# INTEGRATED DESIGN SOLUTIONS:
# WHAT DOES THIS MEAN FROM AN OPEN BUILDING PERSPECTIVE?

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**Abstract**

*IDS (Integrated Design Solutions) is a phrase in currency internationally in the design and construction sector. It has many meanings, including: "IDS are improved collaboration, coordination, communication, decision support, and other work processes enabled by increased horizontal, vertical, and temporal integration of data and information management to enhance the value added in whole network of shareholders throughout the building lifecycle." (1) This paper suggests that the concept of IDS makes little sense unless it is defined in terms of patterns of control. Connecting "integrated design solutions" to "Levels of intervention and control" is congruent with the principles of Open Building. Open Building theory suggests that while the built field can be understood and described in many ways, a most effective way is to use the concept of levels of intervention and control. "Integrating" information (unifying or centralizing) across levels of intervention is often impossible, especially over time. It is therefore useful to study how real estate investments are actually delivered and managed over their life. Value is added by organizing information, collaboration, coordination and work processes in respect to this reality. This leads to studies of "integration" of design, construction, logistics, supply channel management, etc on and across levels of intervention and control.*

**Key Words**: Integrated Design Solutions, Levels of Intervention and Control, Open Building

## INTRODUCTION

### Using Words

Words have their ambiguity, making them useful in everyday conversation because they convey shades and nuances of meaning that, in the context of gestures, tone of voice and social context, make communication possible. But when we need more formal descriptions, these nuances and gestures are not at our disposal. In making formal descriptions, we must be more precise and unambiguous, and are faced with the choice of coining new words or narrowing the meaning of already known words. [2]

Either has it difficulties. The choice here is to discuss the word "integration" in the context of the idea of "integrated design solutions". The ambiguity of these words is well known. I will argue that this very ambiguity – and the resultant confusion - has been a major barrier to better methods and better research in the building sector. The word integration is used indiscriminately in the building industry literature, as I will show.

We have an epistemological problem, in that the complexity of the processes by which parts are aggregated in various stages into elements, components, parts, products, buildings and so on remains ill-described. The paucity of good terms to amplify and clarify these manifestations should tell us that the world of our concern – the ecology of people making things - has escaped adequate intellectual inquiry, at least in the English language.

**Describing the building industry**

The building industry in every country is highly disaggregated. It is inextricably caught up in local politics, real estate, labor markets and local geo-technical and climatic conditions, while also being part of the global economy of finance and products and services. This "ecology" of production is difficult to map and explain. [3] In part this is because data about the behavior of this industry at other than a gross aggregate level is difficult and expensive to obtain, and the data that is available is fraught with conflicting jurisdictions, collection and analysis methods, and problems of industrial secrecy.

I use the term "disaggregated" to describe the "shape" of this industry - instead of fragmented - for a reason. Disaggregated literally means "separated into component parts" (from Webster's). The sense in which I mean this is that the building industry – its many agents and products, rules and processes – operates in ways fundamentally different from other "top-down" sectors in the market, without an overall single "steering" mechanism other than the "economy" or the "building culture". [4]

Starting in the 1960's if not before, the research literature has used the word "fragmented" to describe the building industry, referring to what is widely thought to be its disorganization. [5] [6] [7] Fragmented, having a pejorative ring to it, makes sense as a descriptor when the reference is to "integrated" industries such as the automotive or aerospace industries, in which very few players dominate and in which supply constellations are organized in alignment with their relatively consolidated and top-down structure.

But unlike these industries, the building industry is characterized by the very large number of parties who initiate, conduct and regulate building activities, the equally large number of parties who supply parts and services to these initiatives and the variety of outputs matching the variety of those in control. And, unlike the aerospace industry, for example, a very large number of the players in building processes are laypeople operating in the "informal" sector, as witnessed by the magnitude of sales at home project centers such as Home Depot and Lowes, and their equivalents in other countries and the huge informal sector in less-developed countries.

In this context, when conventional wisdom is that the building industry should behave in a way similar to the automotive or aerospace industries, it is little wonder that "integrated" will be in currency. But those industries are not suitable references, and therefore such concepts as "integrated" need to be used carefully when brought to bear to explain building industry dynamics and to explain or characterize the building industry or innovative practices in it.

**INTEGRATION**

Children in Waldorf schools around the world learn at an early age to experience the merging of two primary colors into a third one. They use the wet paper method. Each child is given a sheet of wet watercolor paper, a brush and two primary colors. The children are invited to apply one

color directly to the wet paper, then the other color. Right in front of the child's eyes, the two colors merge and form a third color. On the paper emerges the reality of three colors: the two original primary colors and the result of their merging. This may be one of the child's first ways to grasp the idea of two things loosing their identity to a third reality. This seems to be the central idea of integration. [8]

In the Oxford Dictionary, "integration" has several meanings, but the most common one is the idea that many things become "intermixed", to have "equal participation" or to "be combined to form a whole" [9]. The word has taken on special significance in discussions of racial relations. Its use suggests the possible loss of identity of the parts to the whole. In a very practical sense, this is not particularly useful either in designing, constructing or later managing, adapting, extending and repairing buildings.

Ortega writes, "The need to create sound syntheses and systemization of knowledge…will call out a kind of scientific genius which hitherto has existed only as an aberration: the genius for integration. Of necessity this means specialization, as all creative effort does, but this time the [person] will be specializing in the construction of the whole." [10]

This call from one of the 20th centuries major philosophers may capture best the drive for that illusive organic wholeness that so many also in our field – the field of the built environment – continue to express. It is the wellspring and the root of the idea of integration. This search for "integration" has been widespread, especially in but not limited to the University. [11]

One of the more recent of such searches is found in Christopher Alexander's magnum opus, titled The Nature of Order. [12] "This four-volume work is the culmination of theoretical studies begun three decades ago and published in a series of books -- including The Timeless Way of Building and A Pattern Language -- in which Christopher Alexander has advanced a new theory of architecture and matter. He has tried to grasp the fundamental truths of traditional ways of building and to understand especially what gives life and beauty and true functionality to buildings and towns, in a context which sheds light on the character of order in all phenomena."

The span of time of Alexander's work (C.A.1968-2008) corresponds closely to the heightened interest, found in the academic and government sponsored building industry literature, in the concepts of "industrialized construction" "prefabrication" [13] and "integration". While Alexander would almost certainly reject many of the fundamental assumptions of those advocating "industrialized construction", there is arguably something shared nonetheless – a sense of having lost the organic unity thought to have once served as the well-spring for action in the pre-industrial era. This is certainly a powerful idea, but it is also romantic wishful thinking for today. I'd like to try to explain why.

**Design Integration**

What can this phrase mean? What are its origins? In what context is this term found? These are questions worth exploring, because the phrase is so much in currency, and has been for so long. We might begin by unbundling the phrase "design integration". First, what does designing mean?

If by designing we generally mean what we do when we make a proposal for what should be built, by someone else, for someone else to use, we probably also have in mind some ideas

regarding the roles involved in these tasks – the roles of initiative, task partitioning, coordination of specialists, and so on.

Fundamentally, we distinguish the act of designing from the act of making what is proposed. Of course, once the distinction is made, designing and making can be undertaken by one party, or by several parties. This is not new. Specialization brought us this distinction very early, always ruled by convention and tacit knowledge as well as specialized skills and tools. I have participated in both, having practiced as an architect making drawings to instruct a builder what to do, and I have also built by my own hands what I – and others- have designed.

If that is at least a point of departure for "designing", what is integration when the word is attached to designing? In architectural and engineering discourse, we see the use of the phrase "design integration" or "integration of design and production". Experts in the building industry around the world have worked diligently for more than 50 years to put the concept of "design integration" into practice. Now, IDS (Integrated Design Solutions) is the term in currency on the international level (1)

Here is a case in point that demonstrates how the word has reached a state of such ambiguity as to render it virtually useless. At a recent international conference on Design Management (CIB W96) in Copenhagen, a session was organized called Design Integration. [14] I was asked to chair of that session, which allowed me to read all of the papers. This reading revealed the following words or phrases associated with design integration among the fifteen papers:

• Concurrent engineering
• Multidisciplinary teams
• Introducing knowledge early
• Thinking in levels of abstraction
• Optimizing
• Collaborative participation
• Inclusion
• Sharing of knowledge and learning,
• Sharing of visions
• Group processes
• Interoperability
• The idea that problems can be subdivided into overlapping, interconnected segments that correspond to existing or emerging disciplines but are connected in a coherent and comprehensive manner
• Lean construction
• Supply chain integration
• Value engineering

These were the actual terms associated with "design integration". What are we to understand from this? Does design integration mean joining designers together somehow? If so, exactly how is this to be done? Is the joining done at the hip, or by brain links? Do we find partnerships, contracts, virtual networks, or the law as the operational devices of design integration? Does design integration mean a hierarchical relationship between parties, or a relationship of equals, or neither? Is a certain kind of physical mating of parts involved? How would we recognize "integration" when we see it?

## EFFECTIVE TERMS OF REFERENCE FOR SITUATIONS OF COMPLEXITY

As mentioned earlier, I have suggested use of the term “disaggregated” instead of “fragmented” when describing the realm of agents involved in designing and building. This means that a number of independent parties are working on a project - consultants from all kinds of design disciplines, even geographically distributed. There is really no question that projects of any size today need many disciplines and thus many parties to get the work done.

We would find it very strange and unacceptable if one party (an individual or a company) claimed to be able to control everything. For a long time we have had specialization and it won’t go away. Rather, we experience more specialization as the world becomes more complex and fast paced.

### Dependencies among parts and parties

IDS has a "PC" (politically correct) ring to it - "Lets make things UNIFIED…", etc. This has shrouded what really matters: that complex wholes composed of many parts have unavoidable, complex and difficult to map dependency relations, only some of which are subject to choice, and all of which are subject to control.

Maybe "integrationists" appear to want to eliminate dependencies by unifying parts, so that the parts no longer have identities among which dependencies can occur. Along with this naturally goes a unification of control. Clearly, if we have a whole composed of two parts, the individual parts can be controlled by one party, or by two. The more parts we have, the more potential parties can take part in making and changing the artifact. When all parts are made into one (integrated - unified) clearly only one party can exercise control because the whole cannot be sensibly partitioned. The "one party" may be a group "acting as a whole" (by consensus or by vote) or it can be one individual who seeks out the advice of others but who has exclusive authority to act (control).

### Levels of Intervention and Control

One way to avoid the trap of “integration” is to understand the idea of levels of intervention. [15] This is not a new idea, but is easily forgotten in an overly technical discourse.

Open Building theory suggests that while the built field can be understood and described in many ways, a most effective way is to use the concept of levels of control, and the concept of change. A LEVEL is a physical configuration under the control of a party. For example, a commercial base building is a level of control or intervention offering space for use by those inhabiting it – that is, those operating on the next lower level, often called the fit-out. This is a two-level distribution of control.

A base building “dominates” the fit-out in that a change of the base building forces the fit-out to adjust, but not the reverse. The "fit-out" is free within the context of the higher level. Further, the fit-out is never known (except in the most general terms) when the base building is designed. The party operating on the fit-out level is in a situation of “dependency” and is, furthermore, not

available for communication or coordination during the design of the base building.

Why has this trend emerged? The answer lies in a convergence of three dominant characteristics of the contemporary urban environment. First is the increasing size of buildings, sometimes serving thousands of people. Second is the dynamics of the workplace and the marketplace where use is increasingly varied and changing. Third is the availability of, and demand for, an increasing array of equipment and facilities serving the inhabitant user. In that convergence, large-scale real estate interventions make simultaneous design of the base building and the user level impractical. Social trends towards individualization of use make functional specification increasingly personalized. Greater complexity and variety of the workplace demand adaptation by way of architectural components with shorter use-life, such as partitioning, ceilings, bathroom and kitchen facilities, etc.

The observed separation of base building from fit-out includes utility systems as well. Adaptable piping and wiring systems on the fit-out level, for example, connect to their counterpart and more fixed main lines in the base building, which themselves connect to the higher level infrastructure operating in the city.

Thus we see a significant contrast between what is to be done on the user level on the one hand and what is understood to be part of the traditional long-term investment and functionality of the building on the other. This is the reason for the emergence of the base building as a new kind of infrastructure.

The distinction here - between "levels of intervention" - is always useful when we compare infrastructure with what it is serving. In the case of buildings, the comparison has multiple dimensions, including the following, framed in terms of familiar in the US office building sector if not more broadly:

| **BASE BUILDING** | **INFILL or FIT-OUT** |
|---|---|
| Longer-term use | Shorter-term use |
| Public or common service related design | User related design |
| Heavy construction | Lightweight components |
| Long-term investment | Short-term investment |
| Equivalent to real estate | Equivalent to durable consumer goods |
| Long term mortgage financing | Short term financing |

When this distinction is made in practice, it is usually the case that each level is under the control of a different "party" or agent. It is even then possible to say that each such "party" must "integrate" their work to maintain quality, schedule and cost. But the use of "integration" here is directly aligned with a pattern of control or level of intervention. That is the key point: integration has to do with the exercise of control and levels of intervention.

**Signs of IDS on the Fit-Out Level**

Residential application of the distinction between base building and fit-out, although based on the same principles as observed in office buildings, shopping malls and hospitals, is particularly

important because it affects a very large market whose potential is not yet understood or exploited.

It is well understood that industrial manufacturing is most effective and dynamic where individual users are directly served. Witness the automotive, electronics and telecommunications sectors. The potential market for residential fit-out is at least as large as that of the automobile industry. Designing base buildings understood as 'architectural infrastructures for living' will stimulate the evolution of a fit-out industry that will itself accelerate innovation and distribution of new domestic fit-out services and systems. [16]

Technical sub-systems and products that can be assembled in full fit-out systems are increasingly available in the international building supply market, and in the Netherlands and Japan, for instance, continued fit-out system commercialization efforts are evident.

In general, the creation of a genuine fit-out industry is not primarily a technical or industrial design problem. As noted above, necessary material subsystems and components like partitioning, bathroom and kitchen equipment, piping and wiring are available. Of course, appropriate new products will make things easier. What is needed most is the introduction of new kinds of service companies. They will use installation teams modeled on the "work cell" familiar in automotive manufacturing, where, in the case of building processes, a trained team brings in all the ready-to-assemble parts – organized off-site in boxes and bundles – and installs everything inside the empty space, and hands over a finished dwelling with a users manual, avoiding the disruptive sequencing of subcontractors. Backed up by sophisticated data and logistics management, these companies will combine efficiency with customization at a range of price points. It is important that the legal and economical frameworks needed for the emergence of such an industry are put in place by local and national government bodies, and by the financial companies that understand the market potential.

The distinction between the more long-term and the shorter-term in residential construction can also be harnessed for the detached suburban house. Building an architectural shell distinct from the dwelling's inside layout and equipment may follow the same separation as given in multi-unit buildings. Here we may choose not to think of the base building as infrastructure. But the same fit-out industry that can deliver "ready-to-assemble" product bundles to large buildings can serve the free-standing house. Here also, the large development project encompassing many detached units can benefit from the availability of fit-out businesses offering competitive fit-out systems and services. [17]

## CONCLUSIONS

The implications of the perspective offered here can be surmised. Many aspects of our work as architects and engineers and builders – in practice, research units and teaching - are involved. Our terms of reference reveal our biases. IDS continues a decades-old situation of envy in the building sector of other "more advanced" industrial sectors, and can be seen as another effort at legitimizing our field.

Adopting the Open Building framework is very disruptive to those with a propensity for and comfort in centralized and top-down control. I would venture to say, however, that if we don't

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adopt it we should anticipate a continued lack of effectiveness in dealing with the forces of reality that will not go away. That is not to say that students will not continue to flock into the schools, or that creative and skillful architects and engineers will not continue to practice and practice successfully.

The problems in pursuing this are not trivial. Necessary professional re-orientation may well determine the pace, direction and quality of change. Note that the practical examples of working with levels of intervention cited above have emerged from sound economic reasoning and a willingness to respond to market forces, not from ideology.

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