

DEMATERIALIZATION IN ARCHITECTURE AS AN IMPERATIVE OF SUSTAINABLE BUILDING

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Summary

Global consumers material culture dominates our ordinary behaviors with enormous materiality level increase – kind of physical objects spam. Nations or societies can be characterized by different models of materialization and various scales of its environmental impact in long time perspective. Architecture and building sector as influential player on global materials flows market should take responsibility to create a truly sustainable development, reducing embodied overloaded components, material hegemony and wasteful energy consumption. Architecture and building process should be dematerialized as much as possible to be an imperative of real sustainable building. Various dematerialization models such as: re-materialization, re-location, de-carbonization determinates eco – efficiency of buildings and quality of life for future generations. Architects should recognize dimensions of dematerialization, its consequences and opportunities of relative and apparent dematerialization to know, how to enrich shaping spaces with soul and psyche, immaterial pieces of our habitats.

Keywords: dematerialization models, material culture, rematerialization, negatonnes.

1 Material culture in architectural design

Evolution of designing methods with focus on environmental and dynamic ecological systems approach is not disputable fact in the field of architectural design today. In the context of public discussion about sustainability ideas in a global building sector, which took more than 20 years since Earth Summit in Rio de Janeiro, we can find various “ecological design styles in contemporary architecture”, some practical tools for green design, urban ecology guides or agendas helping to understand “what are we talking about”. But environment friendly architecture development is too slow and still it is not a main stream in creation of city fabric wellness or living city organism. Each year growing energy and materials consumption in built environment is a proof that global economy is resources hungry. To improve eco-efficiency of new buildings and products or existing ones, we have to change production and distribution policies in a radical and practical way.

There are many consumers needs which can be realized without a necessity of buying a material, physical product with its functional form of matter. Hire a product for short term or calling an appropriate service, can our needs be satisfied and in the same way we can reduce materials and energy consumption fulfilling consumers needs in sustainable way, promoting simple form of product dematerialization (table 1).

Tab. 1 Product dematerialization examples [by Janikowski, 1998]

Physical product	Dematerialized product
washing machine	laundry service
car	mobility service
satellite dish	cable or internet TV
domestic water heater	heat domestic water supply
radiator	heat supply
goods like: video recorder camper drill, etc.	video recorder rental, camper rental, drill rental, etc.
materialized form of information: letter, fax, paper documents, etc.	virtual form of information: e-mail, e-paper, e-book, etc.

Different definitions of dematerialization exist in a public domain, sometimes narrowing interpretation to mass reduction in a product or replacing its meaning with another terms such as transmaterialisation, optimization, digital conversion, profit increase mechanism, etc.

Following sustainable development idea in general, dematerialization can be define as a reduction of materials or/and energy use in existing or only creating products or services to minimize negative environmental impact without compromising the ability of present and future generations to meet their own needs.

Today looking for high quality living, „more and better”, offered by economical growth, in reality can be replaced with “less and worse”. Present consumers society creates more and more needs, incredible number of goods – everyday material objects of desire, which produce problematic wastes and emissions generation for the future.

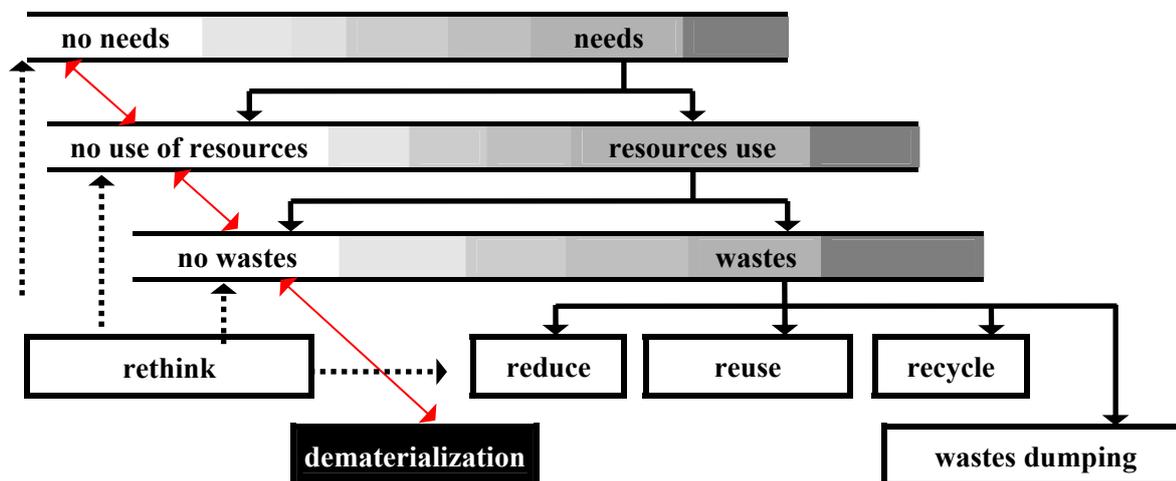


Fig. 1 Relations between creating consumers needs and wastes generation as dematerialization context.

A basic problem of our material culture today we have to face is not a quality of physical products but a completely new definition of “**product – production – consumption**” concept as **resilient, dynamic networking systems**.

Tab. 2 *Connections between ideas of sustainability and dematerialization forms in architecture – examples*

1	Sustainable development	Sustainable architecture – e.g. rematerialization – revision of building materials assortment, natural materials versus artificial, replacement not biodegradable for biodegradable as part of dematerialization form.
2	Service oriented economy , society based on knowledge	Architecture of process, evolutionary design, cyberspace architecture –kilograms for baits exchange.
3	Industrial ecology (clean production, closed loop economy, metabolism, zero waste cities)	Ecological industrial parks –synergy effect, ecoefficiency introduction in design methodology, development of co-housing and New Urbanism idea,
4	Life cycle assessment, life cycle management, life cycle costing	Urban space recycling, city regeneration, brownfield and greyfield revitalization – resources efficiency, waste minimization
5	Factor 4/10	Minimalizm (minimal art), compact cities – ascetic material applications, resources efficiency in urban structures
6	Ecological footprint, ecological space	Urban Ecology, „zero energy” development, carbon neutral buildings – metabolism in urban planning,

2 Dematerialization scales and physical dimensions identification

Dematerialization can be applied in different scales and various physical dimensions. We should treat it as a kind of dynamic and holistic process witch starts early in product programming and planning phase, where first sketches and misty ideas appeared. First drawings, functional programs, basic measures, materials components or energy concepts can be identified as a 2D dimension.

Building spatial models of products or buildings and searching relations between another objects located in physical space is a next step defined as a 3D dimension. Studying proportions and material or energy flows between objects and buildings in space (physical space treated as valuable, not renewable resource too) is important for scale of dematerialization in exact moment. Next added measure is time factor which creates a 4D dimension where for example aspects of product life cycle management or life cycle costing (so influential for dematerialization process) can be analyzed in long life perspective. Going forward – a 5D dimension is a matrix of different simulations of products or buildings, generated for different life cycle scenarios (e.g. variations for end of life scenarios, “life after life” architecture) activated in dynamic time – space dimension. Dematerialization process can be optimized using virtual simulations methods in 5D dimension, showing different simultaneous data including inter alia: negawatt power (an amount of energy saved) or negatonnes (an amount of mass saved or recycled) per functional product unit in a life span. Of course predesign or design stage of product, object or building is not only a focus point of dematerialization. Another phases of life cycle are important too, specially deconstruction stage as a part of the Cradle-to-Cradle disign idea seems to be influential for reuse or recycling old resources for new products in closed loop economy.

3 Dematerialization process implementation in design stage

Locally, for the investment process and globally, for national economies dematerialization process implementation is complex activity with demand of different, interdisciplinary actors engagement and cooperation. It is necessary to considerate different models of dematerialization in early design and planning stage. To find potential of mentioned models it is necessary to discover scale of impact to biotic and abiotic environments just in prenatal phase of new products, objects or buildings, having in mind creation for immaterialized economy with reduced entropy factor.

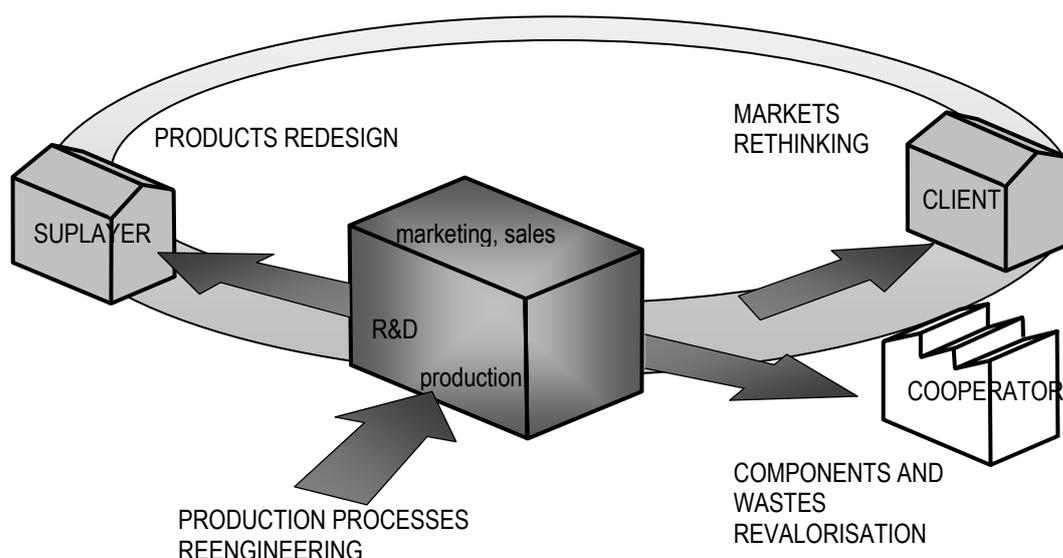


Fig. 2 Materials, energy and economical savings potency in product life cycle frameworks as a background of dematerialization process in fields of production activities.

The simple figure presented above is a kind of „road map” showing possible sectors of ecological efficiency and relations with dematerialization process. Materials, energy or capital savings potency can be identified in four fields of activities (such as: production processes reengineering, products redesign, markets rethinking, components and wastes revalorization) related to product, building or urban complex whole life cycle framework. On this base we can discover different models and scales of dematerialization.

3.1 Dematerialization – MODEL 1

- 1 dimension
- focus on/reduction of: (one variable)
 - **size** or
 - **volume** or
 - **mass**

Another suboption of MODEL 1 can be considered:

- 1A) **minimalization, optimization** – number of materials reduction
- 1B) **rematerialization, substitution** – another material replacement
- 1C) **transformation** – material replacement with service

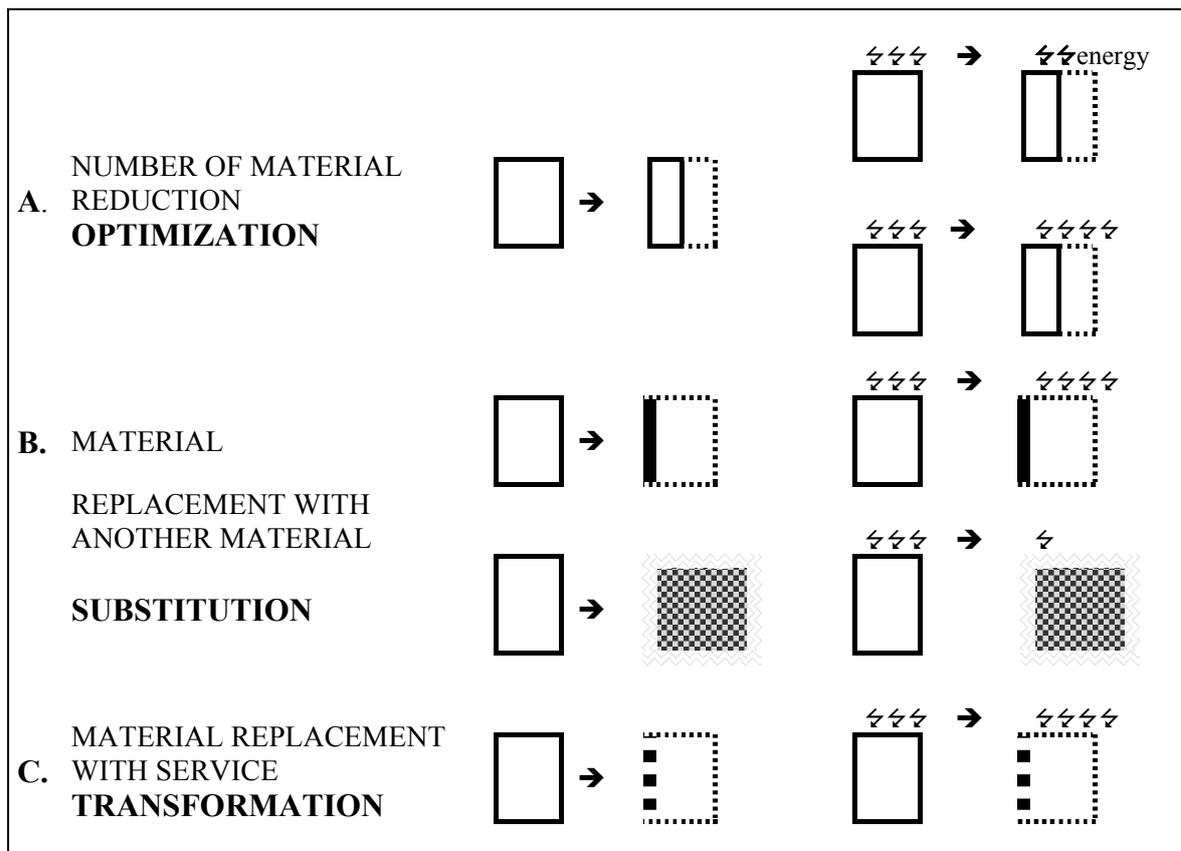


Fig. 3 One dimensional dematerialization model samples and its environmental impacts in context of resources and energy consumption

The simplest, one dimensional model (MODEL 1) is focused on single variable in modified and analyzed product, object or building structure. The relative or apparent reduction of materials used per product unit is the most common aspect examined in this model and its consequences on economical and environmental assessment. Wastes minimization or resources efficiency in a production process or in any functional product unit in its life cycle framework is another aspect of described model contemplation.

3.2 Dematerialization – MODEL 2

- 2 dimensions
- focus on/reduction: (two variables)
 - **mass consumption + energy consumption**

MODEL 2 of dematerialization is two dimensional model of exemplary product, building or urban structure, focused on material and energy consumption influence based on MODEL 1 development.

3.3 Dematerialization – MODEL 3

- 3 dimensions or more
- focus on/reduction: (three variables)
 - **mass consumption + energy consumption + total emissions in life cycle framework**

Complex, three dimensional MODEL 3 of dematerialization is taking in consideration total emissions next to resources and energy consumption in long life cycle perspective. Dematerialization as an economic phenomenon is of interdisciplinary nature. When narrowing it to the building sector the need of involvement of many investment process participants must be highlighted. It is connected with changing of foregoing vertical hierarchy of information into horizontal one in frame of created, often ad hoc, interactive network system.

4 Conclusions

Dematerialization in architecture has different forms, takes place in a different scale, is comprehended and interpreted in different ways. Besides esthetical, business and vogue issues, the ecological motivation of dematerialization implementation, which arise from readiness to cut down the antropopressure, is the need in the framework of quick and irreparable changes in biosphere. Ecological motivations of dematerialization can be based on arousing conscience of wasting society or on forming social and ecological intelligence. Such activity shown in sustainable architecture should be a guarantee of renewal of harmonious relations with biotic environment and favours comprehension of dynamic phenomena which keep the ecosystems in vitality.

There are a lot of tools and helpful strategies which allow successively to implement dematerialization process in economy. In the architectural design, systems of ecological certifications of buildings, sustainable building and ethical investment systems as well as digitization with BIM modelling and internet tools development of open network society seem to be extremely useful.

The important intermediate stage of dematerialization is rematerialization meant as the revision of technology and materials well-used. The purpose of rematerialization is an increase of long-term productivity solution used in building and architecture, minimalization of wastes and pollution what set the first determined step into sustainable architecture. Applying biodegradable materials or possible to reuse/recycle ones will influence the way of designing as well as cause changes on building materials market, formal and esthetic changes in executed objects and will have an impact on space users' behaviour.

Undoubtably the main idea in promotion of dematerialization and sustainable architecture should be economic, social and ecological harmonization what gains the kind of dynamic state of self-support for systems and minimalization of entropy level.

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