Transfer Ready Ideas from Outside to Home-building.
TRIZ Helps to Find Solutions from Other Industries.

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This paper tells how to transfer best ideas to housing and construction from automotive industry, from technologies for blind, deaf, and disabled people, from supermarkets, aerospace, and other sources of innovation.

Tens of case studies I have made preparing newspaper and magazine articles on science and technology have provided the database for the paper. I have written of telephones, cars, clothing, airplanes, nanotechnology, sewing machines, e-books, elevators, water closets, lie detectors, biometric recognition, milking robots and other topics, far from each other.

Journalistic practice teaches to select "the best from the rest". It is absolutely impossible to learn "everything" of every technology or industry. It is necessary to find the important, and only the important, features of the particular technology.

I have seen that there are much more similar features in different industries than experts usually admit. A good example is home-building industry that often have been compared with automotive and aircraft manufacturing. Problems and solutions are not so different. Less obvious, but exciting features can be found in technology for disabled people, and in Design for All, or in Universal Design.

Lessons from "House Ford" and "Citrohan"

In the book *American Genesis* historian Thomas P. Hughes describes lively how new hopes "to fulfil the age-old dream of inexpensive, attractive, and healthful homes for masses" rose hundred years ago [3, p. 315]

German-American architect Walter Groupies "wanted factories to produce standardized, interchangeable houses components that could be assembled rationally into various combinations... wanted different models of houses, but he would limit variation from standardized components to a few types". [3, 316] The goal was to build "cheaper, better, more attractive dwellings", wrote Gropius.

The automotive industry provided the model. Groupies coined the word "Wohnford" or "house Ford". Swiss architect LeCorbusier envisioned "Citrohan", by analogy on the French "Ford", Citroen.

During last decades the idea of mass-produced homes have been repeated many times. Herman Kahn and Anthony Wiener [4, p. 52] listed in their famous book *The Year 2000* , published in

1967, "One Hundred Technical Innovations Very Likely in the Last Third of the Twentieth Century". Innovation number 80 in the list was "very low-cost buildings for home and business use".

Now, more than 80 years later, we know that housing and automotive businesses have been developed separate ways.

We have relatively cheap AND attractive cars. Automotive industry learned already in 1920s to manufacture many different models from a limited number of parts. Today, extensive use of standard modules allows to get cars for every purpose and taste, and with more and more features, without extra cost. Using the vocabulary of TRIZ, the segmentation principle has been used. To learn more of the principle, see, for example, papers on 40 principles in the TRIZ Journal [1], or "Simplified TRIZ..." [8, p. 133-136].

In housing the picture was different already in the beginning. In a fresh book, *Leonard to the Internet*, another historian, Thomas J. Misa, describes how Groupies practically organized house construction in 1920s in Does, Germany: "The houses stood in rows, and rails laid between them carried in the building materials. Such labor-saving machines as concrete mixers, stone crushers, building-block makers, and reinforced-concrete beam fabricators created a factorylike environment... Individual workers performed the same tasks over and over on each of the standardized houses [7, p. 181-182].

There was mass production and standardized houses, but no individuality. The result was, as Hughes puts it, "banal buildings designed with primary concern for cost savings" [2 , 324]. They were, in best case, relatively inexpensive but NOT attractive. Later attempts to mass-produce prefabricated homes failed as well. Kent Larson, an architect at Massachusetts Institute of Technology, describes the causes of failure in the story of Peter Hall: "... they were single-purpose structures with a single form." [2]

We can easily understand successes and failures and get valuable lessons using the evaluation criteria of TRIZ. They are described, for example, in "Simplified TRIZ..." [8, pp. 91-101].

By the criteria, harmful features should vanish, useful features should be retained and new harmful features should not appear.

Automotive industry has been successful since costs have been reduced and at the same time useful features, individuality and attractiveness has been retained and increased. Contradictory requirements has been satisfied largely because of the industry has followed relatively well the segmentation principle, and also other principles and patterns of evolution.

Building and particularly home-building industry has been clearly less successful. Low-cost, prefabricated homes became ugly and unpopular. Beautiful and attractive homes and apartment were and are expensive. Contradictory requirements were not satisfied. One reason is that the segmentation principle have been used only partially. Much handwork on-site is still needed.

There have been much talk of introducing the best practices of car manufacturing to building industry, but very little serious attempts to learn what are the useful features worth to be transferred. Only last years architects have begun to study in detail, which are the secrets of most successful industries.

Kent Larson proposes that house construction should move "toward a mass-customization process" [2]. That is, mass production is not enough. Customization is needed, too.

Mass-customization from the point of view of TRIZ have been considered in many papers. See, for example, Mann's and Domb's article on 'Business contradictions' [5] and the paper of Mann and Winkless on customisable foods [6].

The segmentation principle is actually the same as one important pattern of evolution: transition from macro- to micro-level. So we can also conclude that if you follow the patterns, you will have success in long run. If you ignore them, you will finally fail.

Surprises that Should not be Surprises Any More

Perhaps there are, besides car-making, other industries that can give valuable lessons to housing?

In earlier papers I have told of little known "industries", the technology for deaf people [7], and universal environments, accessible for all people [8].

In the paper on accessibility and Universal Design I wrote of a surprise: ". In a family with four children a bright an comfortable room was made for a disabled child. Other three children, too, wanted to play in this room!" [10].

Let's add yet a couple of examples. One city in Eastern Finland, Joensuu, built 40 specially designed apartments for disabled people in 1980-1990. It happened, that there were not enough disabled persons, and 11 apartments were inhabited by so called "healthy" people.

About ten years later the architect and managers, responsible for the construction, interviewed inhabitants. It was not surprising that disabled people liked accessible homes. The surprise was that also people without any handicaps loved them. They didn't like to move to "ordinary" buildings.

In a seaport terminal in Helsinki colors and lighting were reconstructed so, that visually impaired people could easily find the way. All worked even better than planned. Passengers with weak vision were happy, as expected. Additionally, there were an extra benefit no one had thought about. Visually informative environment helped drunken passengers, too, to get oriented!

It's useful to compare the experience of automotive industry with the results of Universal Design. One can easily make a hasty conclusion, that straightforward mass production is always bad and mass-customization always a better approach.

Temporary, movable ramps, complementing steps and thresholds when necessary, can be seen as an example of flexibility and mass-customization.

Certainly temporary ramps are in many cases the best solution, but as we have seen, very often, too, it is most simple and convenient to make a fixed one. This is the case when the same size fits for all!

Not long ago I observed building works for a summer housing exhibition. I saw temporary ramps that construction workers had made for themselves. Many ramps were in places there were no reason not to make permanent ramps instead of steps.

Here we see also, yet once, that it is useful to observer, how people are using technology and how they do improvements to cope with design flaws.

Lessons from Near and Far Industries

Many industries, not only car manufacturing, deserves to be studied to get ready solutions for housing.

Let's name yet some exciting sources of innovation:

- There is more flexibility in office and industrial construction than in housing. There are ready models for mass-customization.

- Shopping centers and malls, particularly big ones, are barrier-free. There are no thresholds. One should have access to everywhere with shopping carts. For the same reason ramps should be smooth. You can find valuable ideas simply looking around.

- In air liners emergency floor lighting is required. The same idea can be used in staircases . Ready and inexpensive technologies are available.

- Ships are built, or more exactly, assembled from large subassemblies an hull members.

We See the Power of the Patterns of Evolution Yet Once

Let's summarize the results of our discussion on housing:
1. Housing is, in general, less developed than many other industries
2. Automotive industry, design for all, aerospace industry, shipbuilding and others have developed many solutions, so fare rarely used in housing.
3. Many results from various "lead industries" can easily be transferred to housing

Thomas Hughes uses a term "reverse salient", borrowed from military parlance [3, pp. 70-74]. The front line has salients or parts projecting far toward the enemy. Reverse salients are, consequently, inwardly projecting parts.

"The reverse salient in advancing military front proves an apt metaphor for a technological system, because the system, like a military advance, develops unevenly", writes Hughes [3, p. 72]. So he gives actually yet one example, illustrating a pattern of evolution, studied by TRIZ: Uneven evolution of the parts of the system. For details, see "Simplified TRIZ..." [8, pp. 109-111].

If we know where are salients and reversed salients, we can eliminate backward parts with the help of forward ones.

Generally, to find ready solutions from outside:
1. Use the concepts of TRIZ study the evolution of the technology
2. Study many industries in order to find solutions, usable in various industries
3. Transfer good features from "salients" to "reverse salients"

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