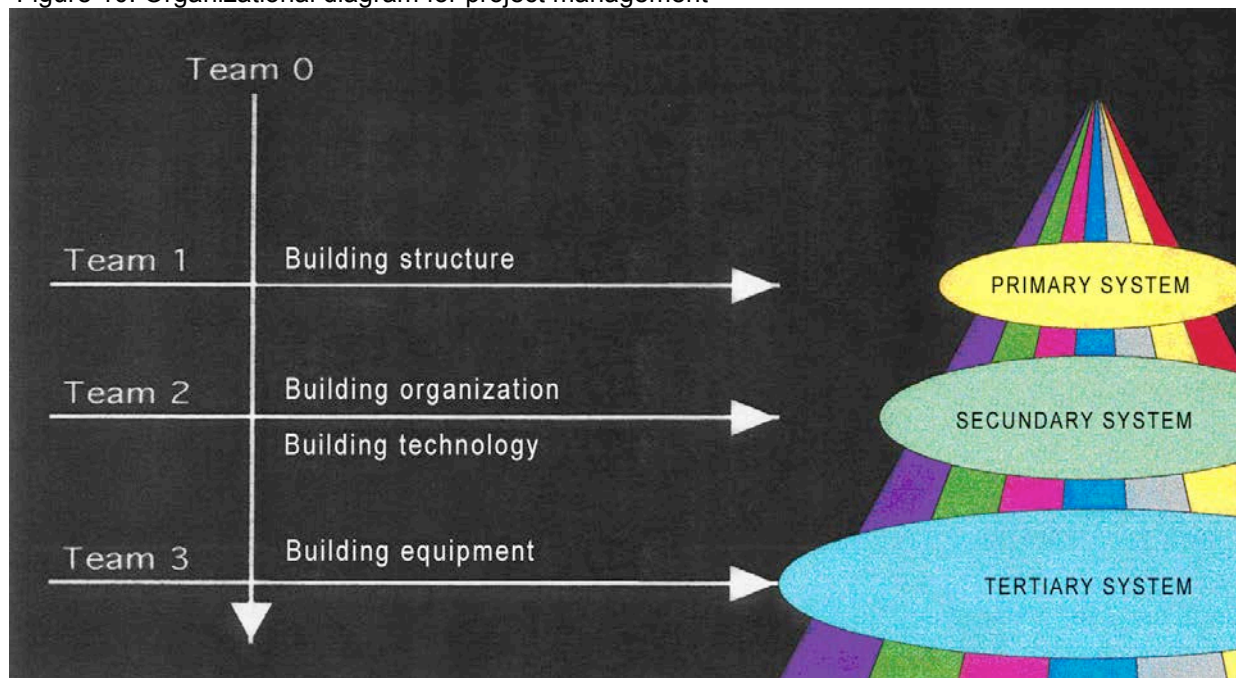
In both jury processes, competing proposals were expected to demonstrate a number of attributes: technical performance (building engineering, cost, ecology), serviceability (building structure/flexibility, function, construction timing, ecology) and architectural (formal properties).

This distributed management process – a radical departure from conventional procurement in hospitals but not in office buildings and shopping centers – was adopted to assure that the building would avoid the rigidity so often resulting from conventional procurement methods.

### The Organization of the Process

The INO project is divided into three major system levels that consist of distinct and separate (but nevertheless coordinated) “management levels”.

Figure 10: Organizational diagram for project management



Team 0 is the organizing team of project managers in the Canton Bern Building Department. Their work involves coordination of both the design and construction activities. The other teams each have their respective level of decision-making. As this report was being prepared, the installation of the secondary system was underway, with completion expected in early 2006.

### Principles of Work Restructuring and Distributed Management

The idea of dividing a large project into these packages differs from conventional project delivery methods used for medical facilities and presents challenges, not all of which were for-seen. It is worth noting that large shopping centers and office buildings are routinely managed in this way, but for some reason the principle has only now migrated into health care architecture in an explicit, structured way.

An open building strategy organizes the project in terms of the anticipated duration of value of a cluster of subsystems. It does so to avoid waste, to optimize boundary conditions, to prepare the facility for long-term manageability in concert with anticipated changes, and to reduce costs of future adaptation.



These are also the principles advocated by lean construction (Lean Construction Institute), a production management based approach to project delivery representing a new way to design and build capital facilities. Lean production management has caused a revolution in manufacturing design, supply and assembly. Applied to construction, Lean changes the way work is done throughout the delivery process. Lean links the objectives of the production system—maximize value and minimize waste—to specific techniques and applies them in a new project delivery process. Lean Construction is particularly useful on complex, uncertain and quick projects. It challenges the belief that there must always be a trade-off between time, cost, and quality.

### **Open-ended Medical Architecture**

This particular example of distributed design management is one way of organizing an “OPEN BUILDING STRATEGY” for the design, construction and long-term management of medical facilities. It is not necessary for different designers to be assigned to each level. But the “partitioning” of design management in this way is a strategy particularly well suited to an institutional client whose interests are long term, scrutinized by the public by means of state legislative action, and also must recognize competition from other similar institutions’ quality of life and environment aspirations. Inevitably, firms other than the original design teams are called upon to renovate medical facilities. In principle, then, this management strategy is not fundamentally different from the way large and complex medical facilities behave “in fact”.

The reason to formulate and adopt this strategy is that it is aligned with the principle of variable life-cycle value of certain “clusters” of building elements and decisions. This is an accounting principle that corresponds to the behavior of large complex facilities. That is, change and adjustment takes place on “levels” that cut across strictly technical systems and trade boundaries. For example, when a new illumination design is specified, it uses existing cable infrastructure “up to a point”. When new partitioning is specified with an adjustment of offices, the design will seek to limit the perturbations of this change on contingent building parts, to save cost and disruption – i.e. the floor and ceilings will likely remain undisturbed, while some of the electrical cabling buried in the partitions will be changed but only “up to a point”. Accumulated knowledge about medical facility behavior under conditions of change should begin to teach us lessons about the boundaries of such “levels”. They are likely to be cross-cutting, involving multiple trades and supply channels and therefore calling for new logistics and working methods.

### **Conclusions**

As John Habraken (1998), Stewart Brand (1994) and others help us to see, the built environment is not static. Transformation is pervasive, operating at various time scales and at various “levels”. We would be surprised if things were otherwise, and not only that, we would be out of work. It is, after all, the work of architects and other designers to help manage what should be built. But to a large extent our working methods are not yet congruent with this reality. We are only slowly recognizing transformation and stability as twin realities. Our teaching, our design and construction practices and our analytical and accounting tools are not yet sufficiently organized in recognition of this. Product manufacturing is much more advanced. Lean construction recognizes this reality, as does some pioneering engineering research.

The commitment of the Canton Bern Building Department and the INO Hospital to the open building implementation is exemplary and should be applauded. At the time of this paper’s preparation, the Canton Bern Building Department Administration is developing guidelines for the procurement of all future projects based on the lessons learned in the INO project. The guidelines explicitly define “levels” and “interface rules” and performance based on distributed design management in the service of flexible architecture. Monitoring of the project is continuing and further reports will be made available in 2006.

## Acknowledgements

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(A symposium was held in Bern, sponsored by the Canton Bern Office of Properties and Buildings and hosted by Chief Architect Giorgio Macchi. The result was a booklet with contributions from an international panel of experts)

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