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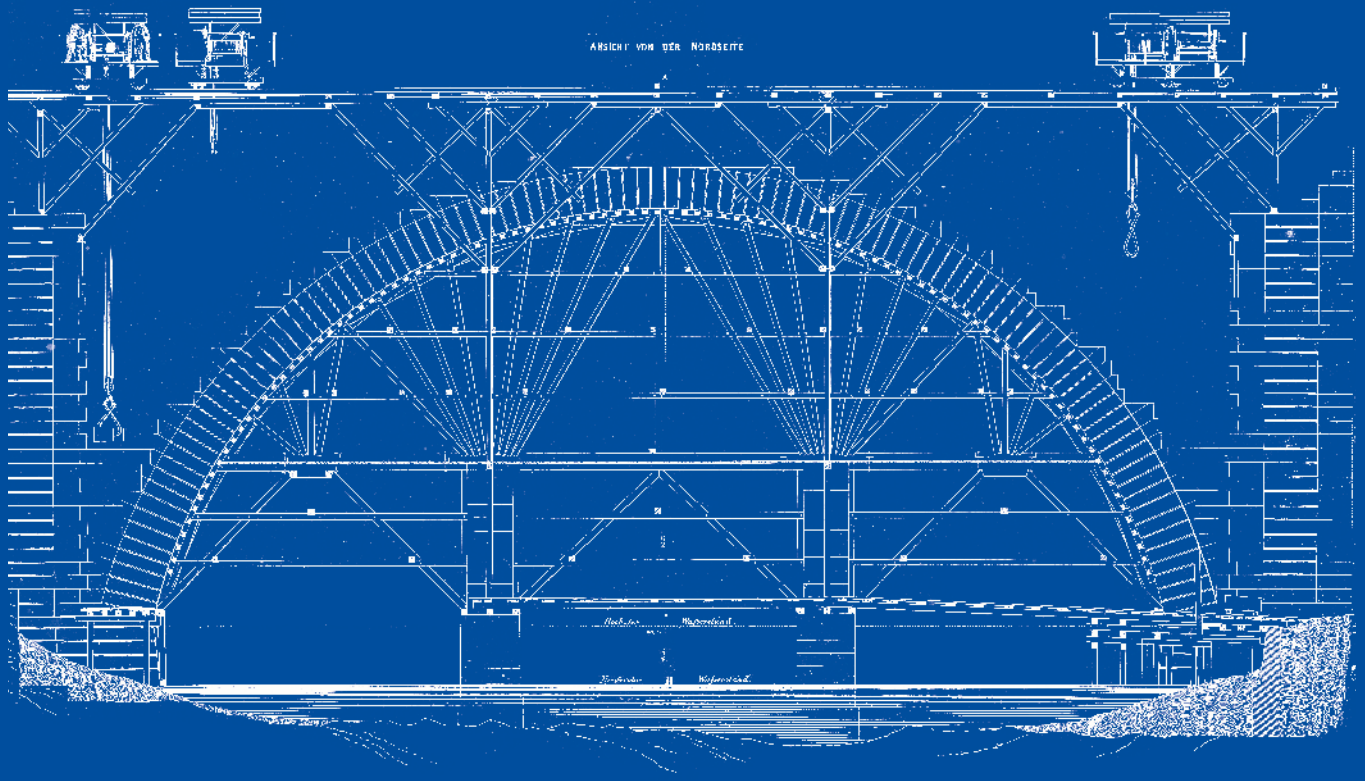
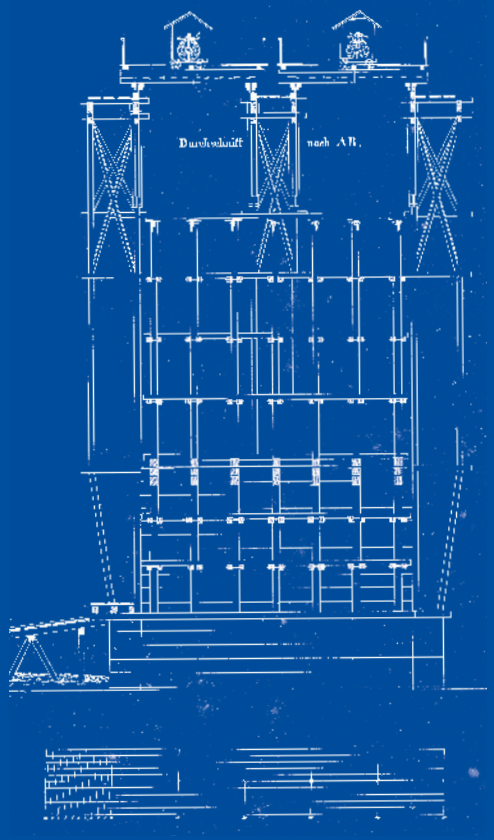


Construction Matters



8th International Congress on Construction History – Zurich

The arrival of the information model, 1969. The new international building industrialization frontier and Italy's "Electronic Challenge"

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Abstract: The 1960s saw the first proliferation of opportunities to adopt computers in the production of the built environment. In Italy, the arrival of the computer was closely intertwined with research in the field of building industrialization. Through journals, books and the fundamental 1969 exhibition *La sfida elettronica* (*The electronic challenge*) at the Building Industrialization Fair in Bologna, its protagonists were among the most significant promoters of the computer as a tool for managing the complexity of building projects, as well as the main reporters on relevant international experiences in this sense. Such interest in the computer had to do with its being an "information machine": an instrument capable of collecting, processing, and transmitting unprecedented quantities of information, a significant aspect given the amount of data exchanged between the actors of the construction process. The most advanced applications of computers in design showcased at the 1969 exhibition and in the following years were constituted by early forms of building information modelling developed abroad, especially in England. The fascination they sparked derived from the fact that they condensed many of the recurring themes of the coeval Italian debates on building industrialization: the idea of open, component-based prefabrication, performance design, and meta-design, all of which embodied political as well as technical and economic ambitions in the Italian 1960s. This study identifies key aspects of Italian research on such alliance between information and industrialization, acknowledging how it was developing in a system of international exchanges and how it especially looked at concrete prototypical applications from the Anglo-Saxon world. It analyzes the beginnings and original aspirations of modes of the profession whose historical development is still ongoing and open-ended.

Introduction

The 1960s saw the first proliferation of opportunities to adopt the electronic computer in the production of the built environment—from structural design to operations research, from representation to fabrication. In Italy, the introduction of computers into design disciplines at the end of the decade was deeply intertwined with the trajectories of research in the field of building industrialization. Through articles published in the pages of scientific journals, books, and the fundamental exhibition *La sfida elettronica* (*The electronic challenge*) at the 5th Building Industrialization Fair, held in Bologna in October 1969, the new machine was promoted and investigated for its use as a tool to manage the complexity of the building project. That the computer was of particular interest to the world of building industrialization had to do with its being an "information machine", to adopt the expression used in a famous 1958 short film made by Ray and Charles Eames for IBM: an instrument capable of collecting, processing and transmitting unprecedented quantities of information, an aspect of great importance given the numerosity and variety of data characterizing the construction process and exchanged between its actors—designers, clients, users, public administrations, contractors, and manufacturers.

The first part of this essay looks at the wide inquiry on and promotion of the possible uses of the computer conducted in the late 1960s by a diverse group of Milan and Turin-based researchers in building industrialization and technology which had its "director" in the figure of Turin Politecnico professor Giuseppe Ciribini. The second part of this essay focuses on the international examples of early building information modelling presented at the 1969 Bologna exhibition and in the following years, and on how these seemed to condense the main themes of the building industrialization debates of that period: the ideas of open, component-based prefabrication, of performance design, of the so-called "meta-design". In addition to expressing technical and economic ambitions, early building information modelling was also characterized by a degree of socio-political commitment in the Italian 1960s, which concerned the possibility of using the digital model as a platform to assess the requirements of clients and prospective users.

The themes, milestones, and protagonists of this intertwining between information and industrialization were here analyzed through a survey of the publications of the time, with particular attention to those documenting *La sfida elettronica*. This analysis can enrich studies carried out to this date on Italian building industrialization of that period (see, for instance: Cottone 2013, Iori 2012, Poretti 1997), on the work of Ciribini (Zaffagnini and Palmini 2022, Bosia 2013, Peruccio 2003), as well as those on the history of building information modelling. This context undoubtedly contributed preparing the terrain for the first extensive applications of BIM in the following decades: this essay looks at its beginnings in order to better understand the full spectrum of its original aspirations.

1. The computer and Italian building industrialization: research and promotion

In 1969, the preliminary report prepared for the Italian national economic program for the years 1971–1975, also known as *Progetto 80*, highlighted how "the automatic processing (transmission and elaboration) of data, conventionally known as 'information technology', [had] undergone considerable development in the major industrialized countries in recent years, also because of the important improvements that it [could] ensure in management methods, both at the level of private companies and public activities" (Foti and Zaffagnini 1969, 12–13). Despite the fortunes of the Italian company Olivetti in the electronics industry market at the beginning of the 1960s, the report noted that "in our country, the use of information technology is currently limited if compared to more advanced countries. On May 31, 1968, 1,176 computers were installed in Italy, compared to 2600 in France, 2,850 in the United Kingdom, 3,800 in Germany and 40,100 in the United States. Considering the number of installed computers per million employees in non-agricultural sectors as an index of their diffusion, in 1967 there were 137 in Italy, 150 in the United Kingdom, 184 in Belgium, 191 in the Netherlands, 213 in Germany, 221 in France and 777 in the United States" (Foti and Zaffagnini 1969, 12–13). The adoption of the computer in all sectors of the country's economy became synonym with modernity and efficiency. The built environment was no exception. Between the late 1960s and early 1970s, the narrative about the unreliability and lack of information in the construction sector, defined as "the black sheep of the consumerist era of countries with a liberal economy" (Meregaglia 1974, 211–217), was widespread in Italy as it was in other countries. For technicians, one of the main causes of this was the high degree of technological archaism. As French architect Claude Schnaidt put it in a 1964 essay for the journal of the Hochschule für Gestaltung in Ulm and entitled "Prefabricated hope", a simplistic yet strong idea had developed in the public opinion: "Traditional building-method—symbol of improvisation, of waste, dirt and all such evils—is contrasted with prefabrication—the glamour ideal of the future" (Schnaidt 1964, 4). It thus does not surprise that, in Italy, the main promoter of the concrete introduction of the "information machine" in design and construction processes, as well as the main reporter on international experiences in its practical applications, was the world of building industrialization—with many of its research projects being financed by the National Research Council (CNR). The computer was among the tools aimed at modernizing the construction sector. Uncoincidentally, one of the first Italian re-publications of the contents of the seminal January 1965 issue of *Architectural Record* dedicated to computers in design disciplines was curated by Nizzoli Associati architect Giuseppe Mario Oliveri, who was responsible for a *Casabella* column on the topic of prefabrication (Oliveri 1965).

In particular, a wide, systematic inquiry on the possible uses of the computer in building was conducted by the Milan and Turin-based research group headed by Giuseppe Ciribini, professor at the Institute of Construction Elements at the Faculty of Architecture of the Turin Politecnico. Ciribini, a member of the Italian Prefabrication Association (AIP), had previously served as *Gastdozent* at Ulm's Hochschule für Gestaltung as Konrad Wachsmann's successor in the Theory and Technique of Building Production course. He was also the director of the Italian Centre for Applied Research on the Problems of Residential Construction (CRAPER), which in 1964 merged into the Italian Association for the Promotion of Studies and Research in Building (AIRE). Both the CRAPER and AIRE were relevant institutions that worked at the intersection of academic research in technology, the industrial world, and politics (Bosia 2013, 163–193).

A first important tool for the dissemination of studies on the computer was the official journal of the AIP, *Prefabbricare*, which Ciribini himself directed. In 1968, the first yearly issue of the journal hosted a contribution by Milan-based engineers Aldo Spirito and Franco Scarantino entitled "L'impiego del cervello elettronico nelle strutture scatolari a pannelli piani", which focused on the computer assisted structural calculation of prefabricated structures (Spirito and Scarantino 1968, 39–42). The third issue of the same year was dedicated to the topic of communication in the construction process. The opening editorial article by Ciribini was entitled "Informazione, cibernetica e processi industriali", and it equated the production of buildings to a complex problem of information and communication management. This was followed by an article, part of a CNR-funded research conducted at the Milan Politecnico, by engineer Giovanna Guarnerio, who had been a member of the award-winning BPR (Belgiojoso–Peressutti–Rogers) design team at the time of the 1960 Milan Triennale competition for the study of industrialized elements for school buildings (Guarnerio 1968, 3–23). The lengthy contribution, entitled "L'informazione come strumento di comando e di regolazione del processo edilizio", served as a *vademecum* on the functioning of the electronic computer. Guarnerio also highlighted how the transmission of information was the organizational and managerial foundation of the production process in the building sector, which was characterized by the exchange of a large quantity and variety of data and documents between its actors: clients, designers, the new central figure of the quantity surveyor, contractors, suppliers. The automatic computer was presented as the tool that could help coordinate all such data. As an example of this, Guarnerio's text was followed by an essay on automatic information processing in large construction companies written by the director of the Productivity Service of English contractor John Laing Construction Ltd. (Geary 1968, 41–44). In January/February 1969, one of Ciribini's assistants at the Turin Politecnico, Massimo Foti, published an article in *Prefabbricare* devoted to the "electronic calculator", where he highlighted some important innovations in computer hardware which a designer might find useful, such as time-sharing systems (which aimed at making the power of large mainframe computers available to construction companies and design firms, thanks to terminals which were connected to the mainframes through telephone lines) and peripheral devices for processing graphic information like plotters and interactive cathode ray tube screens (Foti 1969, 13–22). The contents of the article were partly taken from a book by Foti that Ciribini's Institute published at the end of 1968, once again with funding from the CNR (Foti 1968). As in Guarnerio's essay, a substantial part of Foti's 1968 publication was also meant to familiarize the readers with the computer's functioning and its new technical vocabulary. This was followed by a systematic study of a variety of possible applications, including the use of information models in industrialized building programs. Foti reviewed a series of concrete case studies, mostly coming from the US and Great Britain, which would all soon reappear in the catalogue of the exhibition he co-curated in 1969.

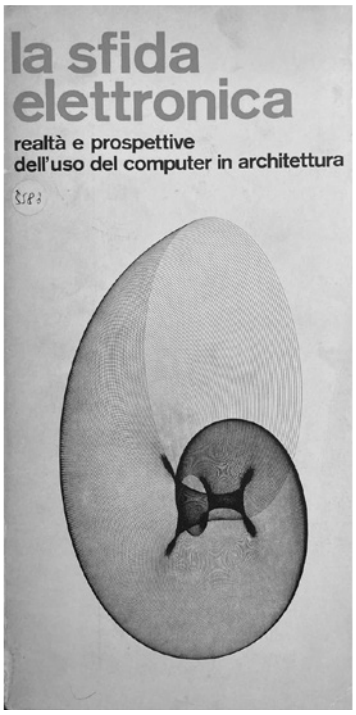


Figure 1. The catalogue for the 1969 SAIE exhibition in Bologna (Foti and Zaffagnini 1969, cover).

2. Bologna, 1969: *La sfida elettronica*

2.1. A seminal exhibition

The culminating moment of this inquiry into the computer was the organization of an exhibition at the 5th Building Industrialization Fair (SAIE), held in Bologna in October 1969, with the intriguing title *La sfida elettronica. Realtà e prospettive dell'uso del computer in architettura* (*The electronic challenge. Reality and prospects in the use of the computer in architecture*) (Fig. 1). The exhibition was curated by Foti and Mario Zaffagnini, a member of the Bologna-based architectural firm Gruppo Architetti Urbanisti "Città Nuova" and assistant at the Faculty of Architecture at the University of Florence. It was Gruppo Architetti Urbanisti "Città Nuova" who curated the exhibition design (Fig. 2).

The exhibition, one of the world's first to be entirely dedicated to the relationship between architecture and computers, transcended the specific scope of computer applications in industrialized construction. Companies such as Olivetti, General Electric Information Systems Italia, Industria Macchine Elettroniche (IME SpA) and IBM Italia all participated in the exhibition, which presented a wide range of hardware and software and explored their possible uses in various disciplines of the built environment—from architectural design to visualization, from town planning to structural and technical installations design. Of great interest were the building industrialization experiences displayed, which showcased Europe's most advanced practical applications of information models. In addition to the graphic materials and technological products on display, informative videos on the computer were projected in a screening room, including the Eames' "The information machine" and Nicholas Negroponte's "Urban 5" (Foti and Zaffagnini 1969b, 37). The very image chosen for the exhibition posters and catalogue cover symbolized this all-encompassing interest in the computer: it was Kerry Strand's *The Snail*, a mid-1960s work of digital art programmed in FORTRAN on a GE-425 computer and printed with a CalComp 502/760 plotter.

2.2. The catalogue

The exhibition was documented by a catalogue, which was curated by Foti and Zaffagnini and reported all exhibition contents (Foti and Zaffagnini 1969), and by the sixth *Prefabbricare* issue of 1969, which was dedicated to the description of the event and hosted an article by Foti and Zaffagnini on "the computer and the complexity of architecture" (Foti and Zaffagnini 1969b, 35–46).

The catalogue opened with a chapter on the allegedly backward state of the Italian building industry and on Italy's delay in the process of "computerization". This introduction was followed by a detailed technological description of computers which were currently on the market, including the recent Olivetti tabletop computers, hardware such as interactive screens and plotters, and programming languages. The next two sections were devoted to task-specific programs for structural problems and for the design of technical installations. A chapter entitled "Communication and control in the building process" focused on the great complexity of building production, understood as an intricated system of public offices, designers, consultants, manufacturers, suppliers, contractors, clients and new specialists, and on the gargantuan amount of data exchanged by these. Computers, and especially time-sharing systems with terminals which could be installed in construction sites, design *bureaus* and municipal offices, could play an important role in optimizing such communication. Here, the curators republished fragments of Guarnerio's previously mentioned 1968 text dedicated to the operability of information on buildings and on the construction process and to the classification and codification of data. The following section on "The design, production and commercialization of components" dealt with "component-based approaches" to building industrialization, with modular coordination, regulations, and the new possibilities of component production with numerically controlled machines. A chapter dedicated to architectural design displayed the "anti-empirical", logical-mathematical design methods developed by Christopher Alexander and Andries Van Onck, who emphasized how the use of computers obliged designers to transfer their attention from the form of objects to their functional programs.

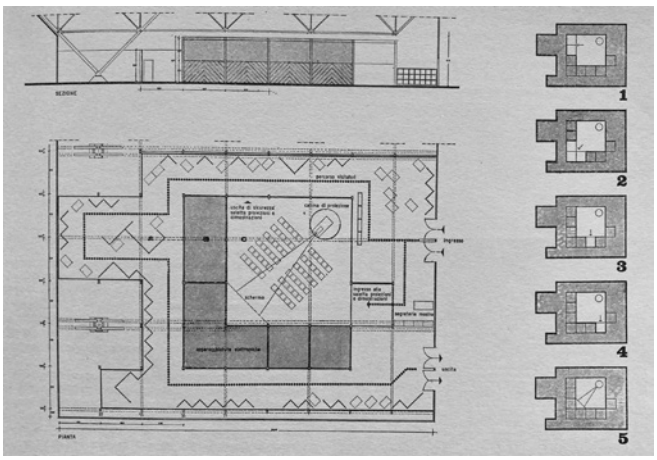


Figure 2. The plan of the Sfida elettronica exhibition space, with the screening room at its center (Foti and Zaffagnini 1969b, 37).

The heart of the catalogue was the section devoted to concrete applications of computer-assisted design, which analyzed eight different case studies: the industrialized construction program carried out by the West Sussex County Council; the work of the "Committee on the application of computers in the construction industry" of the English Ministry of Public Buildings and Works; the use of computers in the preparation of technical documentation by the Bologna Municipality; the distribution studies made by the Department of Building Science of the University of Liverpool; the Research on Urban Quality by Cesare Blasi, Gabriella Padovano, Roberto Galimberti and Ivo de Lotto; the ICES (Integrated Civil Engineering Systems) software package; Leonardo Mosso and Laura Castagno's "programmed architecture"; and the 1968 *Cybernetic serendipity. The computer and the arts* London exhibition. The catalogue ended with two critical chapters on the design possibilities and limitations of the computer, with texts by Massimo Foti, by linguist Silvio Ceccato and by Charles Wymer of Ove Arup & Partners, followed by a useful and detailed glossary and a bibliography on the topics discussed.

3. Early experiments with building information modelling: three case studies imported from England

The most advanced applications of computers in design presented at the 1969 exhibition and in the following years were constituted by early forms of interactive building information modelling developed in England. These experiences were of particular interest for the world of building industrialization.

In the words of the two curators of the SAIE exhibition catalogue, the experience carried out by the West Sussex County Architect's Department in collaboration with the Department of Building Science of the University of Liverpool and exhibited in Bologna was one of the most interesting and comprehensive applications of computers for the solution of design and management problems in the building industry (Foti and Zaffagnini 1969, 95–103). Foti had already published the early results of the experience in his 1968 book (Foti 1968, 69–70). What the Architect's Department conceived was an entire process of computer-assisted design, which started with the analysis of data on the proposed buildings and ended with the definition of the technological project, the automated production of working drawings and the drafting of all technical and economic documents needed for contracting and construction site management. For this process, which would be abandoned in 1974 as it became too expensive (Reynolds 1987, 3), the Department used an IBM 360/40 computer with an IBM 2250 graphic screen, an automatic plotter and a printer.

The computer-assisted design procedure was part of the broader context of public building construction programs in 1960s England. West Sussex had been one of the initiators of the SCOLA (Second Consortium of Local Authorities) and had collaborated in the design of its coordinated component-based building system, which had led to the construction of many buildings and, as with the CLASP (Consortium of Local Authorities Special Programme), had received considerable public funding. However, the SCOLA construction system could not be adopted for any building type. In the late 1960s, the building system used by the West Sussex County Council was based, in addition to the SCOLA system components, on other

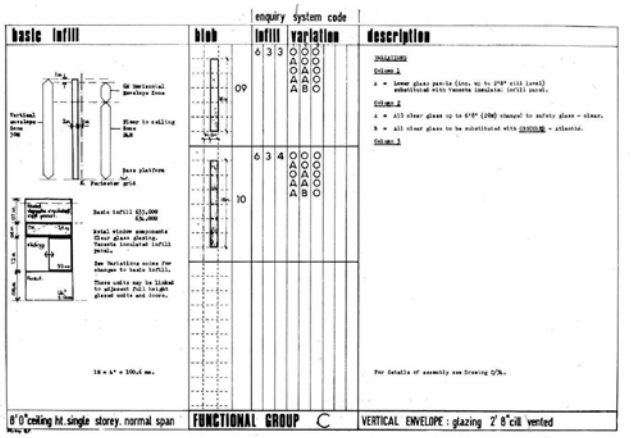


Figure 3. The technical data for a component to be stored in the library of the West Sussex program (Foti and Zaffagnini 1969, 101).

prefabricated reinforced concrete structural elements and on a series of dimensionally coordinated "traditional" components. Because of this variety of building components, the Architect's Department developed a computer-based data library in which to collect the description of the technical features (evaluated according to the Standard Method of Measurement) and the costs (materials, labor and equipment required) of each component of the heterogeneous system (Fig. 3). All components were assigned a specific code number. The library was designed to be dynamic, expandible and updateable.

Yet, the library was not solely meant to collect such data. Their use consisted in the composition of informational building plans on an interactive graphic screen. The operators assigned a code number to each element of the digital drawing. The element would then be attributed the technical-economic data associated with that code number in the library. Foti and Zaffagnini noted how there had already been experiences of this sort in England; however, these had been much more rudimentary and linked to the use of a very limited number of components. The research group of the Royal College of Art in London, for instance, working with the IBIS construction system, had used small iron profiles (corresponding to the horizontal section of the various elements) to compose building plans on a magnetic board. The small profile acted as a medium to represent all technical and economic characteristics of a specific component. At the

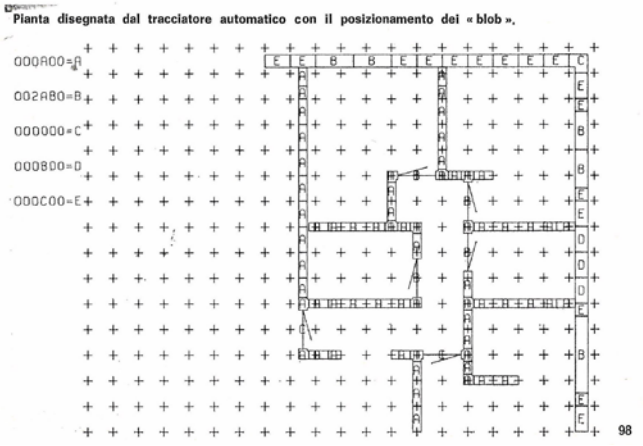
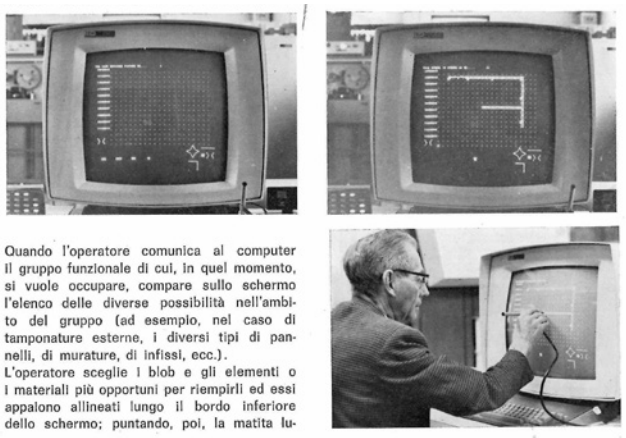


Figure 4. A computer-produced plan assembled with the "blob" system of the West Sussex program (Foti and Zaffagnini 1969, 98).

Imperial College, in London, N. M. Newman had replaced the magnetic board with a graphic screen connected to a computer, and he composed building plans by visualizing on the screen the schematic representation of the horizontal section of the various components of a specific industrialized construction system (Foti 1968, 71–75). Once again, this involved a limited number of components and it would have been impossible to introduce different elements or traditional components into the same construction, a need that was very much felt by the West Sussex County Council designers.

Interactive cathode ray tube screens and electronic pens were becoming fundamental digital "drawing" tools and interfaces for the designer, a possibility that had only started to circulate in the mid-1960s, after Ivan Sutherland's seminal *Sketchpad*. In the West Sussex program, the electronic pen was used to arrange empty spatial units, the so-called "blobs", on the screen. Blobs were not specific building components, but "theoretical quantities" defined in plan by two standard dimensions and in height by a variable modular measure. Their dimensions could or could not correspond to the dimensions of specific components; it was therefore theoretically possible to use any construction system, as long as the overall design was prepared according to the principles of modular coordination. When preparing the project, a modular design grid and a list of functional groups appeared on the screen. When the operators told the computer which functional group they wanted to work on, a list of different possible components appeared on the screen. For example, if the operators wanted to work on external cladding, the screen would show different types of prefabricated panels, masonry, and fixtures—each one identified by its individual library code. The operators chose the most appropriate blobs and the components to fill them with, and these appeared aligned along the bottom edge of the screen; afterwards, by pointing the electronic pen first at the chosen blob, then at the position where it was to be placed, the component moved to the desired grid point (Figures 4–5). The architect could choose the blob filling from the data library. If the stored options did not meet the specific project requirements, other construction details could be designed, coded, and stored. These would then become part of the library. For particularly sophisticated details for which blobs could not be used, the relevant technical-economic information could be processed by hand and fed to the computer through punch cards. The floor plan shown on the screen and resulting from this process was thus made of all these filled theoretical units. However, the quantities indicated were at this point no longer theoretical, and it was therefore possible to automatically produce all technical and economic evaluations and to print drawings for the drawn portion of the building. Routines for heat loss, lighting and fire protection calculation were also developed. At any stage of the design process, it was possible to automatically calculate the number of individual filling units used and the total cost. It was therefore always possible to check the expected expenses and to modify the design should they be not acceptable for contracting purposes. In the event of an error, entire portions of the plan could be deleted.



Quando l'operatore comunica al computer il gruppo funzionale di cui, in quel momento, si vuole occupare, compare sullo schermo l'elenco delle diverse possibilità nell'ambito del gruppo (ad esempio, nel caso di tamponature esterne, i diversi tipi di pannelli, di murature, di infissi, ecc.).
L'operatore sceglie i blob e gli elementi o i materiali più opportuni per riempirli ed essi appaiono allineati lungo il bordo inferiore dello schermo; puntando, poi, la matita lu-

Figure 5. The interaction between an operator and the graphic interface of the West Sussex program, through light pen and cathode ray tube screen (Foti and Zaffagnini 1969, 102).

The West Sussex experience represented an advanced application of "computer-aided building design" to support the processing of very abundant amounts of information on the project, and as such it was of considerable interest from the point of view of technical problem solving. At the end of their discussion of the West Sussex program in the Bologna exhibition catalogue, Foti and Zaffagnini asked themselves, albeit quite optimistically, about the possibility of transforming this computer-aided "executive meta-project" into a "functional meta-project" that also took the requirements determined by user activities into account as far as the choice of the building components was concerned. Only this, they argued, could significantly affect the building's quality and performance, understood as its ability to satisfy human needs (Foti and Zaffagnini 1969, 103).

In the following years, two other experiences with information models, which shared some features with that developed by the West Sussex County Council, were presented in Italian architectural journals and seemed to respond to this hope. In a 1974 issue of *Parametro* (a Bologna-based journal both Zaffagnini and Foti collaborated with), British engineer and former Ulm *Gastdozent* Leonard Bruce Archer presented the COMDAC project, an interactive computer-aided design program developed for the SCOLA and SEAC school building schemes (Archer 1974, 22). The information model was based on a series of programs entitled ASPECT. COMDAC worked with a system building approach that considered user requirements, economic factors and component performance. The characteristics of the digital model were fed to the computer via a cathode ray tube screen and an electronic pen. Users were able to view the three-dimensional model, change scale, move from plan to elevation or modify the drawing on the screen. They could also initiate a catalogue examination routine to insert components in the drawing where required when there was one available of the right size. As in the case of the West Sussex program, Archer's software could also be used to print executive drawings with a plotter, to automatically produce cost estimates and to calculate thermal dispersion.

The PSSHAK system (Primary Support Structures and Housing Assembly Kits), published on both *Parametro* and *Lotus* in 1975 (Lotus 1975, 203–217), was developed by Architectural Association graduates Nick Wilkinson and Nabeel Hamdi, and was there presented in the version adopted for a German housing program carried out using the ERA construction system and under the patronage of the Ministry for Building of the Federal Republic of Germany. As a tool for the PSSHAK, MBC Graphics Ltd. developed a computer program aimed at illustrating on a graphic screen the possible technological solutions to satisfy financial constraints, social

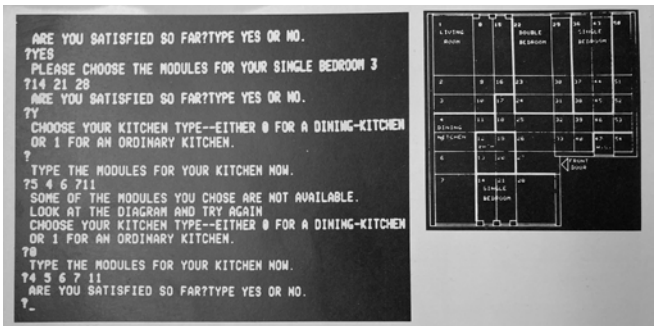


Figure 6. The PSSHAK two-terminal interface (Lotus 1975, 216).

standards and the requirements expressed by the users. Future inhabitants could intervene in the definition of the plan of their dwelling units by accessing the digital model via two interactive terminals: on the first terminal, a series of questions was displayed, starting with the composition of the family. The inhabitant's answers were coded. The second terminal indicated a variety of possible spatial solutions and allowed users to select the preferred option (Fig. 6). The users specified the size and position of rooms, which the other terminal "drew" on a gridded plan taking building regulations into account. The final scheme was drawn at the end of this interview with the future users. Modular furnished rooms and building components (panels, prefabricated floors, movable interior partitions) were then selected from an informational catalogue.

4. Themes of 1960s Italian building industrialization

The critical interest expressed for these three information models is better understood if they are framed within the context of Italian "industrialization theories" (the term is used in Iori 2012) of the 1960s. Indeed, the English case studies seemed to synthesize some of the promises, recurring ideas and vocabulary of the country's debates concerning building industrialization of those years: the so-called "componenting" (or component-based approach to industrialized construction), open fabrication, performance design, and meta-design.

4.1. "Componenting" and open fabrication

Information models such as that of the West Sussex County Council or the COMDAC constituted the ideal tools for processes of "open" fabrication, a type of building industrialization based on components rather than on complete standardized dwelling units. In his review of *La sfida elettronica* in *Casabella*, Paolo Bettini wrote how the "Italian way" to industrialization seemed to be that of prefabricated components, which could be assembled in different building systems, in an "open manufacturing" process that would "make it possible to offer, to a potential market, building components that are all coordinated with each other through a general standardization in terms of dimensions, quality and connections". In this regard, the computer represented "an instrument capable of solving the technical problems of the exchange of information needed for the required coordination" (Bettini 1970, 46–47). Far from being the only route travelled by Italian industrialization in those years and receiving sensible criticism from important scholars and professionals (see: Oliveri 1968, 105), "componenting" was in fact the cornerstone of the approach that had its heralds in Ciribini's group.

Three issues of Ciribini's *Prefabbricare* were dedicated to "componenting" between 1968 and 1969: the January/February 1968 issue (on modular coordination) and the November/December 1968 and January/February 1969 issues (on component design and the "component-based strategy"). "Componenting" was also at the core of the 4th SAIE exhibition, in 1968. In the preface to the catalogue of the 1968 exhibition, Ciribini defined "componenting" as a process that produced building systems by assembling industrialized components individually chosen to fulfill user requirements. Building systems thus consisted in individual ways of choosing and assembling components, selected from the infinite number of possible alternatives. Both the term "componenting" and the approach it implied echoed the British notion of component-based prefabrication and the similar Northern American notion of "systems component design" (Faccio et al. 1968, 11–14).

The idea of open and flexible manufacturing based on the assembly of components chosen from a catalogue had a theoretical rather than practical dimension in Italy in those years, since it required the dimensions of the elements on the market to be coordinated, the connections compatible and the quality homogeneous: quite a daunting task. The standardization and modular coordination of elements, connections and jointing tolerances, as formulated by Wachsmann (Wachsmann 1965, 53–72), thus represented the fundamental tools of componenting (Faccio et al. 1968, 24). Ciribini's CRAPER had actively participated in the drafting of the first European report on modular coordination in building, a product of an AEP project (the European Productivity Agency acted as the technical advisory body of the OECE, Organisation Europeenne de Cooperation Economique), which had laid the foundations of a policy later codified by the Italian Unification Body. In 1970, the Italian Ministry of Public Works published an official *Guida alla progettazione modulare* (Bosia 2013, 67).

4.2. Performance design

An important aspect of the component-based approach to industrialization was that of "performance design": the focus shift from the technological component *per se* to the component understood as a technological system answering to systems of functional requirements. The notion of performance had been particularly popular at the Hochschule für Gestaltung, where Ciribini had taught. As Ciribini himself wrote in *Casabella* in 1969, all functions required of a building should be quantified and compared to the functions the selected technological components could perform. Performance design was understood as a synonym for "systems design": designers should conceive systems of performances responding to the needs emphasized by users (Ciribini 1969, 40–44). The May/June 1971 issue of *Parametro* was dedicated to the subject of performance design, with a lengthy discussion of Northern American building programs where the evaluation of physiological, psychological, social and economic needs played a central role in the building process. According to the authors of the long essay "Dal performance concept al performance design", published in the same issue, acknowledging users' performance requirements represented an attempt to conceive information models in continuous feedback with human

and environmental needs (Baglioni et al. 1971, 61). These models, the authors argued, should be easily codable to facilitate their use and to make the adoption of the computer possible in every phase of the process: uncoincidentally, they explicitly used the West Sussex County Council's computer-aided process and digital library as a positive example of this. This idea of dynamic computer-based modelling, constantly assessing requirements and performances, verified through feedback, and adopted for an evaluation of the compatibility of user activities and spatial units, became a true *leitmotiv* in Italian industrialization theory of that period, with other essays on the topic being written in the following years (for example, see: Zapponi 1974, 165).

4.3. Meta-design, between technology and politics

It is through this lens that one should read the hopes expressed by Foti and Zaffagnini regarding the possibility that the West Sussex County Council's computerized "executive meta-project" could be expanded to become a "functional meta-project" capable of making sure user requirements were satisfied by the building's design. But what precisely did they mean by "meta-design"?

To fully understand the notion of meta-design, we must shift our attention to the heated Italian architectural debate of the 1960s (Imperiale 2014, 478–506), and in particular to the writings of the architects of the Nizzoli Associati firm Giuseppe Mario Oliveri, who discussed meta-design in his book *Prefabbricazione o metaprogetto edilizio* (Oliveri 1968), and Alessandro Mendini, with his famous *Casabella* article entitled "Metaprogetto sì e no" (Mendini 1969). There, Mendini proposed a redefinition of the discipline's methods and of the conventional categories of architectural design: "The specific objective of the designer is to identify, control and elaborate the facts which shape the environment, in order to generalize the personal and social use of objects capable of satisfying the substantial (physical and human) needs of users. The result of this is a type of design understood as 'a process of conscious formalization of the human environment'; it also results in a demythologized designer, because their role is complemented with that of the other people involved with them in the process of 'integrated design' (politicians, organizers, industrial manufacturers, specialists, etc.) (...). But what lies behind all this? Evidently a moral instance: the ethical values, the ideological premises. (...) It means moving from the arbitrariness of conceiving an *a priori*, monumental architecture to an architecture conceived as problem-solving" (Mendini 1969, 5–7).

In his 1969 *Casabella* piece, Ciribini stated that embracing a "meta-design" approach to architectural invention was key to achieve a design based on building performances (Ciribini 1969, 40–44). If "componenting" was the operative mode of building industrialization, meta-design constituted its generating principle: a sort of necessary, preliminary "logical analysis".

The notions of meta-design and performance design highlight how, at least in their intentions, these explorations of possible applications of computers in design did not have solely technical and economic but also political aims and challenged the idea of the designer as an authoritarian, demiurge-like artist. In particular, the integration and quantification of aspects related to the physiological, psychological and social needs of the users, to be met by building components' performances, became a central aspect. In a 1972 issue of *Parametro*, Zaffagnini emphasized the importance of this political stance: "the definition of a performance system referring to human activities as a founding element of construction processes is equivalent to the explicit recognition that parameters referring to users assume a principal role with respect to all others, in particular to productive and organizational ones" (Zaffagnini 1972, 20). International examples such as COMDAC and PSSHAK well highlighted the widespread idea that the information model was not to be intended only as a tool for controlling the construction process, for technological design and for the transmission of information, but also as a platform to allow an interaction between the project's actors, and especially between designers and future users.

Conclusion

This study highlights several interesting aspects concerning the arrival of the computer and early forms of information modelling in Italian design disciplines. First, that the gazes of researchers in technology and building industrialization such as Ciribini, Guarnerio, Foti and Zaffagnini were focused on the Anglo-Saxon and, in particular, on the English context between the 1960s and 1970s, and that we can speak of an actual transfer of themes, approaches, and vocabulary. It was there that the most advanced applications of computers in building industrialization were being carried out.

Then, it is necessary to underline the relevant socio-political aspirations of these theoretical approaches to building industrialization. As Theo Zaffagnini and Otello Palmini have recently written, at the beginning of the 1970s Ciribini (and, I would add, an entire current of the Italian debates on industrialization) formalized a theoretical perspective in which technology became a necessary, but not sufficient, design innovation tool. A politically committed, systemic, performance-based approach to design, partly indebted to Norbert Wiener's cybernetics, became the way to establish a dynamic dialogue between the environment, individuals, and society through technology (Zaffagnini and Palmini 2022, 25–26). This dual technical and political focus constitutes an aspect of great interest with respect to the studies conducted in the world of Italian building industrialization at the turn of the decade, where ideas of technological and economic efficiency were joined by those of forms of user participation in the construction process.

After this preliminary study, the research should be extended to the historical reconstruction of concrete implementations of the ideas of meta-design and of uses of digital models in Italian building processes of this period. The context and experiences described in this essay undoubtedly contributed preparing the terrain for the first extensive applications of building information modelling in the following period: but were they paralleled by practical applications in Italy? Italian industrial companies, contractors and design firms began using computers in these very years. For example, a producer of prefabricated components such as the Emilia-based RDB advertised its own innovative informational tools used to produce economic estimates and customized structural calculations in *Casabella* no. 380/381, of 1973. It is in these years that we also find some of the first

engineering firms specialising in the use of computers—this was the case of Antonio Migliasso's SERTEC, which was born out of Olivetti's technical *bureau* as an independent company in 1968. What were the operational receptions of these original forms of building information modelling by the Italian profession and industry? How did they implement or disregard the spectrum of technical and political promises that the idea carried? Answers to such questions can be given only through deeper, specific interrogations of the private archives of these firms.

Given the contemporary use of the informational tool, which is growing more and more indispensable in design practice and in the management of the processes that produce architecture, furthering these explorations promises to reveal other important stories, perhaps until now underappreciated.

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