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## THE SUPPLY OF HOUSING AS THE COMBINATION OF FACTORS OF PRODUCTION

by  
Gloria de Sama\*

Throughout history, man has considered the house as an extension of his bodily system, as a refuge from the cyclical variations and fluctuations of nature. But as a collective shelter, housing has also been an expression of individual and community will in an order that surpasses that of mere survival.

But the universal reality of housing today is far from being ideal. Very few building types endure such a high level of misconceptions as housing does, in spite of its social relevance and, finally, no sector of the output of the Building Industry arouses a controversy higher than that coming from housing.

Housing targets, programmes, and policies are always provisional and always superseded before long; and housing has been used wrongly, for too long, as a regulator of the nation's economy. At present, the production of new housing falls far short of meeting current needs. Past attempts to solve the problem of housing have, in most cases, been palliative answers to particular conditions, or short term solutions that have created long term problems.

There are many disruptive elements that have contributed to this situation which have been identified in an isolated context. The attitude of viewing the problem in a partial way, may be, to a large extent, responsible for the present condition. Housing is a part of a complex system, this system being the total organization of a community or nation in its social, economic, political, and physical aspects. But housing is, by itself, a complex system which is composed of all those sectors of production whose combinations and interactions determine the supply of housing.

Therefore, housing is at once a dependent subsystem but is also an independent system. Thus the final state of housing will be dictated, on the one hand, by those constraints coming from the total system and affecting housing as a subordinate entity of the whole, and, on the other hand, by those constraints arising from the internal organization of housing.

It is very difficult to determine and identify the constraints emerging from one or the other group; perhaps they cannot be clearly separated as mentioned above since the general level of the economy dictates, by and large, the supply and demand of housing and, at the highest level, it influences the state of being of all sectors of production dealing with housing. However, the general level of the economy can be taken as the most dynamic constraint, either in a positive or negative way; there are, in addition, other constraints much more static in character and whose change would have to overcome the inertia of an already established organization. I am referring here to the legal, financial, and institutional sets of regulations which, in their term, emanate from a political direction and program.

Finally, there are other sets of restraints affecting the output of the housing sector; I am referring here to those factors inherited from within the organization of the Housing Industry, taken in its most comprehensive approach. I want to stress here time factor as it relates to the three groups of constraints. Constraints coming from the legal, financial, and institutional fields are slow and static in terms of overcoming their own inertia, but once the inertia is overcome, they can be immediately released; the constraints coming from the nature of the Building Industry cannot be released in a short period of time, since they involve the design, preparation, and implementation of a change affecting the organization of the Building Industry.

I believe that the organization, content, and ways of functioning of the Housing Industry is of primary importance for the adequate and satisfactory implementation of a housing programme. Therefore, it is evident that there must exist an intimate correlation between the housing target in its qualitative and quantitative

aspects and the ability of the Housing Industry to accommodate this housing demand. No housing programme can be successfully materialized if it cannot count on a Housing Industry adequate in its content, organization, and capacity.

A corollary of the above paragraph is that if a nation has a commitment to the use of industrialized techniques of production, it must have a prior commitment to reorganize accordingly its Housing Industry.

Before discussing the different typical ways in which a dwelling unit can be produced and the intrinsic characteristics of each form of production, it is significant to stress at this point that, almost every industry is idiosyncratic in terms of the combination of factors of production it requires. I am referring to the traditional factors of production:

manpower: type of labor, skill, quantity, availability, training;  
capital: invested in plant and machinery;  
productivity: considered in the light of specific issues within the Industry, such as labor productivity, output per plant, etc.;  
building materials;  
finance as a factor of production.

In the case of the Building Industry, and particularly in the Housing sector, this idiosyncrasy is quite rigid. There is a minimum possibility for the substitution of one factor of production by another, except for the radical substitution embodied by the switch from traditional to industrialized techniques of construction.

Let us briefly analyze how these factors of production are put to work for each prototypical way of making a dwelling unit, what is the content for each one of them, and what is the interface or relation that must exist among the participants of the building process. (1)

1. **On-Off Approach:** is based on a unique custom made design; the participants of the building process (user, client, professions, contractors, manufacturers, etc.) enter into action at various stages along the process and for each stage a determined participant takes upon him the responsibility of management and coordination; there is no teamwork among these participants nor is experience gathered in common. For each operation there is a new combination set up, thus causing an obvious discontinuity in the production cycle of the Industry. It utilizes traditional skills with nil or little mechanization; the work is organized based on craft teams and not on stages of production.
2. **Component Approach:** a factory, on or off the site, produces components designed to perform a specific task; the final dwelling unit is assembled on the site based on an array of these and other components. In order to do this, it is necessary to establish specific unifying devices, such as compatibility in performance standards, dimensional coordination, etc. This approach allows a limited degree of custom made variations which can be considerably increased if more varieties in the components are brought into the mass-production line. Several participants of the building process work as a team for long periods, allowing the gathering of a common body of knowledge and experience; manufacturers and/or erectors are coordinators for several stages of the building process; the work is not organized by craft teams but by operations.
3. **Model Approach:** a dwelling unit based on one module or of several modules that can be assembled in the factory or on the site. No custom-made variations are possible, and there is a limited client's choice; the responsibility of the building process lies primarily on the manufacturer; the work is mainly organized in stages along the production line; there is no need of traditional craftsmen.

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4. Process-Production Approach: factory assembled dwelling units that includes a package deal design, production and erection; there is permanence and stability in the team of participants and there is not a standard product but a variety of them.

I would like to clarify that these four methods of dwelling unit production are prototypical, therefore, there are many variations such as the Rationalized-Traditional, which falls between any two of the prototypes of production models mentioned above. It is evident from the above description that each one of these methods of production requires a special organization of the Housing Industry, a specific interface of the participants of the building process, and a special content of each factor of production, as it has been exemplified by the type of labor required, and by how the work has been organized. It is also evident that the four models of production differ as well in relation with the quantitative output that each one of them is capable of yielding.

Therefore, if we make the commitment to produce a certain number of dwelling units per year (and I would like to emphasize that a housing program cannot be based on numerical targets only, neither can the numerical output of units be the yardstick to measure the satisfaction of housing needs); it is necessary that we evaluate from all forms of production the one or the ones that, because of their intrinsic capacities, will be able to reach that housing target. The next step focuses on the organization of 'profile' that the Building Industry must have in order to correlate harmoniously with that new way of making the product. This step implies the analysis of present conditions and the feasibility and operational implementation of the needed changes in the composition of the Building Industry.

If we take as a case study the housing situation in the United States, we see that industrialization has been pointed out as one of the methods of satisfying the need for increased housing output and as a possible answer to a serious labor shortage. (2)

If the nation makes a commitment for such a way of producing dwelling units, it must first release the constraints that impinge upon this method of production. Therefore, it must set free policies such as those affecting the easiness of the money market, taxes, building codes, zoning, and practices when possible within a national market, and cost of land. Furthermore, the nation must make a commitment to reorganize the Building Industry in accordance with the selected production program, knowing that the constraints affecting the Building Industry take more time to be set free.

If the above mentioned steps are not taken (and let me clarify that I believe some of these steps must emanate from the government at various levels and some from the Building Industry) it will not be surprising that the new way of making the product will not yield the expected results. In the case of industrialized techniques of production, the renderings expected are, among others, the following:

- increased productivity
- reduced costs
- transference of labor from site to factory
- savings in skilled labor
- larger output
- increased speed of construction

and, more fundamentally, technology should become a built-in by-product of the organizational system of the Industry as well as of the design process.

Obviously, industrialized housing has been a word replacement of prefabrication, since it has made no contribution to the advancement of the technology of the finished product. It has introduced mechanization in the building process, making the same dwelling unit in a slightly different way. Very few of the experiments of prefabricated and modular houses that have been developed in this country in the last decade have achieved, at certain periods, volume production and, when so, those systems comprised only a small part of the total market output.

I believe that the inadequacy of the results of industrialized housing products is essentially based also on the fact that these attempts have tried to move from one form of production to a completely new form of production, keeping the factors of production,

the way they interact, and their intrinsic nature in an unchanged state of content and relationship.

It may be argued if industrialization will provide the housing that we need, at an increased speed of construction and at such lower costs that it will be within the purchase power of the lower income groups of society. The final price of a dwelling unit depends, to a large extent, on other costs than construction costs and professional fees. It depends on the money cost (interest over a mortgage), taxation, cost of land, time lag between the starting and the ending point of the building process and, of course, on construction costs which have increased in the last years due mainly to the rise of labor wages.

How much will industrialization cut down the cost of construction of a unit? There are many estimates circulating in the market, ranging in the average of 20% to 25% less than traditional construction. But I believe that this reduction can be increased if, as I have said before, there is a prior organized and total action oriented towards the release of the major constraints impinging upon the efficient application of this new way of production. Only then, industrialization can be measured and evaluated in its total capacity. If the panorama remains as it is at present, the organization and production of industrialized and modular housing will remain based on interpretational judgements at the scale of each enterprise and with partial analysis, and will offer no comprehensive solution to the problem of building in large volume without causing shortages and runaway costs affecting the factors of production, mainly during this inflationary period.

But there are some other reasons besides those explained above favoring the reorganization of the Building Industry. This set of additional reasons has to do with the efficiency of the Industry as compared to that of other sectors of production. As an example, and these are figures given by the Department of Commerce, during the last seven years, the productivity increase per worker per year in the construction industry was of 0.4% while that of the economy as a whole was of 2.5%. Though these productivity indexes show only output per worker, and do not take into account yearly hours worked for both sectors, nor do they consider that part of output of the manufacturing industries which give service to the Housing Industry, these productivity indexes focus on the wasteful ways in which we are, at present, utilizing the most scarce resources.

The structure of the Building Industry and, even more so the housing sector, is characterized by its fragmentation and decentralization; each participant of the process is concerned only in a particular segment of the overall construction process and has a specific area of responsibility, factors which create, in many instances, lack of cooperation and a very poor level of communication. The Industry is basically structured as it was at the beginning of the century, and the fact of its permanency while the whole context has changed so dramatically, has resulted in extreme efforts of self perpetuation instead of transforming itself under the impact of economic necessity into a more rational form of enterprise. "The free play of competition, which in our system is supposed to shake out the inefficient and adjust costs to the market, has been throttled by combination and coercion." (3) . . . of all the participants of the construction process, which try to obtain for their own enterprise the security and stability of their share in the local market, in detriment of the development of new producers' organization, new materials and methods of production and erection, new forms of distribution, and finally, of the integration of the industry at a larger scale.

Therefore, because industrialization is identified and selected as one way of increasing the supply of housing, or because this way of production signifies the savings of the scarce factors of production, or, finally, because the Building Industry or the country as a whole cannot any longer afford the continuation of the present 'state of efficiency', it is obvious that a reorganization of the Industry is very much needed.

In order to undertake this task it is essential to have full knowledge and understanding of the present available resources, in their composition and relations, so as to be able to design, direct and control the changes needed within the Housing Industry.

Greater industrialization in the production of housing implies the following, among others:

- setting up a new combination of factors of production in the Building Industry;
- a new organization of labour and skilled labour in the building trades;
- new building materials and innovative construction techniques as well as the more efficient use of current materials and practices for the employment of industrialized housing systems, (R & D);
- a more sophisticated management practices in order to successfully handle the larger scale of production, construction and marketing;
- greater financial resources in order to assure continuous production and mortgage funding;
- small physical variations in the composition of the demand must be transferred to modular coordination and standardization of the product;
- continuity and stability in housing demand, more than volume, must be secured if the Building Industry is to amortize any substantial increase in research, product development and capital invested;
- a gradual change in the content of each factor of production in proportion to that part of the output which is going to be industrialized, maintaining therefore, a flexible industry.

Flexibility becomes an important characteristic of the organization of the Building Industry. When building programmes are subject, on the one hand, to partial fluctuations of the demand which are due, by and large, to partial fluctuations in the general level of the economy and, on the other hand, to variations in the emphasis put on various programmes, the Building Industry must be able to absorb minor fluctuations in the demand, thus, supply of housing over short term periods, that is to say, within a building cycle, as well as among building cycles themselves. This flexibility, which has to be achieved through a long term period, will allow the Industry to respond to different types of production emerging from a non-totally aggregated demand, (there will always be the custom-made house, the repair and maintenance of

the stock of housing, etc.), in an efficient way, that is to say, by not loosing its trained manpower, its experience, its investments, and by not causing stoppages or shortages that will produce the beginning of an inflationary cycle.

Besides the issues raised above, there is an additional one which must be taken in consideration by all of those involved in the design and production of housing.

At present, industrialized housing is considered to be a synonym of poor quality, monotony, and standardization of the environment in a mechanistic way. I believe that this is not intrinsically true of such a method of production if we constantly keep in mind, at all levels of design, production and erection that the users have to be put in the foreground of our goals and priorities.

The dwelling unit is to be seen as a micro-universe of the individual or association of individuals living in it; in addition, housing is an essential component of the physical environment and, as such, must harmoniously relate to it in a social, economic, and morphological way. There is no irreconcilable dichotomy between the intrinsic possibilities of industrialization and the aims described above if we know how to utilize this method of construction as a tool that materializes and expresses man's highest ideals and creative capacities.

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