



Faculty of Design

2022

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da Costa E Mattos, Erica Azevedo and Da Silva, Diego Fagundes

Suggested citation:

da Costa E Mattos, Erica Azevedo and Da Silva, Diego Fagundes (2022) Micro-Architectures V.2: A practical experiment on how to design with uncertainty. In: Proceedings of Relating Systems Thinking and Design, RSD11, 3-16 Oct 2022, Brighton, United Kingdom. Available at <https://openresearch.ocadu.ca/id/eprint/4350/>

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Relating Systems Thinking and Design
2022 Symposium
University of Brighton, Brighton, UK,
October 13-16, 2022

Micro-Architectures V.2: A practical experiment on how to design with uncertainty

Erica Azevedo da Costa e Mattos and Diego Fagundes da Silva

Federal University of Minas Gerais, Brazil | Nimbu, Brazil

In this paper, we seek to build an interpretation of modularity as a cybernetic-oriented system architecture capable of accommodating the uncertainties inherent to life and, consequently, implicit in any design activity. Micro-Architectures was a socio-spatial framework conceived as a “system of systems” capable of dealing with emerging demands not previously specified—and, at the same time, questioning the very notions of function and purpose usually dominant in the fields of architecture and design. The resulting framework enabled a process of collaboration and conversation between designers and the self-organised residents of a squat in the central area of the largest city in the country as a practical design experiment within the context of the 11th São Paulo Architecture Biennial.

KEYWORDS: systemic design, cybernetics, modularity

RSD TOPIC(S): Cases & Practice, Methods & Methodology

Introduction

In mid-October 2017, we received an invitation to carry out a short collaborative work at a major architecture and design event, the 11th São Paulo Architecture Biennial, whose main actions were distributed in several locations in the city. The action assigned to us would involve revisiting and updating an earlier project called *Micro-Architectures and Other Spatial Manifestos*.

The invitation made by the organisers of the event was to design an intervention to be held in a squat located in the central area of São Paulo. The 9 De Julho Squat would already be the space for the realisation of a series of workshops and exhibitions within the context of the 11th Biennial. Both to enable these actions and to support the infrastructural squatting needs (not only of that particular squat but others linked to the social organisation in favour of the homeless), carpentry was established in the building. The tools and means of this new infrastructure space also made it possible to carry out our project: the collaborative design and construction of a new “micro-architecture” on site.

To understand what this means, it is necessary to briefly present the socio-spatial context of the occupation and its organisation and the previous project on which this new proposal is based. Next, we will present concepts and systemic notions adopted in this new design process and, finally, the resulting updated version from the proposal, called here “Micro-Architectures V.2.”

The 9 de Julho Squat and the 11th São Paulo Architecture Biennial

According to Rivera & Perrota-Bosch (2016), the 9 de Julho Squat was the birthplace of the MTSC, the City Center Homeless Movement of the city of São Paulo. The squat has its history punctuated by a series of territorial disputes of a political nature that are also reproduced in a series of other occupied buildings across downtown São Paulo. As a result of the engagement of a marginalised population, the 9 de Julho Squat began in 1997 when some families decided to occupy the old INSS (National Social Security Institute) building, abandoned since the 1970s. Since then, at least three attempts by

the government to expel its inhabitants have only succeeded in strengthening community ties and the political organisation of this population.

The São Paulo Architecture Biennial, an important international architecture event in Latin America, returned in 2017 after a four-year gap from the previous one. This 11th edition, entitled *In Project*, proposed to “challenge architecture to approximate with other knowledge and forms of co-production of the city”, aiming “at the expansion of the architect’s actions towards collectivity.” (Rosa et al., 2018)

At the time of the 11th São Paulo Architecture Biennial activities, the 9 de Julho Squat had about 100 families occupying the 14 floors of the modernist building. It is a community strongly organised under the motto "Occupy, resist and fight not to leave," chanted during the various public manifestations promoted over the years and which until now has been able to guarantee shelter and opportunities for its participants. Today, the 9 de Julho Squat is the main centre for cultural activities associated with the MTSC popular movement and an open hub for channelling numerous external actions.

In this context, our action with this community was mediated and funded by the 11th São Paulo Architecture Biennial as part of its program. As some actions would already take place there during the event, it was up to us to focus on a specific audience, the children who inhabit the place.

Micro-Architectures and Other Spatial Manifestos—2014

The initial intent of the project *Micro-Architectures and Other Spatial Manifestos* conceived in 2014 was to design and produce transfunctional physical structures that did not fit into predefined notions of function, purpose or clear goals. The project was meant to act as a small-scale architectural practice, generating a series of concrete spatial manifestos that would open up to different and indeterminate appropriations (e.g., not just a bench or a playground, but at the same time both and more). Aligned with this was the idea of taking advantage of urban waste as raw material - for that, we developed a collaborative and open mapping system of these often ignored urban resources so that they could be used by the project and by the general public. Some designs were made, and a structure was built and then placed in some spaces in the city (Figure 1), which gave some prominence to the project.



Figure 1. Micro-Architectures (2014)— The first constructed structure and the collective mapping platform.

A few years later, when we received the 11h Biennial's invitation to reenact the project, our context was different, as were some of our concerns. From our incursions into systemic thinking, we saw this as an opportunity to effectively act cybernetically in the process of design (Glanville, 2015).

On complex systems, modularity and design

In this project, we work at different levels with an understanding of modularity related to the notion of hierarchy and near decomposability as an architecture of complex systems (Simon, 1962) and also with the notion of emergence, complex adaptive systems (Holland, 1997, 2014) and of design rules (Baldwin and Clark, 2000). We associate this notion with the idea of a generating system formed by a kit of parts and rules of connection (Alexander, 1968/2011), and the focus on the use of “pre-broken” materials and the production of joints (Fuller and Haque, 2008) that can be standardised in place of the complete specification of components (Jones, 1983).

In his seminal paper “The Architecture of Complexity,” Herbert Simon (1962, p. 468) presented the notion of hierarchy as “one of the central structural schemes that the architect of complexity uses”. This hierarchy is not related to the usual idea of formal hierarchy where there is a relation of authority and subordination among subsystems, but with the broader sense to refer to a “complex system being composed of

subsystems that in turn have their own subsystems, and so on.” (Simon, 1962, p. 468) In the paper, Simon argues that “hierarchies have the property of near decomposability. Intra-component linkages are generally stronger than intercomponent linkages” (Simon, 1962, p. 477).

This last sentence relates to the definition of modules and modular systems presented by the economist Carliss Baldwin: “The presence of units whose elements are highly connected within the unit and only weakly connected to other units is a defining property of modular systems. The highly connected units are called modules” (Baldwin, 2015, p. 718). Since these are relational concepts, we conclude from this that modularity cannot be treated as an absolute condition but a gradual one relative to the distinction of levels and elements of a system. A system can only be considered modular when it is possible to distinguish its subsystems, which have a strong internal connectivity and only a weak external connectivity.

Modules can be understood as units constructed by the inside-outside distinction made by an observer. If these distinctions can be recursively observed over and over, then we have a nested hierarchy. As a cognitive tool, modularity can still be used both for understanding the world and for proposing complete systems; however, underspecified (Pask, 1969)¹ or a generating system, as in a kit of parts (Alexander, 1968/2011). In the first case, we enter the domain of radical constructivism of figures such as Ernst von Glasersfeld, Heinz von Foerster and George Spencer-Brown, and in the second case, we enter the world of design in dialogue with Gordon Pask and Ranulph Glanville.² It is

¹ Reflecting his work with architect Cedric Price on the *Fun Palace* project in the 1960s, cybernetician Gordon Pask introduced the concept of underspecified goals to architecture systems when striving for adaptive environments: “Specification of the purpose of the goal of the system ... the goal may be and nearly always will be underspecified ... His aim is to provide a set of constraints that allow for certain, presumably desirable, modes of evolution.” (Pask, 1969, p. 496)

² In the paper, “The architectural relevance of cybernetics,” Pask’s argument for the importance of cybernetics to architecture is based on “the idea that architects are first and foremost systems designers” and that concepts of cybernetics “can be interpreted in architectural terms” to form a theory (Pask, 1969, p. 494). Ranulph Glanville, architect and former student and collaborator of Pask, spent a good part of his career working around this idea and came to argue that “cybernetics is the theory of design and design is the action of cybernetics” (Glanville, 2007, p.1178).

important to note that this is not an opposing pair but that in seeking to understand, we are also actively drawing the world.

Micro-Architectures V.2—2017

One of the key points for this new version was to design our actions within the community in a way that was not deterministic or invasive to an already very rich system such as the 9 de Julho Squat. In this sense, any action developed should take into account the pre-existing relationships between residents and their inhabited space. We adopted as a premise the desire to build a sufficiently malleable proposal that, without losing its coherence, could learn and incorporate the expectations and directions of the residents in an effective process of conversation for action. With this in mind, we ended up developing a framework generic enough to be applicable in different scenarios. This framework should be scalable and evolutionary while at the same time functioning as a platform for the particular expression of residents' desires and needs.

Designing the design process

When we started thinking about the design process, we defined some initial constraints to steer the development of the project:

1. As with the previous version of Micro-Architectures, wood should be the main material for constructing physical structures. If, in the earlier version, we made this decision because of the predominance of urban waste, this time, our focus was on designing while following common dimensional lumber sizes for convenience and cost control.
2. The physical-structural system should be articulated and guided by the joints. Connectors that were to be robust and work with standard nuts and bolts. Together, they should make out the physical rules of engagement between the structural wooden elements.
3. Finally, to guide the intervention process at the site in conjunction with the squat residents, we wanted to develop a playful interface for conversation. That interface should work like a “game” mechanism and be able to articulate the

residents' wishes and desires, reveal their expectations and consolidate demands that would inform the final design and construction of the structures.

With these three points in mind, we began to formalise a system for action with four groupings: “plays”, “games”, “parts”, and “modules”. Later we ended up incorporating new ideas and insights, and a different categorisation of stages was defined: “explorations”, “systematizations”, and “construction” (the latter encompassing “parts”, “blocks”, and also, “micro-architectures”). We will explain the conceiving process behind these sets of terms that may seem, at first glance, a rigid structure.

The idea behind the grouping of “plays” was to imagine some possibilities of performance activities and exercises that could include the mind and body of participants in a dialogue between everyone involved and the physical space. They should be able to break the ice and bring about new perceptions and corporal understandings of the space—thus informing the process as a whole. This notion emerged as a complement to the initial idea of a “game” as a playful interface.

As already mentioned, the “game” stage came as a determination of how we could organise the process of thinking about the construction of the structure. The first idea was to use cards to assemble a structure that represented a flowchart of activities, spaces, etc. What we realised with development is that we could better explore this functioning and include game structuring elements such as a set of rules and auxiliary elements and pieces.

With this reflection, we concluded that the role of the first activities would be to explore the space, the possibilities of the given context and other situations that the participants could identify on their own; and that this second moment would be a step to sediment and systematise this information. In addition, we thought these two moments were not tight or even linear—so a little bit of one would end up blending into the other.

Regarding the concrete-material level of this system, we decided to name as “parts” the basic elements that would be necessary to build the physical structures. This would encompass both the specific perforated metal connectors and other parts purchased off the shelf (e.g. lumber, bolts and nuts, steel cables and plywood boards for closure).

With that, we would have “kits” containing all the necessary elements to build the structures.

The “blocks” would compose another level and type of modularity, something close to a menu of already established possibilities. The proposal was not absolutely that everything that was built resulted from a composition of such blocks. It was just a matter of demonstrating the possibilities of the parts system and showing that, in some cases, it would not be necessary to reinvent the wheel. In this sense, we could define “blocks” as basic structures with characteristics of known elements, for example, bench, chair, table, wall, vase, jungle gym, etc.

In the end, the “parts” and “blocks” were seen as levels in terms of a specific moment towards “construction”. Thus, we ended up defining the stages of action as: “explorations”, “systematizations”, and “construction”. The result of this whole process – using predefined “blocks” or not—would constitute a “micro-architecture” in dialogue with its context (Figure 2).

Thus, we concluded that the elements that would characterise this new version of the Micro-Architectures project would be:

1. A modular and recombinable kit of structural parts
2. The integrated action between individuals for the reconfiguration of the parts
3. A meta-project, represented here by a game, through which individuals formulate and express their intentions about space
4. A set of group plays for spatial awareness and problematisation

The objective of the experience is, finally, to explore playing and modularity as resources for the continuous appropriation of space, incorporating and transforming external inputs in the generation of dynamic systems between individuals and spaces.



Figure 2. Assembling a micro-architecture.

Designing a recombinable system of parts and connections

We started this project striving to conceive some sort of a "kit of parts", following the notion of a "generating system" (Alexander, 1968/2011). Yet, instead of designing all the components, we chose to focus mainly on the rules of connection - following the thinking of Matthew Fuller and Usman Haque (2008, p. 34), "concentrating on the production of joints presupposes future amalgamation or integration with things, events and systems that are yet to occur."

In the end, our connectors' physical rules allowed us to work with materials already available on the market. The definition of the connectors' material, shapes and sizes ensured flexibility in the other elements of the system. As John Chris Jones (1983) points out, greater standardisation in joints minimises the need for standardisation of components. In this case, the definition of the material, shapes and dimensions of the connectors ensured flexibility in the other elements of the system.

From references of joint hardware for wood, we designed three variations of perforated metal connectors: a flat triangular plate, a corner triangular bent plate (double the size of the flat one), and a corner rectangular plate bent in an L shape.

Starting from these “parts”, we work with two more levels of organisation: a set of recipes from already planned “blocks” and the resulting “micro-architectures.” One of the simplest “blocks” is similar to the idea of a bench where it is possible to see the use and combination of the “parts” (Figure 3). In this organisation, although a given “micro-architecture” does not need to incorporate any predefined “block”, it can still go the opposite direction where the division of a specific “micro-architecture” could feed the list of building “blocks.”



Figure 3. Bench block prototype demonstrating the use of metal connectors.

Explorations and systematisations—elaborating group plays and the game mechanism

As already pointed out, the process of thinking about the plays that we later organise within the “explorations” level started with the intention of engaging people, in addition to involving the body in the process, putting it in contact with space and with other bodies. In this way, we approach not only the idea of play but also consider using the mechanics of several children's games in addition to some exercises already worked on by the Brazilian director and activist Augusto Boal. His goal with these improvisational exercises was to free the spectator from its passive condition by providing tools for the non-actor (worker, peasant, student) to "distort the body, alienated, mechanized, ritualized by the everyday tasks of capitalist society" (Boal, 1982).³

We decided to conceive and organise our own set of improvisational exercises according to the following main parameters: a) the individual's relationship with himself; b) the relationship of the individual with the other, and; c) the relationship of the individual with the world (Figure 4).

³ It is important to note that Boal's method has already been associated with cybernetics and other types of systemic approaches by authors such as Tom Scholte (2018) and David Diamond (2007). The nature of this relationship is due to the self-reflective characteristics present in Boal's work, as well as the promotion of variety and the ability to generate viable operational models in sensitive and complex social contexts. The following observation exemplifies how Boal's work has been understood from the systemic view: “The dramatic structure of a Forum Theatre piece Boal co-created in Sweden in 1978 at the height of controversies in that nation around nuclear energy provides us with an exemplary case study with which to imagine the further integration of SSM - Soft Systems Methodology - and other systems approaches” (Scholte, 2018).



Figure 4. Group plays as a way of exploring the relationship between body and space.

At the “systematization” level, we proposed to work with playing cards, trying to understand them also under the principle of modularity already present in the parts and blocks.

We designed a set of cards with different images illustrating spatial elements and characteristics. We included a few blank cards to guarantee the incorporation of new elements from the input of the game participants. Another set of smaller cards also made up the game. The cards in this last set made it possible to play modifying actions on the illustrated cards during a match. With these “action cards”, the actions of adding, removing and modifying were determined, affecting the main cards already laid out on the board (Figure 5).



Figure 5. The game as a conversation method.

Each player must also fulfil a "secret objective" during the match. These objectives would be different for each player (e.g. a space to party, to read, to eat or to rest) and should emerge from the spatial exploration activities carried out previously. The tension between contrasting goals would introduce fun to the group and, at the same time, demonstrate how different elements might or might not satisfy very different activities. When carrying out the experience with the children from the squat, we were able to observe moments of negotiation and effective conversation between participants.

The idea of working with action cards was inspired by the theory of operators of modular design by Baldwin and Clark (2000) and, consequently, by the broader theory of complex adaptive systems by Holland (2014).

Summary: Micro-Architecture V.2 diagram

The complete proposal of Micro-Architectures can be understood as a modular composition, where a larger system contains subsystems that are related to each other, however, preserving a certain autonomy.

Thus, each stage or level could be developed and analysed independently, as their internal logic does not affect the organisation of the larger system. This separation also guarantees the possibility of adaptation or evolution (Holland, 2014; Baldwin & Clark, 2000) of the proposal as a strategy and tool for design and intervention—although, of course, not deviating from its original scope, context and objectives (e.g., as it was designed and described in this paper does not apply on the scale of a building).

With what has been presented, we can draw a diagram of the structure of this system that encompasses small systems. In Figure 6, “exploration”, “systematization”, and “construction” correspond to the steps of an action developed from the system.

Within “exploration,” we have a variety of dynamics - among them, those that we carry out, those that have already been elaborated but not used and those that may be developed in the future (from P1 to Px). Within “systematization”, we have the game that was developed and used in the workshop (G1) and a space of possibilities for other games or other ways to reach the same end (Gx here represents this opening). The “construction” stage configures another type of system since here we are dealing with a material aspect. Inside it, we have the Basic Construction Kit that we developed (K1) and, as in the other levels, a field for future development of other proposals as well as variations. Two more levels are derived from the kits of parts that may or may not be related: the “blocks” of simple pre-defined structures and the “micro-architectures” resulting from a contextualised action. Just as “micro-architectures” can use “block” recipes already thought out, they can also be created directly from the parts and eventually feed the “block” base with new structure recipes.

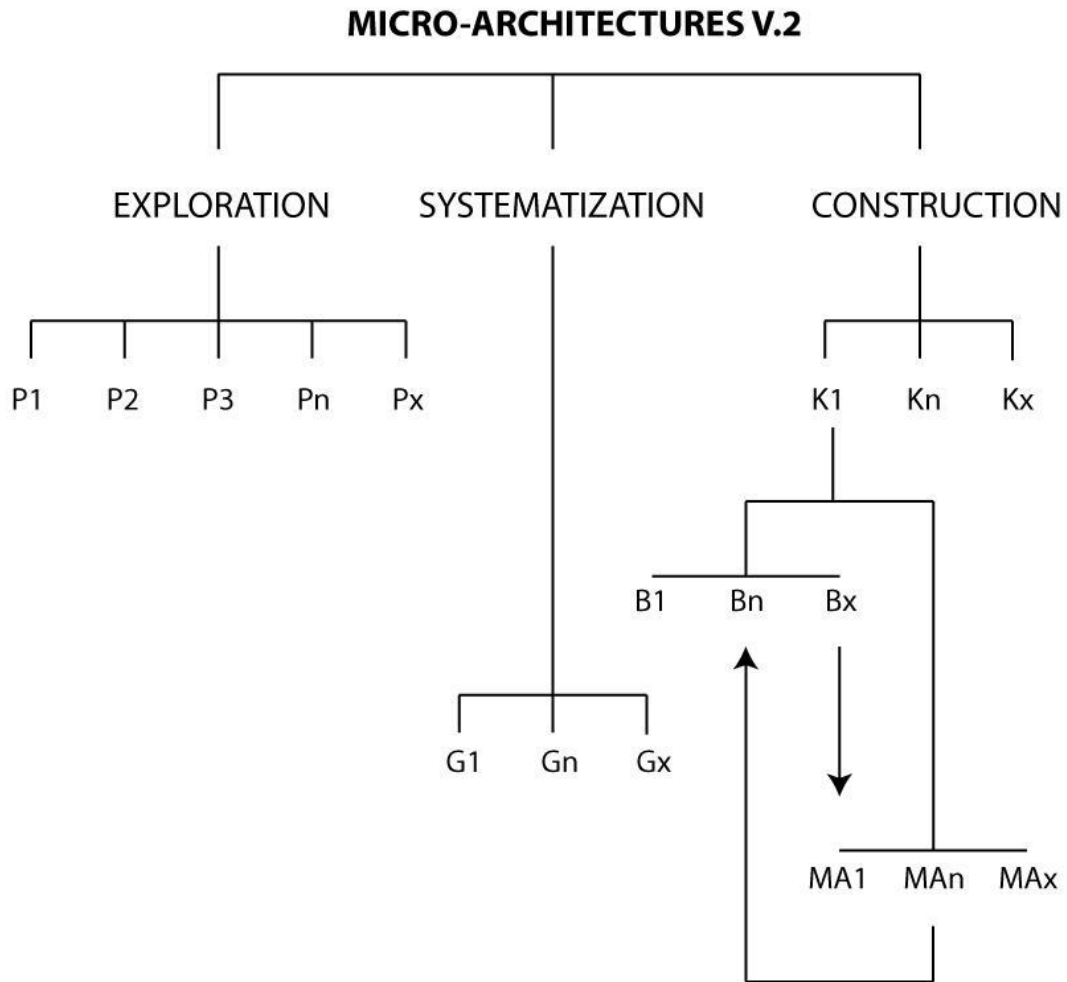


Figure 6. Micro-Architecture V.2 system diagram, where P= Plays; G= Game; K= Kit; B= Block; MA= Micro-Architecture; n= a given number in the set and x= last number in the set tends to infinity.

Some Considerations

In this paper, we decided to focus on central aspects of the conception and design of the system instead of describing the workshop held with the squat children. Although the workshop itself was a very rich process and a necessary extension of the design process towards a collaborative practice, we believe it is important, at this moment, to describe the rules and procedures applied in a framework that can be reproduced and modified in future practices.

The most interesting aspect of this investigation of a practical nature was the opportunity to explore aspects of systemic modularity under different manifestations and scales within the project.

Micro-Architectures was an exercise in trying to understand the nature of some relationships—technical, political and social - arranged in space and, in this process, also acting and designing new relationships in complex and unpredictable contexts.

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