HYBRIDisation – a resilient strategy in times of change and transformation

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Abstract. Our built environment consists of spaces, buildings, and cities that are subject to ever-changing social, economic, ecological and cultural demands. The demand for high quality living space is becoming ever more significant for densifying urban areas. When lifestyles, modes of working and recreational activities intertwine, new concepts on all scales must follow. Consideration of resilience of all kinds is becoming an important part of planning. It requires typologies with resilient characteristics, which can also take on new tasks perhaps not yet known of today. This paper recognises such a typology in the hybrid. Hybrids possess a variety of characteristics and benchmark parameters. A code inherent in them renders them capable of reacting to various situations and differing requirements. Depending on its constitution and purpose, the hybrid code affects a variety of architecturally relevant, environmental levels, namely district, neighbourhood, building, unit, components, infrastructure and processes. "Hybridisation" describes the process of the deliberate application of this code on all levels ("design and injection"), albeit also its decoding, i.e. activation of processes of change. In this way "new genetic alliances" are created, in which differing hybrids interact. By offering advanced adaptability through HYBRIDisation, buildings become resilient to change and allow for diverse modification and development throughout their lifespan, resulting in improved learning ability. This paper explores strategies of HYBRIDisation and the consequences for the interlinked levels to enable hybrid and resilient levels of environment.

1. Initial Situation

Today, long-lasting construction is a top priority in the building industry. In day-to-day planning and on various levels, this leads to challenges for planners, buildings and processes and begs questions as to which strategies are suitable to meet them.

1.1. Demand for planning security in times of upheaval and uncertainty
Buildings and districts are subject to permanent pressure to adapt. Stressors make them fragile and force the testing of their justification for existence. If these programmes, e.g. for living or work, change, they are very often no longer compatible with the built hardware. It is precisely in times of fundamental

change, like digitalization and migration for example, that programmes are written in rapid cycles, something that does not correspond with the usual 50-100 year durability of our buildings. Moreover, solving the problem with incomplete and only partially predictable knowledge in times of upheaval is business as usual in planning. One approach, which takes account of these circumstances, takes the "unknown as the basis" [1] and seeks "approaches for dealing with uncertainty". [2] We have to admit to ourselves that we can only predict future developments to a limited extent, cannot control them and most certainly cannot plan them. [3]

1.2. Demand for resilience in the construction industry
We need buildings that can stand up to "stress" [4] arising from change for the longest possible period, yet do not rule out their own development. So instead of the maxim of resistance and consequent defensiveness against development, a resilient strategy that sees in those new requirements an opportunity for continued development. Here resilience is the yardstick of a system's robustness. If it can overcome stressors, renew itself, continue to develop and emerge from transformation even stronger, then it qualifies as a resilient system. Endurance is the overlying objective, with resilient characteristics and strategies as the route to follow. An important basic prerequisite for resilience is the scope for potential action. Places and buildings in which things can be tried out and which find justification in the event of success whilst, in the event of failure, allowing other possibilities to be tried out without great outlay. [3]

1.3. Demand for intermixed "urban areas"
Studies have shown that, by 2050, about 66%, and by 2100 about 85% of the world's population will live in cities. [5] The associated necessary densification, in combination with changed lifestyles and ways of living and working, puts typologies used to date additionally under pressure and underlines the need for new typologies. By way of reacting to the anticipated population increase in cities, the "urban quarter" construction area category was introduced in Germany in 2017. This category corresponds with the "model of a city with short routes, places to work on site and good social mixture". [6] The goal is to support areas that accommodate residential space and "service and business enterprises in small-scale, mixed use. […] This mobilises additional living space where the city is at its most attractive, ensures well-functioning intermixing and makes conservative use of land." [7] These new zoning codes make it possible to build higher and more densely in "urban areas", and use an apartment as both working and living space. Consequently a new hybrid, multifunctional typology of buildings is necessary. The challenge now is to formulate structural, creative and location-specific typology approaches in such a way that they correspond with current demands and can hold their own in changing times.

1.4. Demand for multifunctional and adaptable building
New ways of working and living, alongside increasing intermixing and combining of different functions, is leading not only to new zones but also increased blurring of what were to date clear distinctions between specific typologies (home, office, school etc.). New demands for multifunctionality and 24/7/365 usage of buildings are taking over. Future usage scenarios orient themselves towards the now. No statements can be made for the long term regarding their validity or certitude. Typologies established and used to date cannot do justice to this requirement for capacity to change and react because of their specificity and monofunctionality, and are under scrutiny as to their usefulness.

1.5. Summary
The future challenge to our built environment is marked by great uncertainty in relation to future developments. We find ourselves in times of upheaval: "globalisation, digitalization, climate change, urbanisation, demographic change and migration, declining status of nation states, increasing economic power of large private companies, […]. New technologies like blockchain and Artificial Intelligence are scarcely tangible as keywords for individuals but, in actual instances of change like gentrification, segregation, Fitbits, one-click shopping, rising sea levels and self-driving cars, they are already influencing day-to-day life today...". [3] John N. Habraken put it in a nutshell with "You can't control!". We there-

fore need spaces, buildings and neighbourhoods that can react as an open system to changing requirements and which, despite change, are guarantors of high-quality living space. Our spaces, buildings and neighbourhoods must urge us to act and thereby to fulfil our responsibility.

Whilst the focus used to be on endurance, today it is the built environment's transformability and the ability to react rapidly that indicate a resilient city. Resilient architecture will always be open architecture that seeks to interact with its environment, enters into collaboration and uses synergies. For this there is a need for new ways of thinking and architectural systems that can enter relationships with one another at a variety of levels and overcome the isolated way conventional monofunctional typologies operate. Hybrids can make an important contribution to this, exhibiting as they do the very resilient characteristics needed in times of unpredictable development.

2. Hybrid code, hybrids und hybridisation

2.1. Definition and demarcation

In connection with multifunctional characteristics, the term hybrid was selected for the profile of requirements for future construction and processes. Supplementing Per et al, which limit a hybrid to an "opportunist building, which makes the most of multiple skills, a key player which revitalises the urban scene and save spaces" [8], the term "hybrid" gains additional scope, to the effect that hybrids indeed do not just cover the building, instead reaching over various characteristics and benchmark parameters. Among their assets, hybrids have at their command a code that enables them to react to diverse situations and different requirements. Depending on its composition and purpose, the hybrid code works on different, architecturally relevant, environmental levels. Levels are district, neighbourhood, building, unit, room, infrastructure and processes for example. These levels are summarised as "hybrids". They are comparable with layers one above the next, which are connected at some points for a certain period. Through the "transmission of stimuli", impetus is delivered, interactions are strengthened and synergies between levels are made possible. On the one hand, "hybridisation" describes the deliberate installation of the code in these levels ("design and injection") and, on the other, its decoding, i.e. the activation of processes of change. Thus, through the interaction of the more widely differing hybrids, "new genetic alliances" are created.

The interaction between hybrids and hybridisation constitutes information processing involving two information levels of the built environment. One information level relates to the genotype. Stored there are all of the information about and characteristics of the hybrid. It is activated by a second information level – decoding. Decoding leads to different characteristics of the hybrid then visibly appearing as phenomenological characteristics, the phenotype, according to arrangement and dominance. Thus, for example, the potential for an ability to adjust is lodged in the genotype, but only becomes apparent phenomenologically in the event of change. In biology, this process of activation and inhibition of characteristics is called "epigenetic imprinting" and explains "when and which contents from the genetic handbook of an organism are to be used". [9] Following this epigenetic principle, the activation of structural and procedural characteristics of the hybrid in the course of hybridisation has to be seen as decoding of the hybrid code.
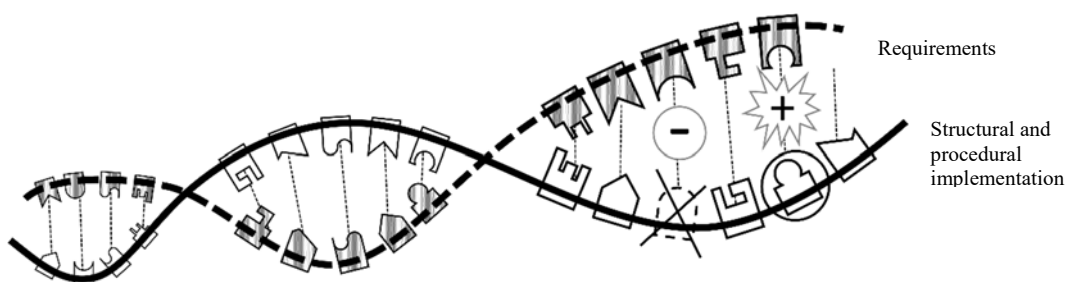

Requirements

Structural and procedural implementation

Figure 1. The characteristics of the built environment stored in the hybrid code are decoded and activated by the requirements. The structurally lodged assets of the genotype now appear as the phenotype.

Table 1. Definitions

| Term	Analogy / definition
Hybrid code	**"Vaccine"** Structural and procedural characteristics that allow an architectural element to mutate into a hybrid
Hybrids (hybrid levels)	**"Recipient":** An architecturally relevant environmental level infected by the hybrid code and inherently possessing the capability to change
Hybridisation	**"Vaccine, activation":** From deliberate designing of the hybrid code, on through laying down its hybrid characteristics in the corresponding architectural element, to activating the hybrid. In addition, the process of interaction and cooperation between the differing hybrids is described by hybridisation.
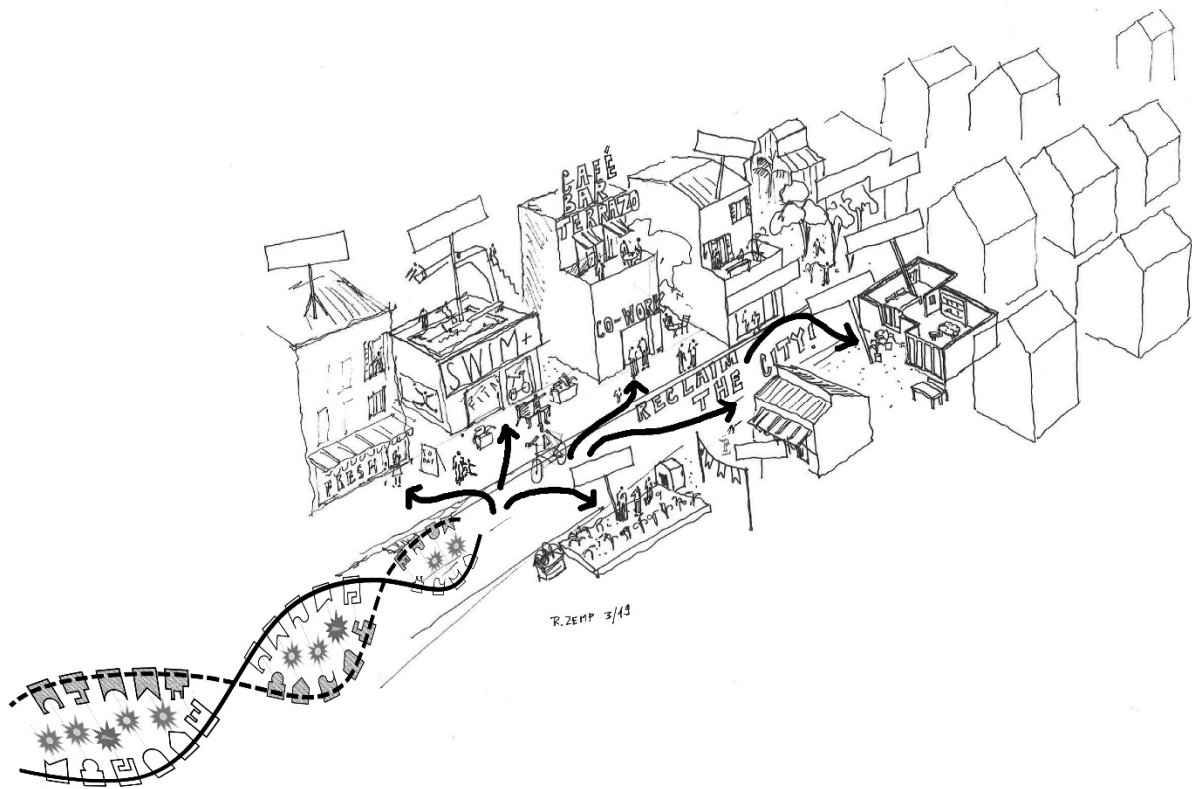
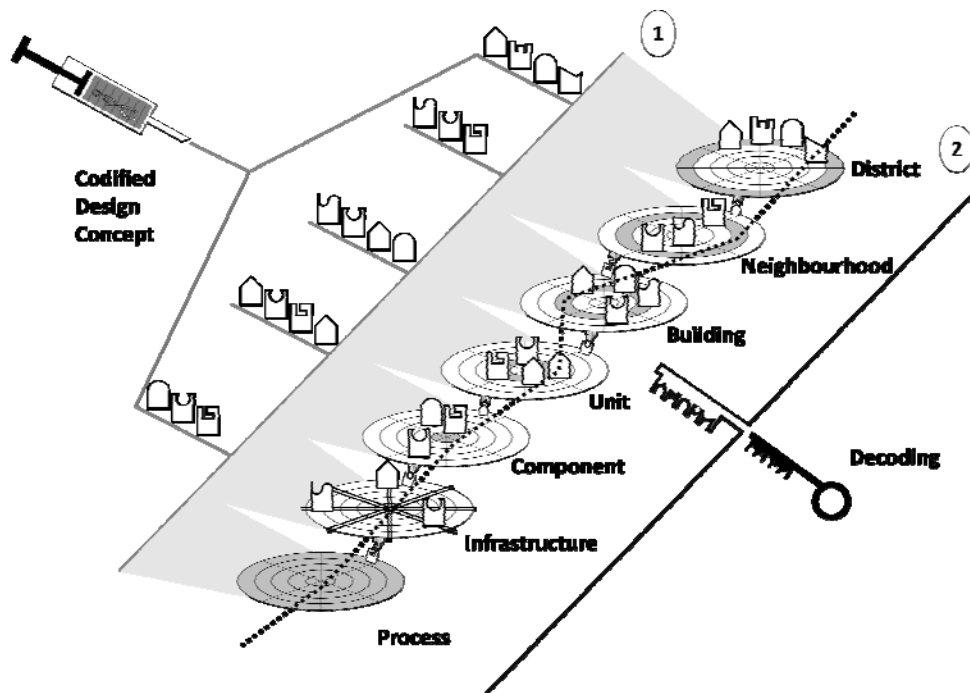**Figure 2.** Effect of hybridisation

Figure 3. All levels are coded with the codified design concept, i.e. potential is laid down (1). In the event of external pressure to adapt, the code is decoded, i.e. the potential is activated (2).

2.2. Demarcation of hybrid buildings and typology

Hybrids differ substantially from conventional, specific and generally monofunctional typologies (e.g. schools, residential buildings etc.). Hybrid buildings can result from the sensible combination of requirements on various originally monofunctional typologies for example (e.g. living and work) and thereby enable multifunctional use. Thus, for example, simultaneous or staggered living and working can take place in one unit of usage, substantially raising the building's occupancy in the course of a day. This is possible if the higher requirements of one use (e.g. acoustics/living) are determining factors for the hybrid building. However, a higher ceiling for example only makes sense if the unit of usage is also used as an office. Seen from this point of view, monofunctional typologies seem more efficient than hybrid ones. But if the demands on the building change, monofunctional typologies are subject to substantial pressure to adapt, due to their specificity and efficiency alongside a dearth of buffer zones. With this in mind, resilient strategies are aimed primarily not at raising efficiency but rather their effectiveness, their efficacy, with their measures then being implemented efficiently for the sake of sustainability. This demands the sensible treatment of reserves and buffers. The combination of adequately sized and proportioned rooms with usage-neutral floor plans and unbundled building services are lodged in their genotype. They constitute the specific code for hybrid building and enable more appropriate, simpler changes of use and support the transformation of the built environment.

Table 2. Comparison between hybrid building and familiar typology characteristics

Character Hybrids	Character Typology
Application-specific	**Task-specific**
Has "unexpected mixing of functions"	Conceived for a specific use
Appropriation as a principle, scope for action	Prescribed use
Multi-used	**Mono-functional**
Oriented towards usage and changes thereof (e.g. learning)	Oriented towards function (e.g. school)
Based on unknown future	Based on tradition
Use creates form	Form follows function
Full-time activity	Part-time activity
Environment as system boundary	**Building as system boundary**
Focus impact on city	Focus on building
Sensible interaction with environment required	Focus on plots
Uses synergies	Self-optimisation

Open system	Closed system
Interconnected and open to development	Singular and complete
Anti-fragile (disruption = opportunity), fault-tolerant	Fragile (disruption = danger), fault-prone
Great diversity	Limited diversity
From visible to undercover	Visible
Changes within and outside the system through spontaneous or planned **initiation**	**Changes** within the system as **reaction**
Change can only be planned and controlled to a certain extent (e.g. appropriation by new users)	Change can be planned and controlled (e.g. classroom reconstruction)

An example of a hybrid which influences the whole district is the multifunctional building named Frizz23 in Berlin (D). Primary goal of the realised concept was to create "commercial with dwelling" which would be enriching for the existing neighbourhood. The city property which had recently become vacant wasn't sold for the usual market price but developed in a participatory dialog process with local stakeholders. A number of different means of funding facilitated the desired social mix. The plot was sold at a reduced price. The difference in relation to the market price was added to the price of the freehold flats and credited to the co-operative flats. This cross-financing makes affordable housing possible at a price per square metre of € 9.50 a month.
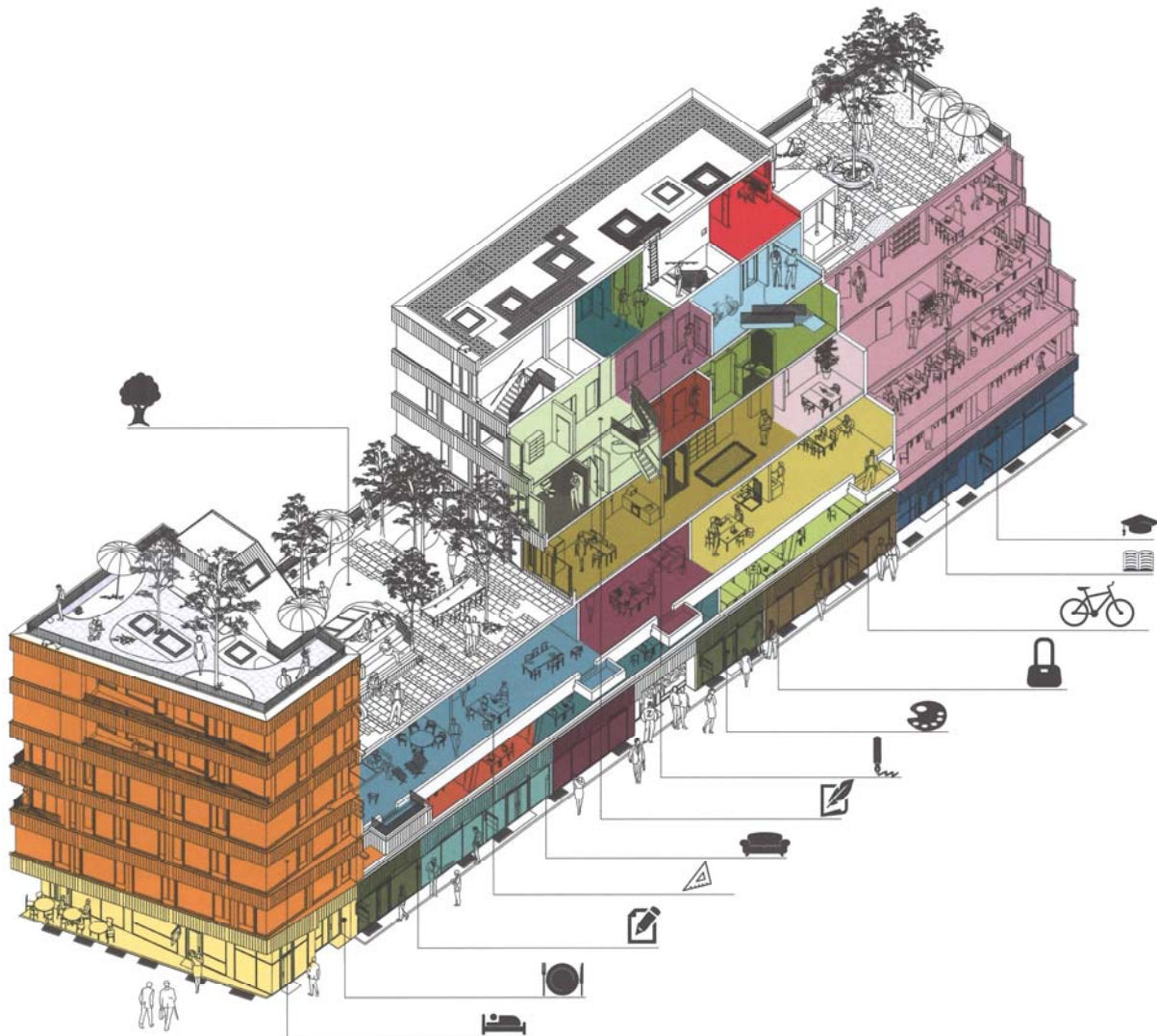

Figure 4. Frizz23, Hybrid Building in Berlin (D)
(Architects: deadline Architekten, Matthew Griffin, Britta Jürgens) [10]

A variety of floor plans and a differenciated mix of uses from trade to dwelling allows for the "self made and mixed city" [11] and makes it possible for the building to be "lively even at night". [12]

2. OG, M 1:500

1. OG, M 1:500

Figure 5. Social mixing through a variety of floor plans and mixed uses (by Deadline Architekten) [11]

That way, FRIZZ23 takes on the role of an incubator in the neighbourhood. It triggers developments, enables interactions, and adapts to new demands. This process of hybridisation usually takes place in several phases and at different times as will be shown below.

Phase 1: Define, Design and Inject Codified Design Concept

At the beginning, the program for the projected hybrids is defined. At the end of this phase, the requirement profile of the projected building is determined and the target agreement (e.g. space allocation plan, use, cost ceiling, deadlines etc.) is formulated. [13] The degree of hybrid character desired is defined and the corresponding structural and procedural characteristics of the hybrid are determined.

With the help of scenarios-methodology and transdisciplinary think-tanks [14], one must identify the relevant developments that will be influencing buildings in the future and formulate scenarios of possible developments. The scenarios serve as the foundation for further decisions. At the end, the design concepts are determined by mathematical spatial concepts and represented in an objective, unprejudiced manner. As a rule, plans, sketches and models serve to illustrate the outlined building concept. This serves as the guideline for the realisation of the building. [15] The building or processes are injected with the hybrid code and can now mutate into open systems, which means constructed or applied as hybrids based on the codified design concept.

The hybrid code orients itself towards the fundamental principles for resilient urban development. [3] The interaction of these principles forms the basis for a strategy to be developed specifically for each of

the levels and processes involved and which is then lodged structurally and procedurally in the code. Three important fundamental principles that enable the hybrid to develop itself further according to the requirements of resilience are: it is adaptable, multifunctional and works synergistically.

Table 3. Hybrid Code – Codified Design Concept

Fundamental principles	Process-related characteristics	Structural characteristics
- adaptable	- scenario-based	- equivalent
- multifunctional	- user-oriented	- usage-neutral
- synergistic	- transdisciplinary	- well-proportioned
	- sense of responsibility	- replaceable/exchangeable
	- reflective	- unbundled
	- cooperative	- fault-tolerant
	- incomplete/open/unexpected	- independent (services)
		- offers buffer
		- effective
		- specific
		- appropriate / sufficient
		- sharing
		- life-cycle-oriented
		- recyclable
		- ephemeral

The fundamental principles cannot be clearly demarcated. They have a collective effect in the overall framework, differently weighted according to the specific objectives of the design, and give rise to the planned procedural and structural characteristics. Here the hybrid code is not to be seen as some panacea that is equally applicable to all environmental levels. It must be conceived specifically for each case, in order that it can act as an incubator, enabling the various environmental levels to react specifically to the pressure to adapt and amplifying their potential for further development. The hybrid code lays down the attributes for the desired resilient characteristics. The code concept is primarily about building up capabilities for the active configuration of ongoing adjustments and strategic transformations. Here the focus is not on conserving but rather it is directed proactively with the future in the sights of its strategies. As a result, the ability to react quickly and an appropriate level of effort in the process of change are important factors for successful activation and on to understanding the city as an open system.

Phase 2: Decoding
In this phase the hybrid code is decoded and hybrid activation follows. Through the scenarios considered beforehand and the resulting, specifically constituted hybrid code, the structural and procedural characteristics lodged in the corresponding level now take effect. This decoding leads to the hybrid being able to meet the new requirements as well as possible and creates new scope for action in urban development. Motivated by new societal, technological, ecological and economic changes, which act as stressors placing the city under pressure to adapt and triggering disruptions, the process of transformation is activated. The term disruptions here does not mean singular events, instead it is far more an overarching theme tending towards persistence and with a societal and global dimension. In terms of stress, they mobilise exceptional powers over a more extended period and necessitate reactive high performance. [16] As soon as the structurally lodged elements (e.g. dismantling lightweight partition wall) or processes (e.g. district management) are activated, the code is decoded and the hybrid principles can emerge specific to level. Hybrids have the ability to react with different strategies in their code.
Hybridisation is a planned process and leads to elements mutating into a "specimen of opportunity which has the mix-used gene in its code". [8] The hybrid code was deliberately conceived for this situation. Through the process of hybridisation, impetus is unleashed towards resilient urban development. This contrasts with conventional, multifunctional building like a shopping mall located, as a rule, isolated at the city limits and making no contribution to long-term urban development. In this sense, hybrids are not separable from the process and purpose of hybridisation and take on a central role as incubators and catalysts of resilient transformation of the built environment in a city capable of development.
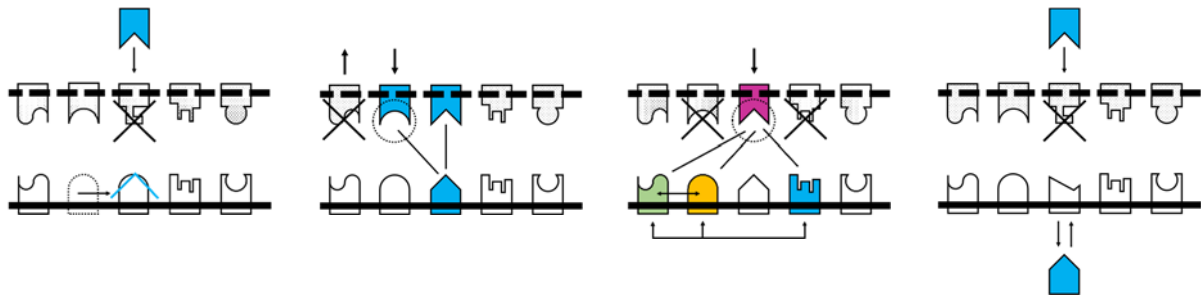
Figure 6. Principles of hybridisation in the interplay of requirements (upper strand) and structural and procedural implementation of the built environment (lower strand):
adaptable, multifunctional, synergistic

Table 4. Structural and procedural implementation of hybrid principles

	adaptable – multifunctional – synergistic			
District	Special zones and areas for experimentation and ephemeral structures	Intermixed districts with corresponding compensatory spaces	Densified construction as an expression of culture of space	Scale and grading of different degrees of public space
	Interim use as activator of development	Diverse forms of construction	Renunciation of speculation and sale of urban land	Public space as a place to meet
Neigh-bourhood	Mix of semi-public intermediate space through placement of volume and façade design	Strengthening of neighbourly activities through provision of space and scope for action	Variety of services on offer for local shopping and sharing economy	
	High quality of intermediate space	District meeting places as incubators of experimentation and development		
Building	Diversity of residential provision through mix of typologies	House rules that do enable and don't hinder	Provision of rooms that can be additionally rented and subdivided	System of access enables different uses
	Unbundling of systems (primary, secondary and tertiary structure)	Sectional configurations and floor plans include buffers (e.g. height, riser zones etc.)	Construction and operation geared to conserving resources (including recyclability of materials used)	High degree of standardisation; modularisation and prefabrication
Unit	Rooms with equivalent proportion and orientation	Appropriation by users (e.g. completion of interior by tenants)	Neutral floor plans allowing easy adaptability	Planning based on users daily needs
Components	Application and installation oriented towards lifecycle	Design enables multiple occupancy and use (e.g. raised floor)	Robust, fault-tolerant and reparable building services	
	Simple accessibility and replaceability	User-friendly usability		
Infrastructure	Harness synergies through resource networks	Maintain independence and state control (e.g. water, public transport, power)	Polyvalent structure for use with various media	Human scale and more non-motorised mobility
Process	Reinforce the activities of those affected (e.g. volunteer agency)	No hindering of new approaches by standards and regulations	Principle of incomplete planning and permanent reflection	
	Cooperative planning culture and urban development (e.g. through citizen involvement)	Forward-looking perspectives through transdisciplinary think-tanks		

2.3. Summary

What all hybrids have in common is their fault-tolerant character. As a result, they lend themselves to development and, in a figurative sense, are "adaptive". The systems involved do not have to be demolished or reconstructed with great effort. Instead, they overcome disruptions, can reorganise themselves

and adapt to the new requirements. The strategies of hybridisation react to any prevailing dearth of offers or create new offers within the district on the basis of altered requirements. Consequently they are suitable for the strategic transformation of the city and create scope for action.

The great challenge here is to take account of unknowns already at the planning stage and to confer on hybrids structural or procedural capabilities that enable them to react. "This is where planners and clients reach their limits: which scenario is likely to occur? How will my client live and work in 10 or 20 years? What effect does this have on planning today's buildings? What are appropriate measures?" [17] Here we cannot avert the need to make assumptions and take a position. If the world changes, our built environment must be able to change too. This should be accompanied by winning and maintaining scope for action: The city is a "stimulating place […]. Not limited, instead complex, opening up possibilities for its occupants to make something of their lives. […] An orderly city is imposed on its occupants and limits their possibilities; a complex, disorderly city challenges its occupants to create something of their own". [18] In this process, hybrids are indispensable.

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