# Adaptability Analysis as a Necessary Baseline for Designing the Conversion of Industrial Buildings

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# Adaptability Analysis as a Necessary Baseline for Designing the Conversion of Industrial Buildings

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**Abstract.** The paper is dealing with the design process of adaptation of industrial buildings for new use. It describes a generalized analysis of the adaptability of industrial heritage at the scale of sites, buildings and their parts. The paper describes the spectrum of new uses and their demands on the target spaces. The architectural instruments for increasing the adaptability of buildings are named, as well as appropriate design principles for conversion with a view to minimizing the necessary interventions and preserving the unique atmosphere and industrial identity of the environment. Alternative and low-impact conversions and interim use of buildings are emphasized.

## 1. What is adaptability

Besides the potential of the site and the structural and technical condition of the buildings, the adaptability of the original spatial structure - i.e. its ability to accept a new use different from the original one - is a priority input for consideration of new use in the form of conversion. Adaptability is primarily predetermined by the concept of the original building or the characteristics of the building shell, which was built to meet the needs of the original production. In the diverse spatial structure of industrial buildings, there are both easily adaptable and poorly adaptable spaces[1].

## 2. Primary Predetermination

Within the classification of production buildings, two basic groups can be defined according to the relationship between the building shell and the production processes for which they are built. On one extreme, special objects, built over technology, form the cover of a particular production facility or, in the extreme case, form the production facility itself or a part of it. It is very difficult to find a new use for these objects, in many cases even impossible. Typical representatives are buildings of primary processing of raw materials - metallurgical or mining industry, lime and cement plants, as well as buildings of energy industry (power plants, gas plants, boiler rooms, machine rooms) etc.

On the other side, universal objects, built over production processes, are flexible, being able to accept the change of production technology, but secondarily also the use of the entire object. These are usually designed very rationally, most frequently as a skeletal building with an open plan and with accompanying facilities and communications located outside of the production area itself. A typical representatives of these are storey and hall buildings of light industry: textile, tobacco, electrical, light engineering, etc. or warehouse buildings. We can say that universal production buildings can be converted for nearly any different purpose without major issues.

Prof. Otakar Štěpánek has already defined this basic division in the Czech environment in 1930s [2]. His successor, Prof. Emil Hlaváček, later specified industrial buildings as "single-purpose" (special), "multi-purpose" (universal) and "combined" (intermediate types) [3]. The third named group is represented by the buildings of the food industry, which are characterized by the fact that they consist of both single-purpose and universal parts. These include objects of the brewing, malting, hop, distilling, sugar and dairy industries, as well as mills, bakeries, etc. Similar classifications have been made analogously elsewhere in the world.

## 3. Detailed adaptability analysis

However, the previous basic division is only a guideline, it serves mainly for initial orientation in the given situation. It turns out that a deeper analysis of the spatial structure which is the target of the proposed future transformation is necessary for a perfect understanding of the existing spatial substance required for a competent and responsible design of the conversion.
As mentioned, adaptability is predetermined primarily by the specific character of the production processes and their needs. The models of industrial buildings necessarily had to be adapted to the context from the very beginning - the size and shape of the site, the surrounding terrain configuration, the surrounding buildings, the specific purpose and the production capacity planned, as well as the economical capabilities of the developer.
The situation is further complicated by other factors, especially the construction history of the plant - the factories have been modified frequently during their lifetime, not only to increase production capacity or switch to more modern technologies, but also after frequent fires. A complete change of use with a new owner was also common, i.e. the adaptation of buildings for a completely different industry. In the Czech environment (and similarly in other countries of the former COMECON) in the situation of the state-controlled economies during the 2nd half of the 20th century, a characteristic feature is the utilitarian method of interventions based on current needs. Without respect for the original concept and the indisputable quality of the architecture and the environment of the complexes, without considering the perspective of possible further development. Surprisingly, in the period of changes after the Velvet Revolution, this approach is even more noticeable. We cannot forget the layer of interventions in the eventual time gap between the shutdown of the production and the new competent use, which often transforms buildings and sites even more radically when adapted for substitute programmes.

**Figure 1.** – Altenberg Jihlava - multiple transformation of the site from silver mining through paper mills, large-scale textile production followed by engineering production and finally fragmented use of the compact area by a number of substitute functions. Photo: © Matěj Ševela

It is therefore recommended to perform a detailed analysis of the adaptability of industrial complexes on a building-by-building or even on a space-by-space scale. In this process, the following criteria and limitations are monitored in particular:

- Dimensions: absolute dimensions, clear heights, proportions of spaces, character of spaces (hall, story building, container...), correlation of dimensions to the human scale, graspability of extent, tract depths, construction spans, similarities to "civil" architecture
- Accessibility and connections: access to the premises, direct accessibility - entrance, driveway, and accessibility for the disabled, relation to the exterior, elevation, relation to the terrain (above ground, on the ground, subterranean), existence of internal communication infrastructure (vertical communication, existence and size of openings, passages…), spatial structure permeability and linkage to the communication infrastructure of the sites
- Parameters of the internal environment: natural lighting, possibility of ventilation, character of the building envelope, availability and parameters of technical infrastructure and its reserves
- Properties of the building structures: load-bearing ability, material characteristics, fire performance, character of the building envelope, thermo-technical characteristics, spatial limitations of the structures (e.g. vaults, density of supporting elements), usability and eventual reserve of the constructions.
- Other constraints, e.g. high occupancy with built-in technological equipment.

On the basis of such a detailed analysis, the following spaces can be further defined: universal, adaptable with limitations, special and non-adaptable:

- Universal spaces are the most versatile, they can be easily adapted to whatever is needed without any structural interventions, in a mode of so-called natural compatibility.
- The second group can be used only conditionally. It requires respect for the identified limitations and/or the application of architectural interventions that mitigate or eliminate the negative impact of these limitations.
- Special, apparently non-adaptable spaces can be re-used and even be used well - but it takes a high degree of creativity by the architect, the proper selection of flexible usage and a non-template approach.
- The non-adaptable parts are not suitable for new activities, but that does not mean they have to be removed; they can remain as a memento, vestige or an exhibit.

By analogy, adaptability should also be evaluated on a wider scale at the level of entire complexes. The following should be monitored in particular:

- the rationality of the establishment
- the presence of a competent infrastructure - both transport and technical, the connection to the surrounding urban structure
- the proportions of the spaces in between buildings and their transformation potential into future public spaces
- possible potential for the development of the complex, as well as the spatial reserves
- and finally, the adaptability of the individual preserved buildings.

Only such a detailed analysis is a sufficient instrument for understanding the environment and for responsible consideration of new use and the conversion.

## 4. Demands of new uses

Similarly, the formulation of the new programme has a major impact on the feasibility of the conversion. Any activity has demands on the spatial structure in which it is to be installed and so shapes the environment. The new function enters the previously established and stabilised environment with greater or lesser demands on its characteristics, but possibly also with ambitions to change this environment. The possible mismatch between these demands and ambitions and, on the other hand, the form of the existing environment has to be managed. From this perspective, two basic situations can be identified:

The flexible, spatially versatile utilization does not have specific space and functional demands. It can even accept the spatial form from the "target" spaces. Among the common functional uses, this category includes in the first place functions related to culture - galleries, museums, clubs, etc. These are activities with a spatially free form. Cultural uses usually do not have non-negotiable demands on the indoor environmental quality, especially natural lighting and thermal comfort, which can be ensured in a compromising way.

From other common functional uses, this category includes a range of uses in non-standard or specific formats - freespace, fluid layouts - loft apartments and offices, open space offices or non-traditional hotels, restaurants and shops, etc. Manufacturing activity - whether physical or intellectual production - can be also relatively well accommodated. Apart from the free spatial form, all these functions are characterised by low density and relatively low pressure on the required area and volume efficiency. Naturally, this category also includes alternative, low-impact and temporary uses.

On the other hand, spatially specific uses do have special and clearly defined demands on space and operational links and must be used to occupy spaces with suitable characteristics or to modify the existing spatial structure appropriately. These are standard forms of premises which usually have their spatial and other requirements specified in legislation and regulations. This category contains the majority of common uses, in particular housing and accommodation, offices, healthcare, education, sports, commercial, and other functions in their standard spatial forms, with requirements for rational layout and high efficiency of use of space.

Of course, when planning a conversion, it is necessary to align the proposed design with today's legislative requirements. The demands of conventional forms of usage are solidly supported by current regulations, codes and standards, which, with few exceptions, do not differentiate between new-build and adaptation situations.

In addition to the above-mentioned space and operational requirements, fire safety requirements appear to be the most critical. Some types of load-bearing structures (cast iron, timber) present problems. The quantity, parameters and location of emergency escape routes are often inadequate.

A standard design task is to ensure the necessary spatial qualities and linkages. The parameters of communications can be under-dimensioned, especially in a case of small and older factories. Ensuring accessibility of spaces for disabled people is also a standard issue. Frequently, the provision of daylighting and sunlighting is very problematic, particularly in the case of conversion to apartments, and would require more invasive interventions. The current building envelope construction has poor thermal performance by default.

A significant conflict can be avoided by an adequate functional choice and level of utilisation that corresponds to the possibilities of the existing building and by a correct, compatible spatial design and logical distribution of the new uses within the spatial structure, based on the detailed adaptability analysis mentioned above.

In general, the suitable approach is respecting the "massive borders" in the building structures as interfaces of the new-use operational units. The correct configuration of the so-called "thermal" envelope is also essential, preferably in combination with designing of a "buffer zone" that could complement or partially substitute the thermal insulation.
Usually, issues can be at least partially prevented by "correct designation" of converted spaces (e.g. so-called studio rather than standard apartment) and especially by the choice of non-standard “free” spatial forms for new uses, which provide "broader freedom of interpretation" of the regulations.

## 5. Interventions to increase adaptability

The interventional concept is in general typical for conversions of industrial buildings, as it also follows from the definition of conversion being one of its preconditions[4]. The interventions accompanying the new activities, announcing the new use and shifting the converted buildings into a present-day context. On a pragmatic level, interventions increase the adaptability, may remove certain limitations, may open up new opportunities, and may ensure the absent requirements.
The intensity and architectural form of interventions can be varied: from discrete touches to major redevelopments. The scale ranges from the level of individual constructions and details, over separate spaces, clusters, up to entire objects or urban areas. The fundamental threshold is between preservation of the authenticity of the spatial perception and the modification (reformatting) of the spatial structure.
The interventions might be reductive. In small scale, it is the common form involving the adjustment of existing openings, perforation of new openings, removing the division constructions (both non-original and original). Removal may also involve the disassembly of remaining technological equipment and the related supporting structures. Metaphorically, the original equipment can be commemorated by new architectural features - for example, by admitting the original openings or technological components or by appropriate form of new build-ins.
On a larger scale, removal is represented by the demolition of buildings or parts in poor condition, unadaptable parts, or purging the area from problematic, non-original interventions, additions, etc.
Opposite of removal are the additions - logically the most common form of architectural interventions. These can be performed both inside and outside the original buildings. Exterior additions can expand the spatial possibilities, replace the removed or absent parts, or compensate insufficient parameters. The most common additions include the insertion of new vertical communications (staircases, lifts), as well as the installation of necessary supporting facilities. This is usually necessary even in cases of low-impact uses (e.g. communications, emergency escape routes, sanitary and technical facilities).
The dramatic transformations with the specific demands of the interior space format (most often housing and accommodation) usually require a fundamental modification of the interior spatial structure. A vertical character of the interiors predetermines the most frequent intervention as a ceiling partitioning, a horizontal one - division (insertion of separating structures). The extreme is the complete removal of the internal structures and their replacement by a reasonable new constructions.
On the scale of the whole sites, we can experience conventional interventions such as extensions, superstructures, additive complementary constructions. The structured industrial complexes

typically suggest to fill the "gap" between the buildings with covering of courtyards, which dramatically expands the availability of interior spaces. Such newly created interiors can easily accommodate all the necessary facilities without complicated interventions to existing parts.
Urban structures with “low density” and with space reserves allow the densification of the entire urban development with new buildings. This can provide coverage of economic needs in the streamlined new buildings and thereby allow the use of existing parts in an authentic form and a simple, compatible, low-impact and therefore low-cost adaptation.
A suitable architectural approach for the conversion of industrial buildings is the “method of inserted elements”, which allows large transformations while still preserving the authenticity of the spatial perception and original constructions and surfaces. The insertion of a system of independent spatial and planar elements allows to restructure and organize internal and external spaces while maintaining a high degree of reversibility. This is an exact and clearly legible artistic method that evokes a spatial and artistic dialogue between original and new constructions. The inserted elements define a new spatial division of the interiors and may ideally accommodate all the equipment needed for the new use.
The inserted layer can also be interpreted at the level of the urban scale. It involves the addition of a system of new public spaces and complementary buildings. It also includes “soft layers” such as a unified informational and navigational system of the sites, a system of landscaping, etc.
Last but not least, the new layer consists of the "haustechnics". The integration of the renewable sources (heating, cooling, lighting) and environmental solutions ("blue-green" infrastructure, waste management) etc. should become part of the architectural conception, not as is often the case, a forced additive - an incoherent layer attached to the finished architectural work.

## 6. Good evaluation of input material

The possibilities may seem limitless. However, today it is imperative to accept that the conditions have changed over the years. Naturally, the Market has re-sorted the offering. The buildings preserved in attractive conditions have in most cases been exploited to their full potential. In case of the large city industrial blocks, new utilization in the form of more or less successful transformation is almost the default. The second option was completely new redevelopments.
In contrast, the smaller sites in less economically attractive localities and in the rural areas may be "blocked" by problematic ownership and/or contaminated by a stabilized substitute function, which is often continually degenerating the buildings by inappropriate interventions and therefore seeming unattractive for new development. The owners often tend to handle the sites as " sleeping" investments, waiting perhaps for a dramatic change in site potential or a change in the market demand. They frequently hold these sites without public access or leasing, seeking a suitable investor for a development, which is more a vision, than a realistic idea. While the sites may be relatively attractive, they often exceed the investment potential of the locality. Who wants to invest billions in redeveloping areas in localities located outside the economic centres? [5] Through this blocking and high expectations, owners are intensfiiing the irreversible physical and moral devastation.

## 7. Conclusions: perfect understanding and pacifying of ambitions

The preserved factories are mainly in non-perspective locations. They're not good looking...often quite ugly, utilitarian converted, partially in decay, and compromising even before adaptation. They are exploited and degraded by a substitute usage that at least hopefully brings in the

necessary cash for the essential maintenance. They have often not been demolished simply because demolition would be too expensive.

In such a situation it is imperative to calm the over-ambition of the initiator and the architect and to evaluate reasonably the abilities of the initiator, the possibilities of construction, the potential of the site and the funding and return on the investment. The straightforward situations have already been exploited! The attractive sites have naturally already been " developed". The "big" grant support programs are already gone and it has been shown that these were not even sustainable in the long-term at the end.

An activity that will use the current potentials of the sites and not require any dramatic transformations and major investments is to be found. A generous vision is certainly a good thing, but we need to accept that it could remain "locked in a drawer" forever. There is a need to adopt low-impact use programmes as a valid option, and not merely as an alternative approach to deal with the industrial heritage. They can represent the only sustainable way to preserve and reuse industrial buildings and, in the long-term, prepare conditions while preserving the existing environment for future, now unexpected, naturally generated, progressive transformations.

In this perspective, the described comprehensive understanding of existing buildings through the detailed analysis of adaptability appears to be an even more urgent and necessary tool. With respect to feasibility and to preserve the authenticity of the environment, the new programme should incorporate the issue of the minimization of the interventions as one of the objectives - “to achieve the necessary minimum, not the possible maximum” [6]. The level of interventions is mainly dependent on the compatibility of the new use and well-understood original spaces. In this sense, a logical distribution of new functions to the vacant spaces, reflecting their adaptability is essential. Of course, “naturally” compatible uses are to be preferred. The concept of appropriate interventions can be effectively inspired by low-impact adaptive use and the principle of reversibility (familiar in heritage conservation theory).

Also, the paradigm of architect’s role and of the process of architectural design itself needs to be transformed. More and more, the architect has the role of facilitator and “program director” of the revitalization process. He or she helps to understand the environment available and guides the plans of the initiator or potential occupants. Today, the design process is more dynamic. The architectural proposal should outline various scenarios based on the level of intensity of use. The conception should be as variable as possible and allow ideally for progressive implementation in autonomous phases. The interventions should be designed not to limit alternative scenarios, and operational modifications of the programme and the concept.

On the background of the proposal, the architect should prepare a minimum necessary scenario that removes the entry obstructions and allows the immediate revival of the area. This will enable the introduction of an additional layer, the temporal and the physical space which is offered to the temporary users.

In terms of sustainability, a slow and progressive regeneration is the only natural. It follows the principles of regeneration in the Nature - does not mean shocks, no radical steps. The clear vision is fulfilled by partial projects on a smaller scale, which are interlinked. Starting from initial, less difficult interventions, which will make the area and buildings accessible and thus will contribute to a positive change of opinions and to a more serious approach of investors. It will set the trend of development, it will help to establish a consensus with the long-term vision for the development of the area, and it will contribute to preserving the continuity of the settlement.

From this point of view, the selection of crystallization points of regeneration is profitable. This may often be the simple opening up of a site, establishing the conditions for the immediate use that will lead to the activation of the areas.
Any slow and gradual regeneration needs to start as soon as possible. There is a format of temporary/interim use aviable, which can also be "low formal". The opening up of the site to the public is a proven feature of kick-starting urban regeneration from the bottom. This represents the cancellation of the “closed area effect”, and the reduction of “local blindness”. Enabling access will define a new mental map of the city in the minds of its inhabitants.
While formulating the architectural and creative concept of the transformation, it is crucial to consciously work with the industrial identity of the existing urban, spatial and building structure. It does not mean just a passive acceptance but an active incorporation of it and the utilization of the creative potential as the baseline for the proposal [7].
So: get to know the environment perfectly, suppress ambitions, act in a rational way and remember the industrial identity! This may seem like an obvious thing to do, but unfortunately, the practice so far proves, that such an approach is not the default.

**Figure 2.** – Examples of low-impact conversions with concept of inserted elements. Left DOK Liberec - a railway warehouse adapted to a cultural centre with a café and coffee roastery. Right Kolovna Praha Troja - adaptation of a brewery to a bicycle service and shop – discreet architectural interventions and preserved patina of a decaying industrial building. Photo: © Jan Pustějovský

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