

Managing Change: the application of Open Building in the INO Bern Hospital

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Abstract

This paper discusses a significant and innovative architectural management method, used for the first time in a medical facility under construction in Bern, Switzerland. The 50,000 square meter project – the INO - is being managed by the Canton Bern Building Department. 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 discussed in this paper 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.

Background

For at least 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 learned that dynamic societies require agile architecture. Two alternatives face clients with dynamic requirements:

1. Scrap and build – 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 – 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 medical facilities. A sharp departure from conventional functionalist thinking and architectural management practices, open building 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. That is, built environments are under constant change, and responsibility for these trans-

formations is widely distributed. No one makes all decisions, at all environmental levels, over any extended period of time. There is a definite hierarchy at work that inherently organizes this transformation process. For example, the framework of streets sets the context for the properties on which individual buildings are constructed. Individual buildings – such as office buildings or shopping centers – are built and then filled-in, with an almost constant “churn” of the so-called “tenant fit-out”, designed by architects other than the designer of the building. 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. The same unsymmetrical relation exists between the building and its fit-out.

Lessons for Hospital Facilities Clients

This hierarchical structuring of the ordinary built environment makes complexity manageable. 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 19th 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. Built by one party and one architect one hundred years ago, they are now being adapted by other architects for new uses.

The reason they are being successfully 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. 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



Figure 1 *The Insel University Hospital Campus in Bern, showing Phase One of the INO in the foreground*

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

Many clients and their design teams are exploring new approaches to the problems of change in medical facilities. One such departure from the norm was a radically new way 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

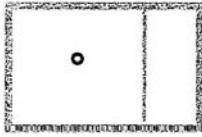
been using for decades, in order to obtain a new facility to meet the future with more assurance. (Building Futures Institute 2002).

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

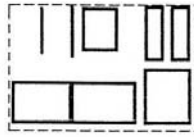
SPATIAL ORGANIZATION

System Level 1



Primary system, fixed:
Site logistics
Building envelope
Structure system
Interior logistics

System Level 2



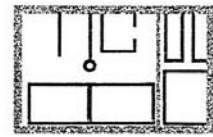
Secondary system, adjustable:
Interior walls
Floor covering
Ceilings

System Level 3



Tertiary system, flexible:
Furniture
Mechanical equip
Hospital supplies

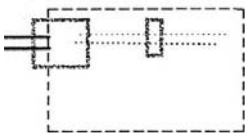
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Composite system

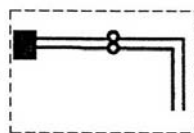
TECHNICAL SYSTEM ORGANIZATION

System Level 1



Primary system, fixed:
Electronics
Location of head offices
Installation structure

System Level 2



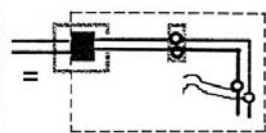
Secondary system, adjustable:
Equipment for head offices
Installations
Illumination

System Level 3



Tertiary system, flexible:
Ports for apparatus
Room specific installations

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Composite system

ORGANIZATION OF DESIGN ON LEVELS
INO HOSPITAL . BERN, SWITZERLAND

Figure 2 illustrates the basic approach to managing this complexity

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 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 and political circumstances.

The traditional idea of delivering health care facilities up to now had been that it was easier and more economical to optimize a construction project by comprehending the "whole" with all its inter-dependencies. 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 determines the structure of the hospital and gives conditions for the development of the following systems. The interfaces

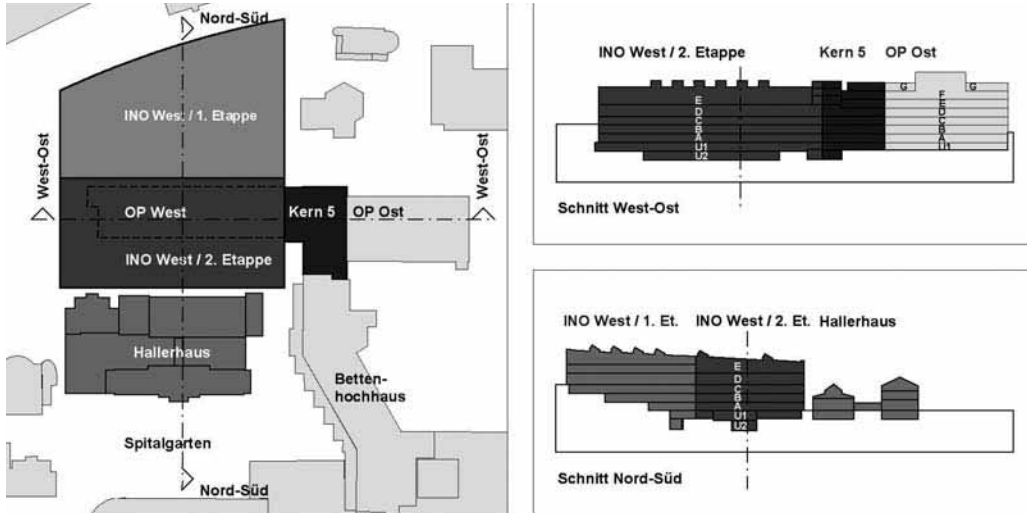


Figure 3 Phasing of the INO. The “OP West” is the wing of the 1970’s building that would be demolished to make way for Phase Two of the INO. The “Hallerhaus” will be demolished upon completion of Phase Two to make space for a landscaped garden at the heart of the Insel campus.

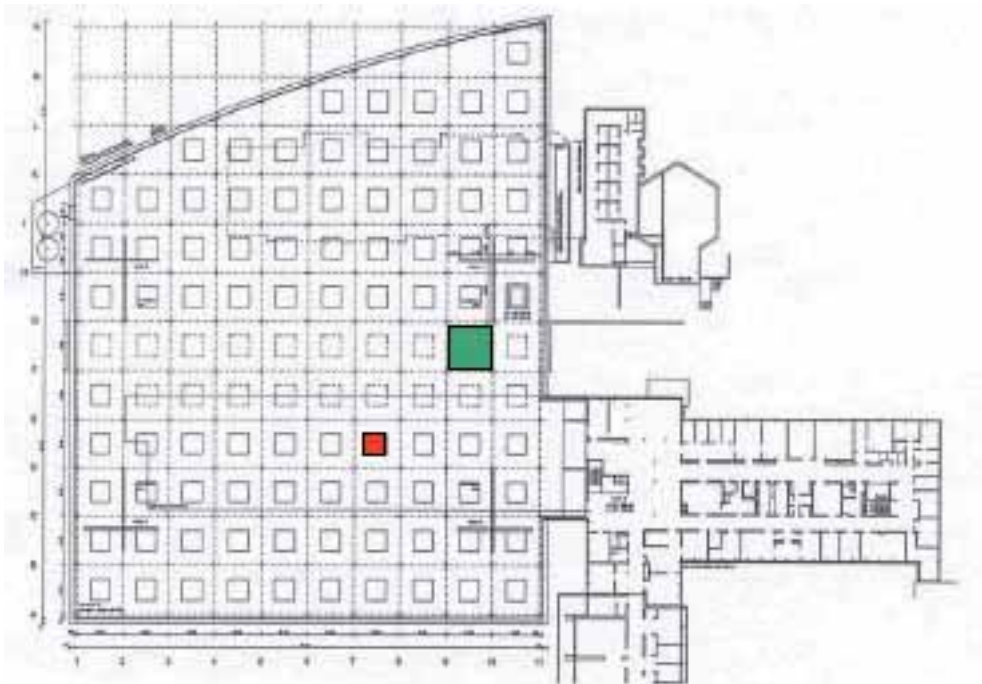


Figure 4 Plan of a typical floor of the primary system, showing an 8.4m x 8.4m structural grid. The primary-system architect was Peter Kamm and Kundig, Architects. This firm had designed one of the pioneering residential open-building projects in Zug, Switzerland, in 1973.

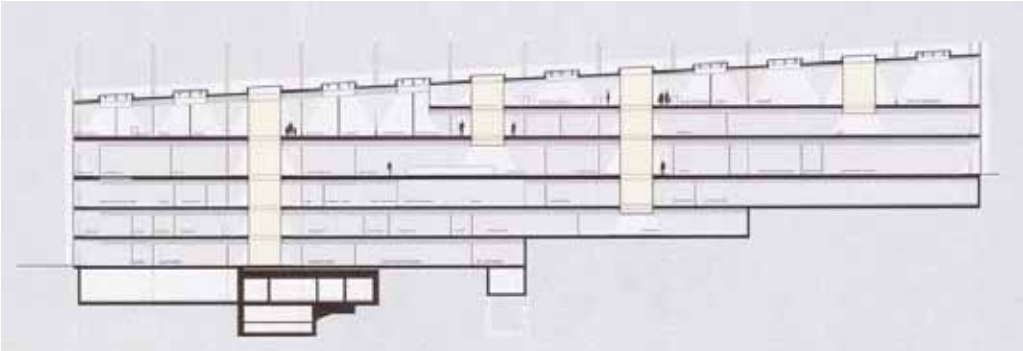


Figure 5 Building section showing one possible distribution of vertical light shafts The actual shafts now in place are different from those initially proposed in the secondary system because the functional layout changed twice before secondary system installation even began.



Figure 6 Roof of Phase One of Primary System - a “green” roof with skylights

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 to design 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.

The winning entry for the primary system was designed by Kamm and Kundig Architects, an architecture firm in Zug, Switzerland. This firm had designed one of the pioneering residential open building projects in Zug, Switzerland in 1973. What follows is a description of their scheme.

The INO – no matter which design was selected, was to be implemented in two phases.



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 precast 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.



Figure 8 West façade showing double skin with operable windows behind an outer layer of glazing.



Figure 9 One floor plan of the Secondary System, designed by Itten and Brechtbuehl, the winning team

After completion of the first Phase, the operating rooms and ancillary functions in an adjacent building would be moved into the new building and the old building demolished. This building was constructed in the 1970's and was already obsolete because it was incapable of being adapted.

The architectural scheme for the INO proposed by Kamm and Kundig is remarkable in its simplicity but is controversial in a number of respects. One aspect that raises most questions is the very large floor plate. Most hospital architects maintain that narrow floor plates are necessary to allow natural light and ventilation to all spaces, and also allow the most planning flexibility. For a number of reasons – having to do with the site organization, concepts of massing and also fresh insights about internal adaptability and access to natural light – this scheme has broken from these traditions.

Fixed mechanical systems risers are placed in each quadrant. Fixed vertical and horizontal circulation routes are also located as part of the primary system (see below). One of the planning innovations of the primary system shown in Figure 4 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 Figure5)

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. Sub-

missions 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).

The Primary System enabled the planners of the secondary system – and the client – to study a variety of layouts for the OR suite on one of the floors. During the planning period, this was vital as other functions of the new addition were also in flux. In both jury processes – for both the Primary and Secondary systems, 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).

The Organization of the Process

In addition to the distinction between autonomous systems levels based on the concept of expected durable value, the INO project is divided into three major system levels that consist of distinct and separate (but nevertheless coordinated) “management levels”. 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. In Figure 12, Team O is a firm providing the 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.



Figure 10 One alternative layout of the OR suites



Figure 11 One alternative layout of the OR suites

Principles of Work Restructuring and Distributed Management

The idea of dividing a large project into these autonomous levels differs from conventional project delivery methods used for medical facilities and presents challenges, not all of which were for-seen, concerning coordination between the separate firms responsible for each level. 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 institutional clients whose interests are long term, scrutinized by the public by means of state legislative action, and also must recognize competition from other similar institutions’. 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” (if not in the theories of “integrated whole buildings” now in currency).

The reason the Canton Bern decided to formulate and adopt this strategy is that it is aligned

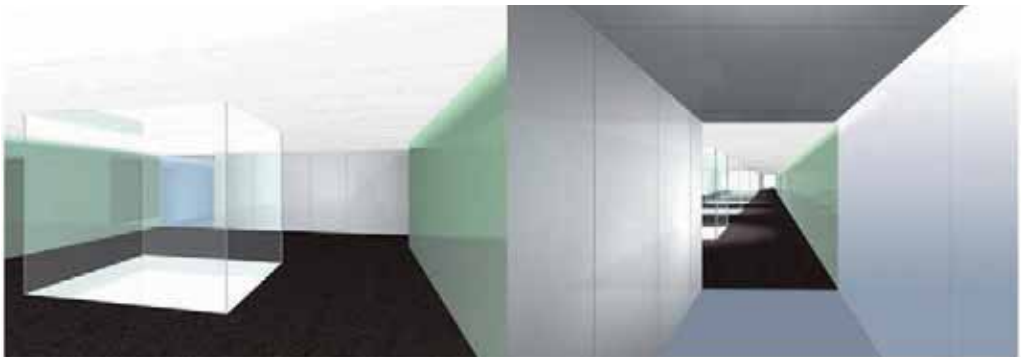


Figure 12 Interior perspectives of light-well lit corridors, part of the Secondary System design

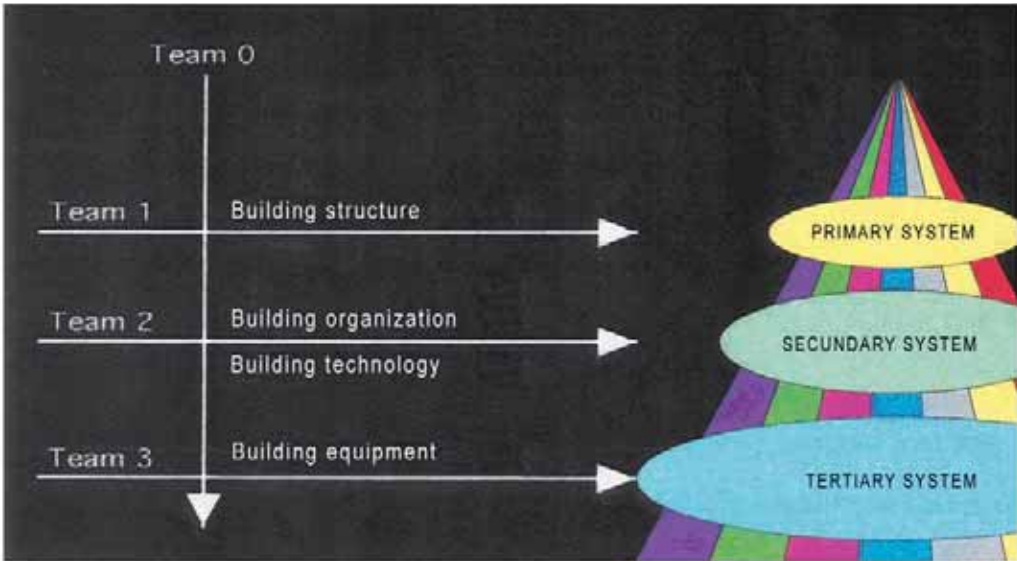


Figure 13 Organizational diagram for project management

with the principle of variable life-cycle value of certain “clusters” of building elements and decisions – called “levels” in the open building literature (www.open-building.org). This is a principle that corresponds in fact, 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”. Usually, the technical systems are under the control of different parties, in part because the work is distributed in time and also because no one party can or should be responsible for all work.

Accumulated knowledge about medical facil-

ity 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 coordination 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 open building implementation should be applauded and scrutinized. 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. This decision, according to interviews with the staff, flows from the efficacy already exhibited in the separation of the three levels. Their autonomy (the word used by the Director of the Building Department) must be maintained as a matter of principle. Changes made in the functional program since planning began seven years ago already demonstrate the effectiveness of the strategy.

In evaluating this project, it is important to distinguish several innovations. The first is the commitment to defining autonomous systems levels, based on cycles of change. The key word is autonomous. The second is the commitment to distribute design responsibility for each level to a different design team. These need not be connected. It is possible to implement the first without the second. Lessons learned from the INO may lead the Canton Bern Building Department to continued adoption of the first without the second, because difficulties in resolving coordination issues between separate firms was the cause of significant problems in the implementation of the INO process.

Finally, while the client of the INO selected the Kamm and Kundig scheme from a juried competition, the specific design of the primary system in the INO is not an inevitable consequence of designing on levels. The large floor plate is

not the only answer. If shortcomings are found in this scheme based on its implementation and use, they should be studied carefully, but should not stop others from using the concept of levels to manage change and complexity in entirely different designs.

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References

- Brand, Stewart 1994, How Buildings Learn: What Happens After They are Built. Viking, New York.*
- Building Futures Institute, 2002. Report on the INO Hospital. www.bsu.edu/bfi > Research Domains > Open Building Studies > Reports > INO report.*
- Habraken, N. John 1998, The Structure of the Ordinary: Form and Control in the Built Environment. MIT Press, Cambridge.*

Kendall, S & Teicher, J. 1999, *Residential Open Building*. Spon, London.

Kendall, Stephen October 1999, "Base Building and Fit-out; Principles for 21st Century Building Maintenance and Management". *RE:Building Maintenance and Management* (bimonthly Japanese Language journal), Tokyo.

Kendall, Stephen 2002, "Performance on Levels", In *Measurement and Management of Architectural Value in Performance-Based Building*. *Proceedings of the CIB W60/W96 Joint Conference on Performance Concept in Building and Architectural Mangement*. Hong Kong, CIB Publication 283 (pp 35-42)

Lean Construction Institute. <http://www.lean-construction.org/>

Prins, M, Bax, T, Carp, J & Templemans Plat H 1993, "A Design Decision Support System for Building Flexibility and Costs". *Design*

and Decision Support Systems in Architecture. Kluwer Academic Publishers, the Netherlands. Pages 147-163.

Templemanns Plat, Herman 1995, "Annual Cost and Property Value Calculation Based on Component Level". *Financial Management of Property and Construction*. Pages 15-17. Newcastle North Ireland.

- Templemanns Plat, Herman 1990, "Towards a Flexible Stock of Buildings: The problem of cost calculations for buildings in the long run". *Proceedings, CIB World Congress, New Zealand*.

- Venturi, R & Scott Brown, D 2004, *Architecture as Sign and Systems for a Mannerist Time*. Harvard University Press, Cambridge, MA.