Invisible Technology in Design

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WHAT IS INVISIBLE TECHNOLOGY?

First, I will attempt a definition of invisible technology, then I will discuss what invisible technology has to do with the building process and its prime actors, especially the client and the architect. Lastly, considering that many of us are teaching in architecture schools, and drawing on my own experience at the School of Architecture of Venice, I will share some insights with you about how one can teach invisible technology.

I will approach the concept of invisible technology using a quote from Italo Calvino from a lecture he gave at Harvard some years ago. Referring to lightness as one of the most evident peculiarities of our times, he said, "The second industrial revolution doesn't show itself like the first one, with dramatic images like rolling-mill presses and steel casting, but like bits of a weightless information stream running on circuit."

But there is a paradox: if ever a word exists that could hardly suggest the idea of weightlessness and invisibility, that is "technology."

In our current imagery, the word "technology" is associated with machines. And in our schools of architecture, technology is associated with buildings, skyscrapers, bridges and with systems, materials and components. But buildings, bridges and machines are clearly visible. What is then the "invisible technology," the weightless technology, we want to speak about?

To approach this concept, let us take a closer look to two processes that are very different from each other. The first one is the process through which an American citizen, let's say Mr. Brown, buys his home, and the second is the process through which a corporation builds its own headquarters.

Let us start with Mr. Brown's house. Mr. Brown's house is a typical American house, like millions of others: stick built, with plywood, thermal insulation, plaster, etc.

The process that lies behind Mr. Brown's house is very simple. There is Mr. Brown, as the client who buys from a builder, say Mr. White, the house designed not expressly for him by an architect hired by the builder.

Mr. White procures the materials, assembles them together and constructs the house that he sells to Mr. Brown.

Mr. White, the builder, provides the design, as well as the construction and the procurement of the materials, while Mr. Brown buys his house almost like he buys his car. As in the case of the purchase of his car, Mr. Brown will never know about the relationships between the builder, the architect and the subcontractors and he cannot interfere in any way in those relationships.

The process involved with Mr. Brown's house is simple; so is the information flowing between the different actors.

Let us now examine the case through which a big corporation, say Channel 4 Television, builds its own headquarters. This process has an higher level of complexity than the previous one.

The model that describes the process followed for Channel 4 Television can be synthesized as follows. There is a client, Channel Four Television, who needs a custom-made building with a strong character that could be in itself an advertisement for its client.

This is the reason why the managers of Channel 4 Television do not look for a ready-made building or an already-completed one, as Mr. Brown did. So Channel Four Television calls in a professional, Mr. Fuller Peiser, to define an accurate brief. The brief was used as basis for a design competition, and the competition was won by Sir Richard Rogers.

When the design process starts, Fuller Peiser suggests to Channel 4 Television that they hire a large design team to manage the development and the delivery of the project.

So Channel 4 Television appoints a quantity surveyor, a structural consultant (Ove Arup and Partners) and other professionals specialized in service equipment, mechanical engineering and acoustics, and also appoints a manager-contractor (Bovis Construction) to manage the tender stage, the choice of sub-contractors and the work on site.

The manager-contractor, Bovis, "translates" the design made by the project team into a set of specifications; on the basis of these specifications are set in motion the tender phases and Channel 4 Television draws up a series of sub-contracts for manufacturers and suppliers of the components and for the installations of the building.

The timing in this process is critical: Channel 4 TV needs to enter its new headquarters as soon as possible. Also critical is the financing, as the interest required to finance the required budget are very high.

Mr. Brown's house and Channel 4 TV are two buildings that are very different in their architecture and their technology: the former is completely traditional, the latter much more innovative. However, a normally experienced technician easily understands the architecture and the building technology of both.

What nobody, instead, can easily understand at first sight are:

- what is the set of knowledge that enabled the transformation of materials, machines and services into both Mr. Brown's house and the Channel 4 TV Headquarters;
- what are the instruments that enabled Mr. White (Mr. Brown's contractor) and Channel 4 TV to find the required money, to choose the participants and to organize the team that is able to design and construct their respective buildings;
- what is the organization that allowed the processes to function as a team which is mobilized to reach the intended goal;
- finally, what is the underlying logic that established the criteria

and the rules to make both Mr. Brown's house and the Channel 4 TV headquarters reasonably safe, durable, and suitable for the needs.

Now, I propose that we give to all these things—that is knowledge, instruments, organization, logic—the name "invisible technology." The "invisible technology," in short, is that which is immaterial in the process that leads to the making of a building.

Invisible technology is not a new concept. In the realm of computers, from their beginnings, there is a distinction between visible and invisible technology: the hardware is the visible technology, the software is the invisible one. Furthermore, invisible is the capital that moves daily from the Hong Kong Stock Exchange to London and Wall Street. And invisible is also the term used by Alvin Toffler to define the characteristic of the economy of the next millennium, the economy of the so-called prosumer.

I think that everybody agrees with me if I affirm that the level of success of Mr. Brown's house and of the Channel 4 TV headquarters process, as indeed the success of every process, does not only depend on the materials chosen and used (that is the visible technology), but also on the organization and on the skill of the professionals involved in the process (that is the invisible technology). The quality and the efficiency of the invisible technology is decisive for the quality and the efficiency of the visible one. This is particularly so nowadays because the quality of almost everything that is "visible" is, on average, good, since it follows standards, is lab tested, often has a warranty and often is insured.

What is difficult to obtain nowadays is the quality of everything that it is not a visible industrial product, that is: the flow of information, the way in which the information is transformed into a project, the criteria adopted to choose the project participants, the means to control factory and site work, the management of time and cost, etc.

SINCE WHEN—INVISIBLE TECHNOLOGY?

Invisible technology is becoming more and more important in the building processes of today. It has doubtless grown with the growth of the complexity of building, in parallel with innovation of techniques and materials. But, most of all, the importance of invisible technology has grown with the increase in the range of skills and the number of professionals required today to manage an architectural design and a building process efficiently.

Invisible technology was born with a kind of "big bang" in the second half of this century with the spread of a new universe of knowledge and with the adoption of new technical specializations. After this big bang, the traditional roles of the owner, the engineer, the architect and the builder—that once were hard to distinguish and that, sometimes, were embodied in one person (for example Sir John Paxton conceived, designed, and built the Crystal Palace)—underwent a radical transformation.

After this big bang, the organization of the building process, together with information and finance, became intertwined with the traditional concept of construction as the production of durable goods (real estate); similarly, the "montage financier," as the French call the financial organization of a construction operation, is closely linked to the actual assembling of the components in site. In other words, after this big bang, the concept of the building process and of building process management (that is, of invisible technology) has become as critical as the earlier concept of systems of construction.

WHOSE RESPONSIBILITY— INVISIBLE TECHNOLOGY?

But, we could now ask, if the quality of our processes depends on the invisible technology and if invisible technology is information, finance and organization, why not asking the help to business experts trained in the business schools?

The question seems justified, in the sense that our colleagues, teachers and professionals, of business administration have set up a totally new science, the science of management, to organize the invisible side of actual innovation in many fields of the economic process. And in many economic sectors, the science of management gives rise to good techniques and good solutions to problems.

So, why are so few architects and construction professionals studying in management schools? And why, in our schools of architecture, are so few lecturers teaching business administration? Maybe because our architects and our professionals do not want to learn the sciences that are useful for managing the complexities of the building process and the invisible technology? We have, I believe, to look further for the reason. The reason is probably that the "making" of the building process is different from the "making" of all other industrial processes, if only because an architectural work is not like any other kind of manufacturing work.

Of course, we know about many of these peculiarities; unlike every other industrial product, the construction product has a very strong relation with its context, with history, with collective memory and with society. This means that every building has to compose not only with a site, a town, a climate, a history and a tradition, but also with symbolic and cultural aspects. For this to happen, the building process includes architecture and architecture is most important subject which does not exist in any other industrial process. Despite the fact that many of the aspects of architecture are systematic and measurable, many other questions related with architecture have to do with symbolic and cultural aspects of the project. And these aspects are surely not measurable.

These characteristics of the building process make hard to transfer all those techniques established by our friends in the business schools to the task of managing the invisible technologies of the building process. Moreover, the characteristics of the building process often result in the methodologies, used with success in different contexts, failing when applied to the building process.

This does not mean that management techniques and methodologies cannot be useful in the building process. It only means that all these techniques and methodologies have to be adapted to deal with the peculiarities of the building process and especially to deal with the fact that this process has not only physical and measurable sides, but also, as I mentioned previously, has cultural and symbolic ones too.

Now I will try to give an answer to the question: Who's responsibility is invisible technology? I will also address the more specific question: how does invisible technology relate to the main actors in building process—the clients and the architects?

As we all know, invisible technology has become part of the personal know-how of every manufacturer, including a manufacturer in the building process. The market, now global, leaves no room for mistakes and demands knowledge about invisible technology.

Almost all general and specialty contractors use invisible technology to organize the building sites, to manage the finance of a contract, to manage time and costs and to organize purchasing. Apart from this kind of operators, I think that clients and architects are the two actors of the building process mainly involved with the invisible technology.

The clients

Clients, as we all know, are definitely the most important actors in the building process; without a client, no building process is possible. However, each promoter of an architectural work has an unique characteristic. He or she is an absolutely inexperienced actor, an actor who most of the time promotes the construction of a building only once in his or her lifetime. Due to this characteristic, the client often does not understand the complexity of the process he or she is starting up.

Every client who is beginning a new process is scared by the escalating costs of land, materials and services. In such a context, who wants to tell the client that he or she has also to pay for the invisible technology, something that cannot even be seen?

For this reason, it is difficult that invisible technology be part of the know-how of most of clients and developers; they still consider invisible technology as a cost that can be avoided.

Nevertheless, as you all know, some clients, not contractors or manufacturers, gave birth to the concern for invisible technology in the early 1960s. These clients (in Europe, the British Local Authority Consortia; and in America, the Systems promoters in California, Toronto, Montreal, Florida, and Boston) were unsatisfied by the low quality and high costs of conventional construction, and invested resources into a great utopia: to give to the construction industry a level of efficiency that was close to any other industrial sector. These clients commissioned new kinds of professionals—architects, engineers and economists, also unsatisfied by the prevailing quality of the building process quality—to define rules and criteria for a better management of these processes.

Invisible technology was born from these new processes. And the invisible technology as it matured turned into totally new ways to manage the relations among clients, designers, contractors and building industry.

Significantly, the invisible technology that was born from those efforts lead to a transfer of new methods, new materials and new components into the construction industry. One must remember that the so-called systems approach, performance design and performance specifications are, in a certain sense, direct outcomes of that transfer. The organizational innovations also allowed new communication channels to be opened up between clients, architectural designers and manufacturing industry; thanks to the new information flowing through those channels, there could be a more efficient matching between clients' requirements and available technologies.

For this reason every client should find an important tool in invisible technology to manage the building process and its complexity:

- a tool to clearly understand his or her needs;
- a tool to express a good brief;
- a tool to choose the best architect and the best professionals;
- a tool to ask and select the best tenders from subcontractors;
- finally, a tool to check time, cost and quality.

The architects

After the client, how does invisible technology concern the architect?

More even than the clients, many architects are reluctant to accept invisible technology. Above all, they do not accept it because they do no accept rules that bear on their way of working. Architects are reluctant to compose with other actors in the process; they are unwilling to conduct their task with rhythm and organization, and within the paradigm of the contemporary building process. Creative work, they say, does not exist under the rhythm of industrial work.

But architectural design alone cannot manage the complexity of present-day construction processes. Construction rules are not fixed any more as they used to be and they cannot be managed with a well-done drawing. New professions, like quantity surveyors, mechanical engineers, financial counselors, liability and insurance consultants, project and construction managers, tender experts, performance specifications specialists, safety and security technicians, etc., join the traditional ones. All these new professionals have to be coordinated and organized as a system. Invisible technology can be the glue that makes these different domains of knowledge work together as a system, much as the visible technology makes components, materials and plants work together as a system.

Invisible technology, we must not forget, is the organization of the whole process, including creatively setting up and respecting rules.

Richard Rogers, in a recent interview, was very clear about this, saying, "It's absolutely not possible to do our job with these clients, without following their rules. They only work with the kind of people who know the rules ... and they perfectly know what they want ... they perfectly know how to spend every single penny. "

The complexity of contemporary architectural design has swept away the traditional sequential approach. The current approach is, instead, a "team approach," and a design team, like every team, has to play following some rules. These rules are required to manage a microcosm—the team—made of very different professions which can include architecture geotechnics, structures, mechanical, electrical, heating and ventilating, security services, acoustic, air quality, lighting, landscape design and interior design, time and cost management and, in fact, process organization as well.

Each one of these subjects requires a specialist actor and every actor demands equal status, including participating in the design process from the beginning. Consequently, being aware about complexity and having the ability to operate in a 'complexity atmosphere' are both extremely important nowadays, particularly if the architect is to be the coordinator of these knowledge and skills, and maintain his or her position as the captain, the leader of the team.

That is not easy for the architect since, when confronted by the actual complexity of every project, the architect is forced to make a difficult choice: On the one hand, he or she can decide to use the specific skills of the architect, learned in the university, that is to say, the characteristic of being the only actor of the building team who is able to work on the cultural and symbolic aspects of the building process, the aspects that make the building process different from the rest of industrial processes.

Taking advantage of this, he or she can strongly declare the right to be an artisan and to adopt an artisan approach (even if the context is one where every other actor of the building process belongs to an industrial culture and has an industrial approach). On the other side the architect can decide to accept the actual complexity and:

- be conscious of being part of a process where architectural rights are not the only ones;
- be able to continue working on the symbolic and cultural meanings of the architectural projects, combining it with strong technical and economical knowledge;
- especially accept to question him or her self and to accept comparisons with the rest of the building team;
- and finally demand to be heard, but also learn to listen to the other participants.

In the first case, the architect saves his soul, in the second, he becomes a manager.

To get close to an answer to this dilemma, I want to quote again the words of Richard Rogers: "We architects must be able to use two hats: one of the businessman and one of the architect [...] the problem is being unassailable on both subjects.

I'm not against who want to be architects in the most "artisan" way [...] I think that other procedures of working do exist [...] giving good answers to big urban problems; obviously, these procedures will be different from the common one, from an organizational and technological point of view.

But if we are not able to give these answers, someone else will, and those answers will be worse than ours. "

The future of the architect is being played out around this choice: artist, technician, or manager?

TEACHING INVISIBLE TECHNOLOGY

Since we are all working in schools of architecture, we must now ask, "How can we teach invisible technology?"

We must start by recognizing that the present difficulty of many architects in dealing with this question has its roots in our schools

where all knowledge (first about architecture, but also about technology) tends to be optimized in terms of its own target, forgetting the common one—the target of teaching how to become a good, i.e. complete, architect. To move toward this goal, it is important that everyone of us understand that a school of architecture is not a beauty parlor where students put a good make-up onto poor plans and volumes, but also that technology, tectonics, physics, acoustics, engineering are not a sort of intensive care unit for an architecture that is only thought about in terms of form. It means teaching that decisions taken during a design process involve everyone. People working on the form, but also people working on costs, on materials and on building processes.

Just as invisible technology helps managing the process, guiding it towards a result of good quality which is congruous with its context, so teaching invisible technology in our schools means, at least:

- teaching to deeply understand the production process, its rules and its management;
- teaching to recognize all the actors involved at every moment of the process;
- teaching to understand the language and the information to be shared in every single stage of the process.

In particular, teaching invisible technology means make people conscious of the complexity of the process and its organization, and aware of its continuously changing aims. They must also be conscious of its economic and management context, and how it rapidly brings new problems and new actors to the foreground or, conversely, can leave in the background the actors and their targets that once were important.

I am sure that an architect who is really familiar with Invisible Technology will never go to the background!

NOTES

Calvino.: *"Leggerezza." Lezioni americane*, Garzanti, 1988.

M. D'Alessandro. "Design and Technology. A conversation with Richard Rogers." *Disegno Industriale e produzione edilizia.* Department Newsletter. no. 15/16, 1991.