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PROCESSES SIMPLIFYING REPRODUCTION RATHER THAN AUTOMATION AND ROBOTIZATION

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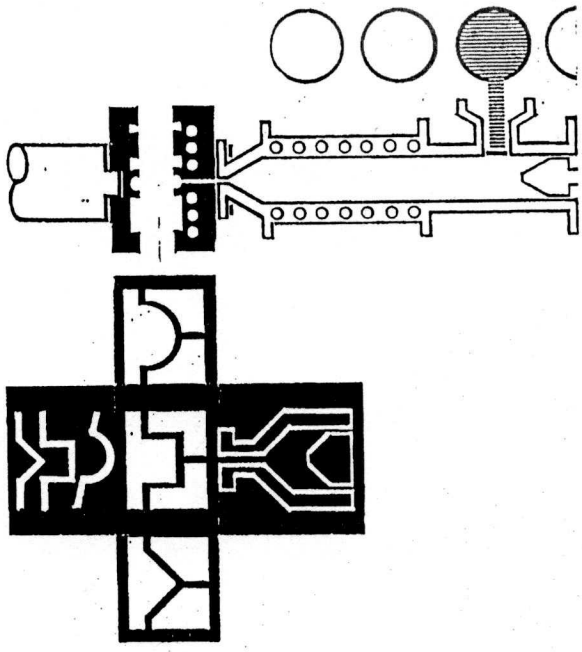
INDUSTRIALIZATION

We obviously live in an industrial and post-industrial era, where any product done in a craftsmanship fashion is bound to be luxury. Yet, there is still a lot of craftsmanship in the building industry today and the old saying is still true: if a car was produced the way a building is delivered, very few people would be able to own one; if an electronic calculator was produced the way a building is delivered, it would cost a fortune.

QUANTITY

Industrialization and post-industrialization are based on quantity, on volume: to justify with an important market the investment in a technology capable in return of simplifying the production of complex goods. That is the very nature of industrialization: a quantity will divide the investment into small (eventually infinitesimal) fractions, thereby reducing the production costs down to derisive amounts and making (if the economy is transferred to the pricing) the product available to a large audience. For instance, ask a friend who has a workshop in his basement to build a chair for you: he will buy some wood, glue and paint and, using hand tools, he will probably devote some 10 to 15 hours to do it. You are pleased and you want to distribute the chair to your neighbourhood, so you ask him to build 100, 200 and perhaps 500 chairs: he will not repeat 100, 200 or 500 times the operations involved with the first single chair. He will think about it and most likely buy a complete array of the most sophisticated electro-mechanical apparatus available today: the initial cost is high, but the number of chairs will reimburse it and probably leave an even greater benefit per chair than what he managed to get from the first single chair.

If you foresee a larger market and order 50,000 chairs then the plastic injection process will be considered: the mold itself costs a lot, over 50,000$, but it will produce plastic chairs at the rate of one per two minutes: that is one dollar per chair + material, a cost no other process can match. Of course it is a completely different, design, visually an aesthetically different, but it can be as solid and as comfortable: form follows process. Therefore, the critical investment in a more productive process, although costly at the outset, is generating a benefit progressing geometrically with the number of units produced.



DEGREES OF INDUSTRIALIZATION

Five degrees of industrialization are usually, recognized. The first four are PREFABRICATION, MECHANIZATION, AUTOMATION and ROBOTIZATION: **they are merely recycling the traditional processes, switching the tasks from the craftsman to the machine.**

Whereas the fifth one, which we will call "REPRODUCTION", implies **research and development of innovative processes capable of short-cutting the long sequential operations of craftsmanship nature, therefore truly capable of simplifying the production.**

A- PREFABRICATION

Pre – fabrication means **"before" and/or "elsewhere"**. In the building industry, it generally implies building in a factory components or full modules similar to the ones done on a traditional construction site, and in most cases using the same processes.

Still for the following reasons, prefabrication can very often bring the construction costs down, as much as 15% in some instances;

- Rationalization of the tasks along a production line;
- Specialized tooling and handling equipment;
- Semi-skilled labour;
- Climatic protection;
- Bulk purchasing due to the single delivery point.

B- MECHANIZATION

The emphasis is on mechanized **tooling to ease the work of the labour** (pneumatic harmer, power tools, etc...). Usually the case whenever there is large scale prefabrication.

C- AUTOMATION

The tooling is taking over; the foreman is still around, although the engineer and the programmer are not far. A study about Swedish wood-frame panels assembled by automation indicates an economy up to 27% compared with traditional construction methods.

D- ROBOTIZATION

The same tooling is performing by itself diversified multiple tasks.

E- REPRODUCTION

Reproduction is innovation intensive: **simplifying the production of complex goods by introducing a different technology,** and therefore achieving more substantial economies than mechanizing, automating or robotizing around the traditional construction methods.

Reproduction is meeting directly the purpose of industrialization where quantity justifies an investment to simplify production.

Misawa Homes' precastable autoclave lightweight concrete ("PALC") is operating along that concept: the PALC panel replaces with a single material all the parts and operations of the prefabricated wood frame panel (structure/ insulation / vapor barrier / cladding / interior finish / etc...). Combined with an automated assembly line for the full 3D module, that approach can lead to a production economy of up to 50%.

Of course, reproduction is not necessarily available as a downright option: it is often present together with some of the other degrees industrialization.

Three analogies can illustrate the full meaning of reproduction: printing, the printed-integrated circuit and the printed plumbing core.

First analogy: PRINTING

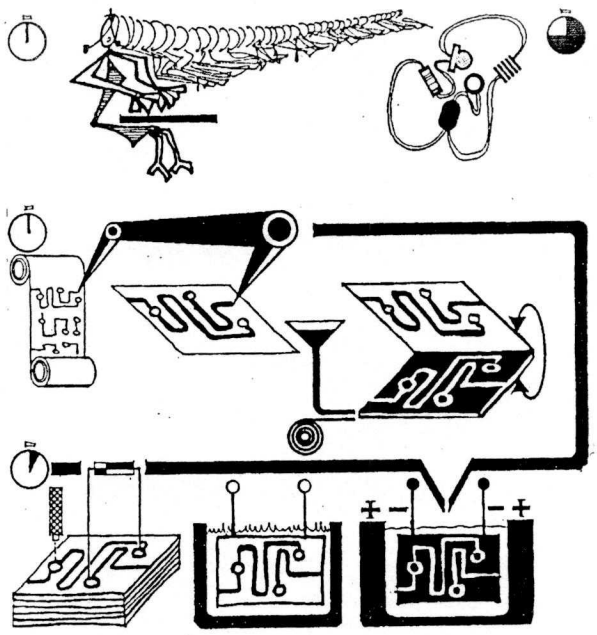
Instead of hiring a staff of copyists to rewrite "n" copies of the Bible, Gutenberg carved a large amount of wood types. He invested a lot of time in doing that, more time than to rewrite one, two, three even four copies of the Bible.

But when the types were available, Gutenberg did set them to produce a full page, inked them and made contact with "n" sheets of papers to therefore produce "n" copies of the page and, eventually, of the full Bible; a lot faster and easier than with the copyists.

Gutenberg has therefore justified quantitatively a process capable of simplifying a complex product. The rotary press that came later went even further by replacing the on-off operations by a continuous production, that a knife will complete to obtain separate pages at the end.

Second analogy: THE PRINTED-INTEGRATED CIRCUIT

If the electronics industry had replaced by machines the labour that used to weld components to wires in the old wired circuit, they would have moved to mechanization, automation or even robotization. But a "new Gutenberg" had the idea of replacing the time consuming and multiple hand-made weldings by a simple and almost instant operation: silkscreening the circuit paths reversed (negative) on a plate, and getting a positive conducting network by electrodeposition. The "printed circuit" has a completely different configuration from the wired circuit, either man-made or even automated, but meets the same requirements much better (less space, high precision and more solidity). And the product can be modified just by changing the pattern of the silk-screening.



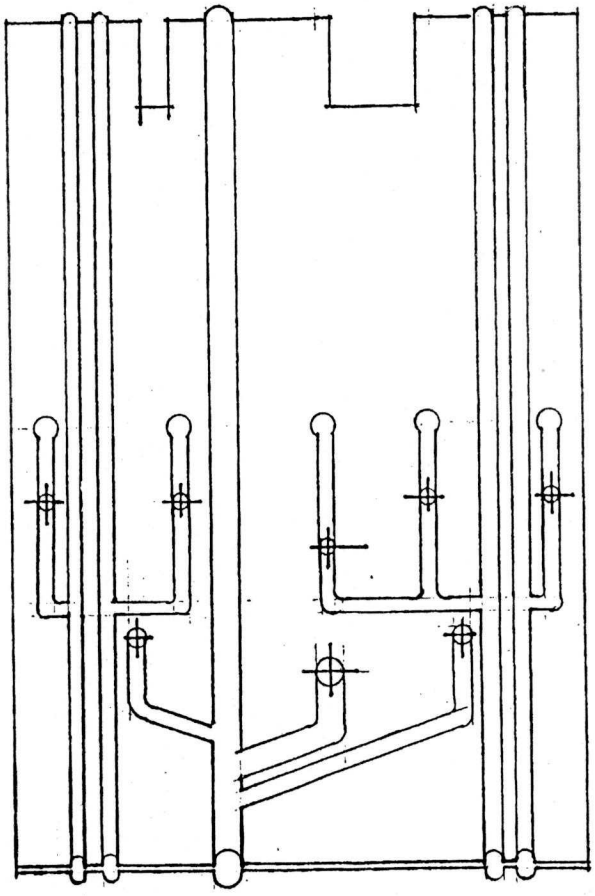
Afterwards, the integrated circuit went one grant step further by printing the components themselves on the circuit. And this explains the multiple low cost electronic goodies available on the market.

Third analogy: THE PRINTED PLUMBING

Let us move from the printed circuit to residential plumbing; as it is also a network connecting components.

Traditionally, the pipes are cut to pieces, attached to couplings / gaskets and connected "in situ" between themselves and to the components. Some manufacturers did offer a "prefabricated" plumbing core; but as the market did not respond, no automation or robotization followed.

Heinz WAGER, from Ulm, came with a bright proposal directly connected to reproduction: a true printed plumbing core formed by two pre-molded sheets (vacuum formed plastic or deep-drawn aluminium) where each sheet has the conducts embossed as half circles. An adhesive applied with a roller covers only the flat part and leaves the face-to-face half circles as open conduits.



THE TECHNOLOGY MATRIX ("PALETTE")

Based on those three analogies, we can define as the key to industrialization the development of an innovative process capable of simplifying the answer to a complex product.

It is foremost important that the process specifically meets the needs. Listing the performance criteria is the only way to connect needs to technologies.

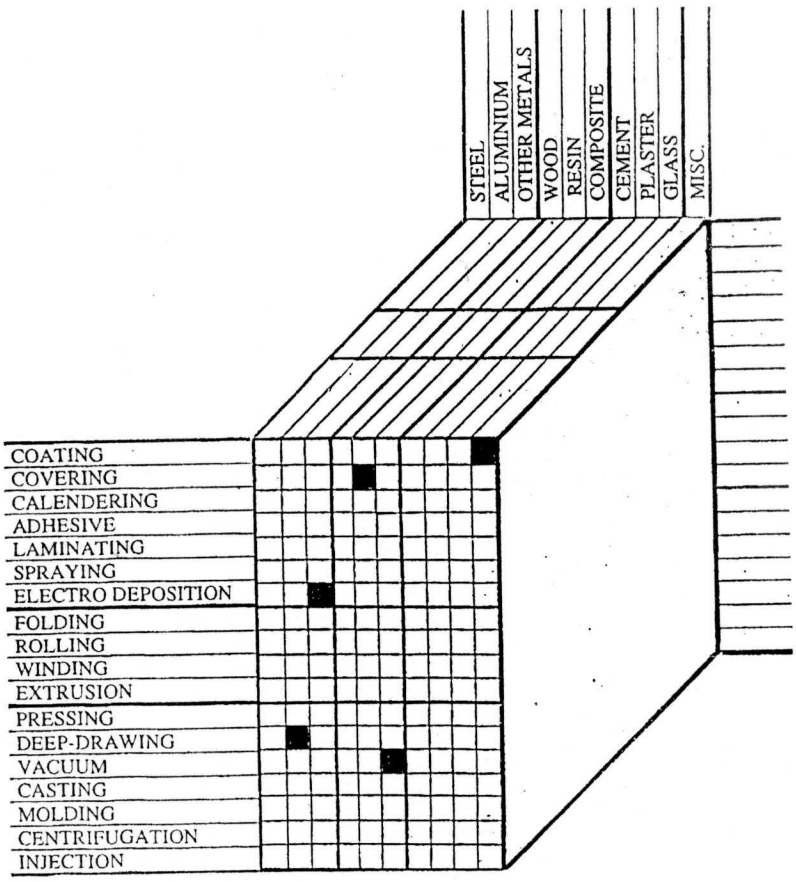
By aiming at the performance rather than the form, the criteria will permit a more open selection of technologies. Even if it means, quite appropriately, that the product has a new image, closely related to the process as it was the case with the printed circuit.

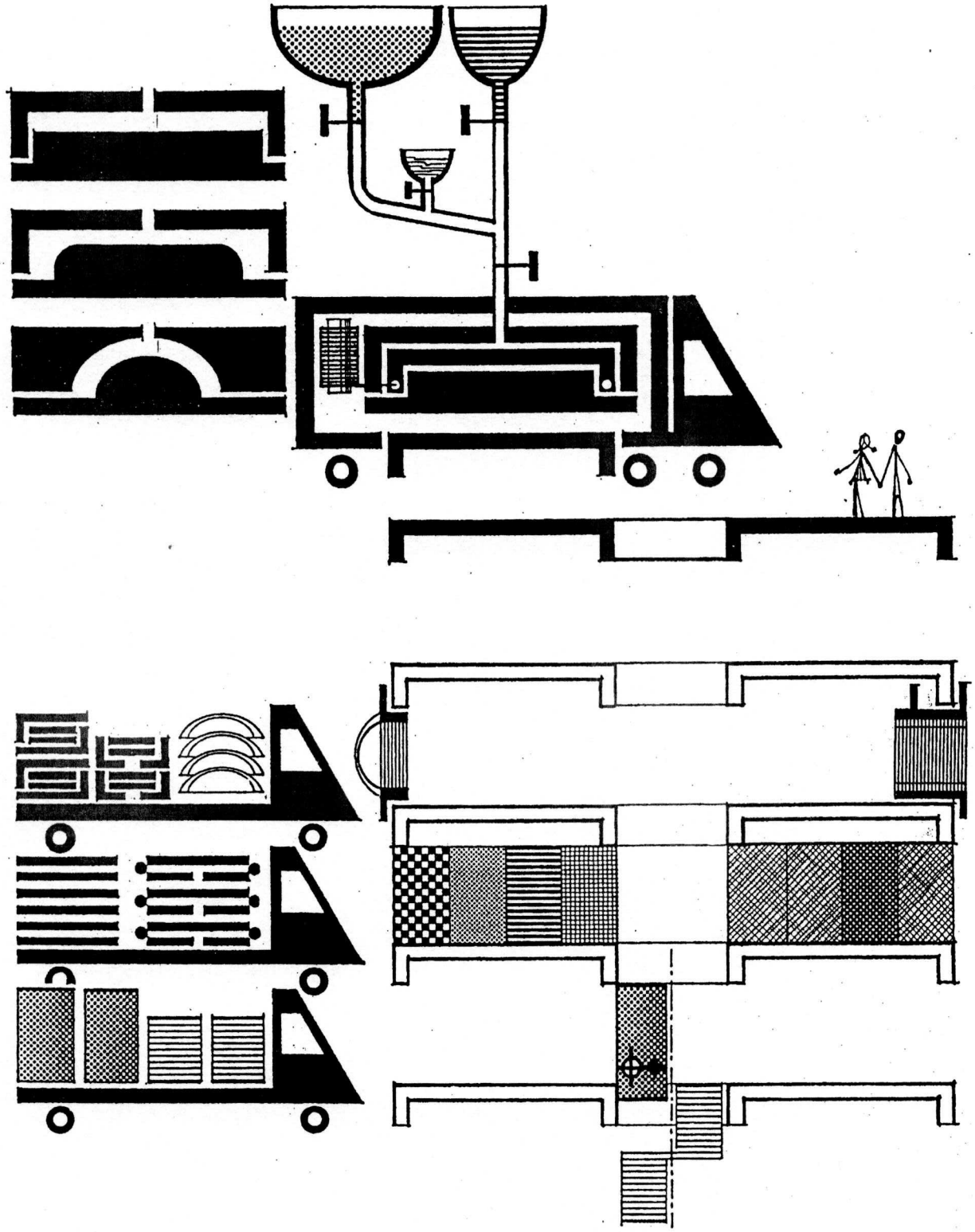
Like the painter who can select from the basic colors on the palette, the designer can start with a matrix of technologies, where processes interact with materials.

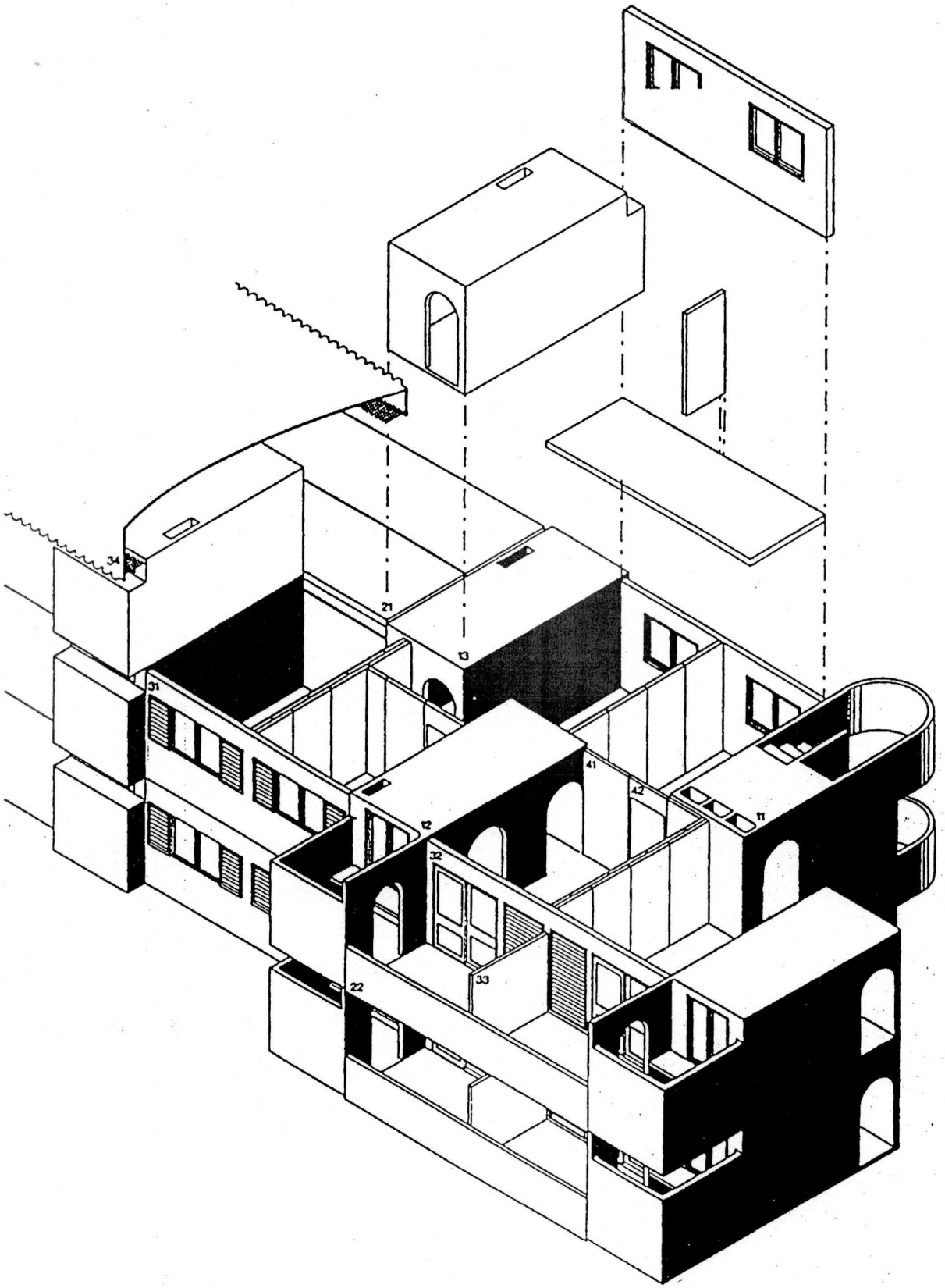
Matrix where one can locate, for instance, the two interactions that led to the printed circuit: coating (silk-screening) ink (misc.) over lead (other metals) electrodeposited on a plate.

Matrix where one can locate, for instance, the two interactions that led to the plumbing core: deep-drawing an aluminum sheet (or vacuum-forming a composite sheet) and covering with adhesive (resin) the flat parts.

There is more to do than was done and there is no limit to the possibilities of the Technology matrix or "palette": the matrix is promising more innovation than the mechanization / automation / robotization of our traditional craftsmanship methods. Therefore the emerging technologies should simplify production rather than replacing the human hands with machines: **REPRODUCTION RATHER THAN AUTOMATION AND ROBOTIZATION.**



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