Vol. II

Patrik Schumacher

THE AUTOPOIESIS OF ARCHITECTURE

A New Agenda for Architecture

Vol. II

THE AUTOPOIESIS OF ARCHITECTURE

To Zaha Hadid

Vol. II

Patrik Schumacher

THE AUTOPOIESIS OF ARCHITECTURE

A New Agenda for Architecture

WILEY
A John Wiley & Sons, Ltd., Publication

This edition first published 2012

Registered Office
John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom

Executive Commissioning Editor: Helen Castle
Project Editor: Miriam Swift
Assistant Editor: Calver Lezama

ISBN 978-0-470-66615-9 (hardback)
ISBN 978-0-470-66616-6 (paperback)
ISBN 978-1-119-94046-3 (ebk)
ISBN 978-1-119-94047-0 (ebk)
ISBN 978-1-119-94048-7 (ebk)
Design and cover design by Kate Ward
Typeset in 9.5/12.5pt TradeGothic by Aptara Inc., New Delhi, India
Printed and bound in Great Britain by CPI Antony Rowe, Chippenham, Wiltshire

Contents

The author and the publisher gratefully acknowledge the people who gave their permission to reproduce material in this book. While every effort has been made to contact copyright holders for their permission to reprint material, the publishers would be grateful to hear from any copyright holder who is not acknowledged here and will undertake to rectify any errors or omissions in future editions.

Fig. 1 © Hochhausstadt, east-west street, project for a high-rise city, 1924. Ludwig Karl Hilberseimer. Ludwig Karl Hilberseimer Papers, Ryerson and Burnham Archives, The Art Institute of Chicago. Digital File #070383.HochhOst. © The Art Institute of Chicago; Fig. 3 © Hans Strand/Corbis; Fig. 4 © Susumu Nishinaga/Science Photo Library; Fig. 13 © Mrs Kenzo Tange, Paul NoritakaTange and Tange Associates, Tokyo; Fig. 31 © From Gyorgi Kepes, Language of Vision, Dover Publications Inc., New York 1995, originally published by Paul Theobald, Chicago 1944, p.102; Fig. 32 © gta archives, ETH Zurich: legacy of Bernhard Hoesli; Fig. 39, Fig. 40 © From Max Wertheimer, Laws of Organization in Perceptual Forms, First published in 1923 as Untersuchungen zur Lehre von der Gestalt II, in Psycologische Forschung, 4, 301–350. Translation published in Ellis, W. (1938). A source book of Gestalt psychology (pp. 71–88). London: Routledge & Kegan Paul; Fig. 42 © From Hermann Rorschach, Psychodiagnostik: Methodik und Ergebnisse eines wahrnehmungsdiagnostischen Experiments (Deutenlassen von Zufallsformen) / Mit den zugehörigen Tests bestehend aus zehn Teils mehrfarbigen Tafeln. Bern ; Berlin : H. Huber, 1932 2nd Edition: Dr. W. Morgenthaler; Fig. 16, Fig. 19, Fig. 20, Fig. 21, Fig. 22, Fig. 23, Fig. 24, Fig. 25, Fig. 26, Fig. 27, Fig. 28, Fig. 29, Fig. 30 © Bill Hillier; Fig. 17 © From Bill Hillier and Julia Hanson, The Social Logic of Space, 1984, figures on p 150. © Cambridge University Press, reproduced with permission of the author and publisher; Fig. 18 © From Bill Hillier and Julia Hanson, The Social Logic of Space, 1984, figures on p 151. © Cambridge University Press, reproduced with permission of the author and publisher; Fig. 51 © From Bill Hillier and Julia Hanson, The Social Logic of Space, 1984, figures on p.63. © Cambridge University Press, reproduced with permission of the author and publisher; Fig. 52 © From The Winnebago Tribe by Paul Radin, published by the University of Nebraska Press; Fig. 55 Photo: Imaging Department © President and Fellows of Harvard College; Fig. 56 courtesy OMA © Rem and Madelon Koolhaas-Vriessendorp; Fig. 57 © Udo Hess; Fig. 61 © The Bridgeman Art Library; Fig. 62 © The Walters Art Museum, Baltimore; Fig. 67 © Austrian Archives/Corbis; Fig. 69 © Daniel Köhler and Rasa Navasaityte (www.lab-eds.org); Fig. 73 © Francis DK Ching; Fig. 76 © Werner Forman/Corbis; Fig. 77 © Maren Klasing and Martn Krcha; Fig. 78 © Konrad Hofmann, Maren Klasing, Martn Krcha and Manuel Froeschl; Fig. 79, Fig. 80, Fig. 81 © Mario Gasser and Philip Weisz; Fig. 59, Fig. 86 © Frei Otto; Fig. 87, Fig. 88 © Institut für Leichtbau Entwerfen und Konstruieren, Universität Stuttgart, Germany; Fig. 102, Fig. 103, Fig. 104, Fig. 105, Fig. 106, Fig. 107 © Ludovico Lombardi (on behalf of Craft_id); Fig. 13, Fig. 14 Images redrawn by Patrik Schumacher, according to the original © Christopher Alexander; Fig. 15 Image redrawn by Patrik Schumacher, according to the original © Simon Nicholson; Fig. 43 © Patrik Schumacher, redrawn by the author with permission from Fondation Le Corbusier; Fig. 5, Fig. 6, Fig. 7, Fig. 8, Fig. 10, Fig. 11, Fig. 12, Fig. 35, Fig. 36, Fig. 37, Fig. 38, Fig. 41, Fig. 46, Fig. 47, Fig. 48, Fig. 49, Fig. 50, Fig. 108 © Patrik Schumacher; Fig. 44 © Zaha Hadid and Patrik Schumacher; Fig. 109 © ILEK Universität Stuttgart, Germany; Fig. 112, Fig. 113 © Gerry Cruz, Spyridon Kaprinis, Natalie Popik and Maria Tsironi; Fig. 2, Fig. 58, Fig. 70, Fig. 71, Fig. 72, Fig. 74, Fig. 75, Fig. 82, Fig. 83, Fig. 84, Fig. 85, Fig. 89, Fig. 90, Fig. 91, Fig. 92, Fig. 93, Fig. 94, Fig. 95, Fig. 96, Fig. 97, Fig. 98, Fig. 99, Fig. 100, Fig. 101, Fig. 110, Fig. 111, Fig. 114 © Zaha Hadid Architects; Fig. 9, Fig. 33, Fig. 34, Fig. 45, Fig. 53, Fig. 54, Fig. 60, Fig. 63, Fig. 64, Fig. 65, Fig. 66, Fig. 68 out of copyright.

Introduction to Volume 2

This is the second volume of *The Autopoiesis of Architecture*. The two volumes together present a complete outline of the theory of architectural autopoiesis, a systematic treatise on architecture. This treatise proceeds via a comprehensive discourse analysis of the discipline, and on this basis tries to steer the discipline's self-conception and development.

Volume 1 introduces a new theoretical framework within which architecture may analyze and confront itself in terms of its most fundamental concepts, methods and values. Volume 2 continues to analyze architecture's discourse *and* proposes a new agenda for contemporary architecture in response to the challenges and opportunities posed by current societal and technological developments. The Volume ends with a manifesto for the new style of Parametricism, promoted as candidate to become the unified, epochal style for the 21st century. To be credible, a unified style must be backed up and guided by a unified theoretical edifice that is able to integrate many partial theories: a theory of architecture's societal function, a theory of the discipline's self-demarcation, a theory of the avant-garde, aesthetic theory, media theory, process theory etc. The theory of architectural autopoiesis presents such an integrated theoretical edifice. It is nothing other than the rational reconstruction and systematization of the discursively evolving discipline, made explicit as unified theory and opened up to criticism and constructive elaboration. Selective rational reconstruction and systematization are necessary to give *coherent* guidance to a comprehensive architectural practice that covers the totality of the built environment and its contemporary adaptive challenges.[1]

Architecture is one of the great function systems of modern, functionally differentiated society. The theory of architectural autopoiesis is a ***reflection theory*** or ***self-description*** of architecture formulated from within architecture. As such its purpose is to contribute to the necessary self-steering of the autopoiesis of architecture. Like all reflection theories – for example, economic theories, jurisprudence, the

1 The coherence of a unified theory helps to avoid self-contradiction in addressing the different theoretical and practical questions a multi-faceted discipline like architecture poses. A unified theory gives one's various statements and practical engagements consistency. Without such guidance one is prone to get in one's own way, blocking yesterday's achievements with today's efforts. A unified theory is necessary to give leadership to the discipline. It is of practical urgency with respect to giving consistent leadership to a large firm like ZHA operating globally across all programmes and scales.

epistemologies formulated within science, political theories etc – the theory of architectural autopoiesis oscillates between ***descriptive*** and ***normative*** modes of theorizing. Of necessity, as ***committed inside communication***, it is simultaneously a descriptive and a normative theory. By describing, conceptually systematizing and reconstructing the ***rationality*** of architecture's history and current state, the theory gathers the necessary internal connectivity to make normative claims and projections plausible. The tension between descriptive and normative moments permeates the totality of *The Autopoiesis of Architecture.* However, the balance between the two moments is struck differently in the two volumes. From Volume 1 to Volume 2, as we move from *framework* to *agenda*, the balance shifts towards the normative pole, and indeed includes more projective, speculative moments.[2]

The elaboration of architecture's agenda in Volume 2 proceeds in six parts, parts 6–11:

Part 6 *The Task of Architecture* sets out the general task of architecture in the terms of architecture's lead-distinction: *to give form to function*. An adequate concept of how to understand and address functions within contemporary architecture is proposed. Architecture's task is then elaborated along two dimensions: organization and articulation. To meet contemporary challenges architecture must enhance its capacity in both dimensions. Theoretical resources that contribute to this enhancement are brought to bear: network theory, Gestalt theory and semiology. In particular, an axiomatic framework for reinvigorating the semiological project within architecture is provided. The elaboration of spatial complexes as systems-of-signification is promoted as a core competency of architecture.

Part 7 *The Design Process* elaborates the second item on the agenda: the enhancement of architecture's design process reflection. Here the achievements of the design methods movement are recuperated. Design rationality is challenged by the expectation of continuous innovation as well as by the increasing complexity of architecture's task domain. Many design tasks are new and complex. This double burden demands a new theoretical reflection concerning the methodological credentials of design processes as rational decision processes. The theory of architectural autopoiesis offers a conceptual apparatus for the description and analysis of design processes, promotes innovative design process heuristics and

2 The fact that every ambitious self-description enters an ideological battleground concerning the discursive culture and direction of the discipline/profession is more palpable in Volume 2. However, aggressive polemics have been deliberately avoided in order to allow the elaboration of a coherent theoretical system to take precedence. The hope is that the analyses, theses and projections deliver a package that convinces without polemical battles.

attempts to formulate adequate contemporary criteria of design rationality.[3]

Part 8 *Architecture and Society* addresses the necessity for the autopoiesis of architecture to update and upgrade its internal representation of society in line with society's development. Luhmann's conception of a polycontextual, functionally differentiated world society is – once more – offered as adequate conceptual horizon for architecture's orientation. The dialectical relationship – coevolution – between the autopoiesis of architecture and its societal environment is addressed in Luhmann's terms. Then the reflection goes deeper and touches on the fundamental dependence of society's emergence and ongoing development on the built environment as the indispensable substratum of socio-cultural evolution. Finally, the investigation turns to the manifold societal conditions and institutions on which the autopoiesis of architecture depends.

Part 9 *Architecture and Politics* addresses architecture's relationship with one of the subsystems within its societal environment: the political system. Architecture's relationship with the political system is singled out for in-depth analysis not because of the inherent importance of this relationship but because of the widespread, disorienting illusions that abound concerning this relationship. The theoretical clarification of architecture's systemic position relative to the political system becomes the premise for the attempt to define an adequate, productive role for avant-garde architecture in relation to contemporary politics.

Part 10 *The Self-descriptions of Architecture* presents key treatises that have been seminal in the historical evolution of architecture's autopoiesis. This agenda item – architecture's self-descriptions – reveals the general requirement that architecture, like all function systems of society, must reflect its own constitution with respect to its societal function in order effectively to steer itself in the absence of authoritative directives from outside. Comprehensive theoretical treatises are the most adequate form this necessary reflection can take. Three key texts have been selected and subjected to a detailed, parallel analysis: Alberti's treatise of 1485,[4] Durand's treatise of 1802–5, and Le Corbusier's treatise of 1923. These treatises are confident, comprehensive accounts of the discipline, each reflecting architecture's societal function and arguing for principles, methods and repertoires that should guide the

3 Adequacy here means that the criteria allow us to critique and enhance design proposals without imposing sterile and unrealistic ideals.

4 Alberti's *De re aedificatoria* was written in 1450. It first circulated as a hand-copied manuscript and was then published in 1485 as the first printed book on architecture.

discipline in discharging its function. Each of these texts had been seminal in inaugurating or representing one of the epochal styles of architecture: the Renaissance, Neo-Classicism and Modernism respectively. The analysis of these three texts has been structured by the conceptual grid that underlies and organizes *The Autopoiesis of Architecture* itself, thus directly confronting the theory of architectural autopoiesis with these prior attempts at providing architecture with a comprehensive self-description. Here thus arises another occasion of autological self-inclusion for the theory of architectural autopoiesis: an occasion for the theory to analyze and historicize itself as an attempt, once more, to provide architecture with a viable self-description, this time expounding the emerging epochal style of Parametricism.

Part 11 *Parametricism – The Parametric Paradigm and the Formation of a New Style* moves beyond the general theory of architectural autopoiesis[5] and utilizes the theory's conceptual apparatus and theses to distil, analyze and evaluate a powerful new tendency within contemporary architecture. The author is himself a contributor to this tendency, as designer, teacher and author.[6] Parametricism is expounded as candidate to become the new epochal style with global reach and universal scope.

Patrik Schumacher, London, February 2012

5 The theory of architectural autopoiesis does not stand or fall with the success of Parametricism. Its scope and validity are broader. As a general theoretical framework it might be embraced by theorists and architects who do not agree with the author's evaluation of certain contemporary architectural tendencies.

6 The author first coined the label 'Parametricism' in 2008 during the Venice Architecture Biennale, and then further expounded the style in a series of articles and lectures.

6. The Task of Architecture

The theory of architectural autopoiesis identifies architecture's societal function[1] as the innovative framing of social *interaction*. Interaction is defined as communication between participants who are physically present, as distinct from remote communication via writing, telephone, Internet etc. All communications, and thus all interactions, are embedded within social systems understood as systems of communications. All social interactions take place in designed spaces filled with designed artefacts. Architectural artefacts – as well as other designed artefacts such as furniture, appliances and clothing – thus participate in the reproduction of social systems of communications. Architectural artefacts frame virtually all social communication systems, with the exception of those systems that exclusively reproduce outside the interaction between physically present participants. The designed environment matters: it frames all interactions. Only on the basis of the designed environment as complex system of frames can society be reproduced on the level of complexity it has attained.[2]

All architectural communications, as well as all communications of all the design disciplines, are communications in the medium of space.[3] Architecture frames social interaction. This very general formula characterizes architecture's societal role, responsibility and *raison d'être*. At this level of abstraction the formula can say nothing about *how* architecture might be able to discharge its responsibility, ie, *how* it might be able to order and frame the manifold social interactions that reproduce society.

1 See Volume 1, part 5 *The Societal Function of Architecture*, in particular, Chapter 5.1.3 *Framing as Societal Function of Architecture*.

2 To understand the power of architecture's societal function – namely to frame, order and orient social interaction – one might consider the following thought experiment. Imagine that the complex built environment of a city like London is replaced by a flat, undifferentiated surface. Now try to imagine how the 10 million inhabitants of the city stranded on this surface might try to recreate and order social interaction on the level of complexity that is currently sustained by the built environment.

3 All architectural communications are spatial communications. This also applies to drawings and models, including digital models. The drawing/model is architecture's specialized medium developed with the advent of architecture as self-referentially enclosed function system. See Volume 1, part 4 *The Medium of Architecture*.

Architecture's *raison d'être* – its general societal function or responsibility – must be translated into more concrete terms that allow for the formulation of tangible tasks for architecture. The autopoiesis of architecture itself has always – since its very inception – provided for this translation, namely in the terms of its lead-distinction: form (= frame) vs function (= interaction). Architecture's general societal role is thus continuously reassured, elaborated and made concrete via the continuous application of its lead-distinction on successive scales and levels of abstraction/concretization. The 'functions' architects address refer to clusters of social interactions understood as social systems. For instance the function-type 'residence' frames families or households, the function-type 'school' frames the respective social system. Many such functions can be distinguished, named and listed, at different levels of abstraction/concretization, and then confronted with various spatial forms that might also be distinguished, named and listed.

The historical coevolution of the built environment's pre-architectural repertoire and society's pre-Modern manifold of interactions led to the sedimentation of a catalogue of social institutions that correlates with a catalogue of spatio-formal types, ie, the traditional catalogue of building-type solutions. But these traditional 'solutions' are not yet conceptualized as solutions to problems. Rather they are naturalized as unquestioned essences. The traditional concepts like villa, church, palace, town hall, town house etc represent the as yet undifferentiated unity of sedimented form-function complexes. The emergence of architecture as autopoietic system – armed with its lead-distinction – implied the possibility to break down these fixed, taken-for-granted form-function unities. The old canon becomes available for dissection and recombination, in both the formal and the functional dimension. Now function and form can be distinguished as aspects of an artefact. The unification of these aspects becomes problematic. The distinction of form and function poses the question of their effective correlation. The presumed essences are dissolved. Traditional forms can now be criticized with respect to their ability to satisfy functional demands. Functions are now posed as problems. Forms are probed, selected and elaborated as solutions to problems. The distinction of form vs function marks the inauguration of architecture as rational-reflective discipline. It is the precondition of innovation.[4] Only the distinction of form vs function allows the framing of social interaction – a necessary dimension of all social evolution – to become a subject of critique and innovation.

4 Innovation is the *raison d'être* of the discipline's reflective rationality.

The task of architecture can thus be cast in terms of architecture's lead-distinction: ***to give form to function***. This general task formula confronts an increasingly rich world of social institutions with an expanding panoply of forms. Within this abstract conceptual horizon the designer can tackle every concrete design task as the concrete confrontation of a given functional problem with a specific set of forms. As will be elaborated below, this uniform task formulation can be further unfolded by a second, crucial distinction: the distinction between ***organization*** and ***articulation***. This distinction is as general and universally applicable as the distinction of form and function. The distinction is equally defining for architecture, and indeed equally venerable in terms of its pedigree in the history of architectural theory.[5] Architectural forms function via organization and articulation. Articulation can be further analyzed into phenomenological articulation and semiological articulation.

Organization and articulation are the constituent dimensions of architecture's task. However, before elaborating these dimensions, it seems useful to further clarify the general architectural concept of function and to reflect upon how the understanding of functions in architecture might be further developed and upgraded in the light of the current/emergent challenges the autopoiesis of architecture must cope with.

6.1 Functions

THESIS 25

While functional typology remains indispensable as initial orienting framework, functional reasoning in architecture has to upgrade towards a conceptualization of function in terms of action-artefact networks.

The distinction of form and function is architecture's lead-distinction and as such a permanent communication structure of architecture's autopoiesis. The concern with function is an inescapable feature of all architectural communications. It concerns all architectural artefacts, from the overall building, to each space, each architectural element, and tectonic detail.

The *concept* of function is a primary concept within architecture right from its ancient inception and then again from its rebirth in the Renaissance. The classical Vitruvian trinity of *firmitas*, *utilitas* and

5 See Chapter 6.2.1 *Organization and Articulation: Historical and Systematic*.

venustas attests to this.[6] The *term* 'function' entered the autopoiesis of architecture only in the 19th century, perhaps most prominently in the writings of Viollet-le-Duc. The term seems to have been borrowed from the biology of Georges Cuvier. Cuvier insisted that the understanding of the structure of organisms had to be grounded in relating structures to their functions. He emphasized the principle of functional organization that allocates specific functions to the various parts of the organism in correlation to all its other parts and its overall conditions of existence.[7] The influence of Cuvier's idea of functional analysis and his principle of the correlation of parts is evident in Viollet-le-Duc's writings. 'In every specimen of mason-work each piece taken separately in the case of dressed stone, or each section in concrete works, should clearly indicate its function. We ought to be able to analyze a building, as we take a puzzle to pieces, so that the place and function of each of the parts cannot be mistaken.'[8]

In the case of Viollet-le-Duc's notion quoted above, the concept of function refers to the contributions that the different parts of a structure make to the overall performance of a structure. Here these contributions are primarily technical. The different parts have no independent social function. The case is different if we consider the different rooms of a villa. Here each room has an individual social function and as such contributes to the overall functioning of the villa as ordering frame for the family's life. This second way of applying the concept of function can also be found in Viollet-le-Duc: 'There is in every building, I may say, one

6 Alberti's corresponding terms are *commoda, firmitatem* and *gratiam*.

7 Cuvier argued that an animal should be understood as a functional unit, whose structure is determined by its relationship to its specific environment. Each animal part or organ has its specific function: for example, the lung's function is respiration etc. All of the organism's organs relate functionally to one another and operate together. Cuvier believed that no part could alter its form or function without adversely affecting the entire organism. Cuvier emphasized this principle of biological integration – the correlation of parts – as one of the most fundamental laws of comparative anatomy. Cuvier explained his principle with the following example: if an animal's teeth are such as they must be, in order for it to nourish itself with flesh, we can be sure without further examination that the whole system of its digestive organs is appropriate for that kind of food, and that its whole skeleton and locomotive organs, and even its sense organs, are arranged in such a way as to make it skilful at pursuing and catching its prey. For these relations are the necessary conditions of existence of the animal; if things were not so, it would not be able to subsist. The principle of the correlation of parts – underpinned by the idea of conditions of existence – led Cuvier to the claim that one can infer the structure of the whole animal from any one of its parts. See: Georges Cuvier, *The Animal Kingdom – Arranged in Conformity with its Organization*, G & C & H Carvill (New York), 1832.

8 EE Viollet-le-Duc, *Lectures on Architecture*, 2 vols (1863, 1872), trans B Bucknall (1877, 1881), Dover Publications (New York), 1987; Vol 2, p 33, quoted in: Adrian Forty, *Words and Buildings*, Thames & Hudson (London), 2000, p 176.

principal organ – one dominant part – and certain secondary orders or members, and the necessary appliances for supplying all these parts, by a system of circulation. Each of these organs has its own function; but it ought to be connected with the whole body in proportion to its requirements.'[9] Although the term function was imported into architectural discourse only in the 19th century, and was given a new impetus by the advancing science of biology of the time, both the concept and its underpinning analogy with the animal organism were already fully operative in Alberti's foundational treatise. Alberti writes: 'Just as with animals, members relate to members, so too in buildings part ought to relate to part. . . . Each member should therefore be in the correct zone and position; it should be no larger than utility requires, no smaller than dignity demands.'[10] Alberti parallels functional integration with aesthetic harmony: 'The parts ought to be so composed that their overall harmony contributes to the honour and grace of the whole work.'[11] However, the primacy of the functional determination and correlation of the parts is clearly stated: 'Each part should be appropriate and suit its purpose. For every aspect of building, if you think of it rightly, is born of necessity, nourished by convenience, dignified by use, and only in the end is pleasure provided for.'[12] Alberti's implied notion of function (utility, purpose, convenience, necessity) is of equal generality as Viollet-le-Duc's notion.

More detailed and comprehensive accounts of the emergence and development of the concept of function within architecture can be found in works by Adrian Forty, Christoph Feldtkeller and Philip Steadman, among others. Here the main point is to establish the universal presence of the concept of function since architecture's inception as well as its generality that encompasses both the architectural artefact's functioning with respect to social demands and the functioning of the artefact's parts with respect to their contribution to the artefact's overall function. Thus the concept of function refers to both the architectural artefact's ends and its means. Since this generality might lead to confusion, a distinction is called for: the distinction between substantial and subsidiary functions. This distinction will be elaborated below. Before introducing this distinction and elaborating how the substantial functions of architecture are ordered by means of a system of fundamental function-types, another important distinction must be introduced: the

9 Ibid, p 90.
10 Leon Battista Alberti, *On the Art of Building in Ten Books*, translated by Joseph Rykwert, Neil Leach & Robert Tavernor, MIT Press (Cambridge, MA), 1988, p 23.
11 Ibid.
12 Ibid, p 24.

distinction between functions and capacities. This distinction will be introduced in the following chapter.

An important aspect of the concept of function as indicated by the historical references quoted above seems to be the idea of the functional integration of parts. The function of an architectural artefact is always defined relative to an encompassing functioning unit to which it is considered to contribute. Therefore, for any particular application of the notion of 'function' it is necessary to specify a system-reference, ie, the functioning whole with reference to which the functional element is supposed to contribute by fulfilling its allocated function. An architectural artefact is built up as a cascade of functions serving functions. This cascade is usually ordered hierarchically: encompassing functions are fulfilled via a series of subsidiary functions. One can also find webs of functions that cannot be neatly decomposed into distinct levels. However, the cascade or web of functions always culminates in categorical social functions that are given to architecture as its external reference, its *world-reference*.

That functions constitute architecture's world-reference, and that functions are always embedded within cascades and networks of functions, does not tell us what kind of entities the functions of architecture and design are. The fundamental starting point of the theory of architectural autopoiesis is that everything within its domain is communication. This is a consequence of the theory's self-embedding within Luhmann's social systems theory. Everything social is communication. Therefore everything architectural is communication. The theory operates within an ontologically homogeneous domain: everything is communication.

Architecture's lead-distinction is the distinction of form vs function. According to the theory of architectural autopoiesis, both forms and functions are communications. ***Forms are framing communications, functions are framed communications.*** This is the fundamental, necessary axiom of all further theorizing about form and function within the theory of architectural autopoiesis. The built forms of architecture are the final communications of architecture that are released into society to serve as framing communications within the respectively accommodated social systems. The functions of architecture are those communications, communicative interactions and communicative event scenarios that are framed by architecture's forms. All design is ultimately communication design.

We might demonstrate the pertinence of this axiom by considering some examples. What is, for instance, the function of a bread knife? To cut bread. Or to be more precise: the function of a designed bread knife

is the ***action*** or ***action type*** of cutting bread. What is the function of a phone? The action (or action type) of having a phone conversation. The function of a designed car is the action type of driving a car, including (perhaps most importantly) when the user of the car is picking up his girlfriend. The function of a dinner table is the action type of sharing a dinner. The function of a lecture theatre is the social event type that we call lecture. What is important to note here is that all these functions are in fact communications. To cut bread at the dinner table is a communication. All actions, as distinct from mere bodily movements, are communications. By cutting the bread at the table the user of the knife might communicate that he wants to guide the event, as a good host, that he wants to express concern, hospitality etc. The knife itself frames this communication. It is itself a framing communication. The design features of the knife participate and give connotation and nuance to the communicative action of cutting the bread. Its weight and size modulate the gesture. Its appearance – modern versus traditional – gives identity to the user etc. It is these communicative aspects of the action that are the concern of the contemporary product designer. The technical feasibility of the knife's cutting operation is the concern of the product engineer. (The functions engineers are concerned with are physical processes.) In a similar fashion a lecture theatre can be analyzed as a framing communication whose function is the communicative interaction scenario that is the lecture or lecture event. The lecture is a communication that is framed and modulated by the specific design of the lecture theatre. It matters whether the theatre is long or broad, flat or steep, open or closed, with a lot of space between the seats or tightly packed etc. These differences are framing communications that regulate the participants' expectations and put them in a particular mood and provide a sense of anticipation.

All design is ultimately communication design. The design of social networking software, the design of tableware, the design of an evening dress, as well as the design of a living room, embedded within the design of the encompassing apartment, which is in turn embedded within the design of an apartment building. The functions of architecture and design are communications, communicative interactions, communicative event scenarios and communication systems, all operating within cascades of subordination/superordination, as well as in more loosely structured networks.

6.1.1 FUNCTIONS VERSUS CAPACITIES

The distinction of functions versus capacities is a relatively recent acquisition within the autopoiesis of architecture. This conceptual

augmentation of architectural discourse responds to the increasing fluidity of architecture's task environment.

Rapidly shifting and differentiating life/communication processes with rather fluid requirements imply that thinking in stereotypical functions is no longer always appropriate. At the same time new design techniques deliver new formal repertoires with as yet unclear utilization potentials.

While a ***function*** of a building, space or architectural element is an actual, regular utilization effect of the respective building, space or element, a ***capacity*** of a building, space or architectural element is an occasional or only potential utilization effect. (The concept of utilization effect is coextensive with the concept of social communication (action, interaction). All utilization effects of architectural artefacts are social communications.) Functions might be manifest or latent. A function is ***manifest*** if it is explicitly acknowledged as the purpose of the building, space or element. Most buildings, spaces or elements have one single manifest function that is referred to in the space/element's name. For instance, the manifest function of an office building is to be utilized for office work, the manifest function of a lecture theatre is to accommodate lectures, the manifest function of a bedroom is its regular night-time utilization as sleeping place, and the manifest function of an entrance door is to be utilized as point of entry etc. (All these activities can be understood as communicative action: working, sleeping, lecturing, listening to a lecture, entering a building.) In addition to its manifest function, a building, space or architectural element might routinely be utilized in ways that are not explicitly acknowledged. However, these unacknowledged utilizations might still occur regularly, offering advantages that continue to motivate the reproduction of the respective forms of the buildings, spaces or elements in question. For instance, generous entrance steps into a public building might have the implicit or ***latent*** function of serving as informal lingering space that gives the respective institution a sense of welcoming animation. Reception desks in lobbies have the latent function of controlling access.[13] Their typical placement within lobbies indicates that this latent function is an aspect of their reproduction. (This distinction of manifest versus latent functions has been borrowed from sociology.)

The ***routine utilization*** of a certain form of building, space or architectural element is decisive for defining its functions, both manifest and latent. Further, the ascription of a function requires that this routine utilization feeds back to and ***motivates*** the ***regular reproduction*** of the

13 Controlling glances are deterrent communications. Even the mere occupation of a strategic entry position is a communication.

specific form of building, space or element. Capacities are effects where this aspect of a routine utilization that motivates regular reproduction is absent. Functions are declared or hidden ***purposes***. Capacities are ***potentials*** rather than purposes. They are affordances that have neither been asked for by the client, nor are they expected by user groups. Capacities might occasionally be utilized, however, without becoming a factor in the reproduction of the forms that have these capacities. With respect to capacities one might distinguish ***actual*** from ***virtual*** capacities. Actual capacities are current affordances that are occasionally utilized within the life/communication processes of the accommodated social system. For instance, all the rooms of a residential apartment have the capacity to become students' studios if the apartment is taken up by a student commune. Virtual capacities are as yet undiscovered, potential affordances that might be actualized only within a transformed life-process. Virtual capacities are involved when architectural design research has its most speculative moments. Virtual capacities are to be transformed into actual capacities. To the extent that these actual capacities become recognized, regularly utilized and then expected, they become functions. If they acquire a name that is used to designate buildings, spaces or elements they become manifest functions.

The distinction of functions versus capacities might be illuminated by reference to a similar distinction that is being made in relation to biology. Biological functions can be defined as selected effects.[14] An effect of a certain organic structure or trait of an organism can only be described as a function of the respective organic structure or trait if this effect presents an advantage for the organism and has contributed to the differential survival of the organism's ancestors utilizing the effect. The respective structures/traits have been *selected* in the sense that the population with the structure/trait exhibits a higher rate of reproduction than a comparable population without the structure/trait. The concept also requires that these selected effects are still contributing to the ongoing survival and reproduction success of the population in question. Functions are relative to a given life-process within a given environment. The underlying capacity might lose its function – becoming a mere rudiment – if the life-process changes within a transformed environment. At the same time, capacities that were dormant might become active and relevant for survival/reproduction within the new life-process. At any time,

14 Concerning the selected effects theory of function see: Karen Neander, 'Functions as Selected Effects: The Conceptual Analyst's Defense', in: *Philosophy of Science*, Vol 58, No 2 (June 1991), pp 168–84. The paper defends an etiological theory of biological functions according to which the proper function of a trait is the effect for which it was selected by natural selection.

any organism has an inexhaustible excess of virtual capacities. These capacities include the sum total of all traits that emerged as yet unutilized side effects of structures that evolved under certain selection pressures: differences that make no difference yet. The limit for the identification of capacities is located in the observer – biologist, architect, user-group – and his/her/its resources of discrimination. Any feature that can be described at all becomes a virtual capacity if a potentially relevant effect can be imagined that would put the feature to work within an (imagined) future environment or life-process. With a change in selective pressure – induced either by an environmental change or by a change of survival strategy on the part of the organism – these capacities might become relevant contributors to the further survival and proliferation of the organism in question. Side effects become selected effects, capacities transform into functions. This process whereby hitherto redundant features become vital functions is called ***exaptation***[15] in contrast to ***adaptation*** where a given functional feature is gradually optimized relative to a stable selection criterion. Exaptation includes both the first utilization of fallow features and the re-functionalization or 'détournement' of functional features, ie, their enlistment for new functions. In retrospect both the redundant features and the functional traits reveal their capacities by becoming evident as so-called ***pre-adaptive advances***. Both biological and cultural evolution proceed as much via exaptation as via adaptation. Exaptations are usually followed by further adaptations.

As indicated above, exaptation does not only involve the utilization of hitherto unutilized features but also (and perhaps predominantly so) the re-utilization of features or structures in new capacities that eventually stabilize into functions. The human hand evolved from extremities that were originally (like the feet) organs of locomotion. The evolution of the human speech organs (tongue, voice) involved the détournement of structures that originally evolved as organs with the functions of eating, breathing, and perhaps signalling via screaming. The significant fact with respect to highly evolved, complex organisms is that their body's organization and its structures are much more fixed and stable than their life-processes. The utilization (functionalization) of these structures and their capacities is much more malleable than these structures themselves. When a new pattern of utilization has been established, optimizing adaptation is set onto a new course and slowly reshapes and refines the structures in question according to the exigencies of the new

15 Stephen J Gould & Elisabeth S Vrba, 'Exaptation: A Missing Term in the Science of Form', in: *Paleobiology* 8 (1), 1982, pp 4–15.

life-process and its selection pressures. In the domain of architecture it can also be observed that evolution largely proceeds via the re-utilization of already evolved spatial types for new purposes rather than starting from scratch with each new requirement. In the world of architectural and artefactual evolution, a similar dialectic between exaptation and adaptation can be observed. Revolutionary, creative advances happen when new capacities are discovered and transformed into reproducible functions. Further cumulative advances are possible by means of adaptive refinement in view of the new function and its criteria. A new capacity for both the engine and the carriage was discovered in their combination within the first motor car. Since then a cumulative advancement of this new 'life form' has been witnessed, and it is still ongoing on the basis of a fundamental body plan that is now over 100 years old.

Contemporary avant-garde architecture has discovered the category of capacities, and the attendant concept of an always excessive virtuality, as a vehicle for evolutionary acceleration. The proliferation of as yet uninterpreted forms is not only tolerated but promoted as the production of as yet uncharted capacities.[16] The conversion of abstract forms into speculative proto-capacities is proceeding in design processes that employ a form-to-programme heuristics. Sometimes this creative work of functional interpretation is left to audiences that encounter and inhabit experimental projects after their construction. In any case, the architect has no control over which of his/her discovered and promoted capacities are finally selected, recognized and reproduced as designated functions. Architects control form (internal reference), they do not control function (external reference).[17]

If architectural functions are selected effects then the question does indeed arise of how this selection process takes place. The ascription of functions is safe, trivial and even inevitable only in the case of stable, stereotypical social institutions. The standard set of rooms in a modern, residential apartment is an example here: living room, dining room, kitchen, bathrooms and bedrooms have designated functions that the designer can rely on and work with in his design thinking.[18] The final

16 See, for example: John Rajchman (guest editor), 'The Virtual House', *Any* magazine, September 1997.

17 The lead-distinction of form vs function effects the re-entry of the distinction between system and environment into the system. Form is architecture's internal reference (self-reference). Function is architecture's external reference (world-reference). See: Volume 1, chapter 3.4.2 *Form vs Function as the Lead-distinction within the Design Disciplines*.

18 Strictly speaking even these stereotypical functions are up for détournement. All rooms in an apartment that is taken up by a commune of students are re-utilized as studios, including the living room and the dining room. The détournement sometimes goes even further: the first

arbiter of the advancement of social functionality, of the transformation of capacities into functions, is indeed the appropriation of the designed territories by the accommodated life-processes of the users. The more fluid and uncertain those life-processes become, the more must the discourse of architecture shift its attention from the anticipation of ascribed/designated functions to speculation about capacities. The plausibility of such speculations can be enhanced via an upgraded medium of architecture that is able to build up and visualize various social scenarios that tease out the virtual capacities of a designed spatial configuration and morphology.

Although the notion of a territory's capacities is certain to gain more prominence within architectural discourse, the concept of function cannot be replaced or eliminated by the promotion of the concept of capacity. The latter concept requires the former in its definition: a capacity is defined as a potential function. It is a ***proto-function*** in the sense that it has yet to acquire a determinate and desired effect by being selected according to the purposes and pursuits of the social communication processes framed by the territory in question. What must be refuted decisively here is the idea that all stable functions, and by implication all stable social institutions and expectations, are about to dissolve into a maelstrom of ever-changing forms of spontaneous communicative interaction. There can be no complex, productive social process that is just built upon fluid spontaneity. Complex social processes are ordered social processes. The very societal *raison d'être* of architecture is to stabilize and order patterns of social communication. That's the meaning of framing.[19] Without the stabilizing force of architecture no social complexity can be built up. Neither can social complexity be maintained without architectural stabilization on the high level of artificiality and thus improbability that has been achieved within contemporary society. What we must focus on is the innovation of frames and their functions, not their dissolution. Capacities must ossify into functions, within ever accelerating cycles of innovation. There can be no social life without expectations, without institutions, without (manifest and latent) functions. The functional designation of territories might become loose, multiple and transient, but it will not disappear. Functions will mutate from fixed stereotypes into more variable event scenarios. The functional distinctions will evolve from rigid dichotomies into richer

London studio the author occupied as independent apartment was originally designed as a kitchen.

19 *Framing* has been identified as architecture's societal function. See Volume 1, chapter 5.1.3 *Framing as Societal Function of Architecture*.

manifolds that might be susceptible to architectural ordering via gradients, allowing for smooth transitions and interpenetrations. All this is welcome and necessary, a higher, more complex and variegated order, requiring a more sophisticated repertoire of architectural framing. As will be explored below, the challenge of framing more complex patterns of social communication requires the upgrading of architecture's framing power along three dimensions that collaborate in the establishment of architectural order: the organizational, phenomenological and semiological dimensions of architectural order. The speculation about new capacities of new architectural forms will play an important part in architecture's attempt to address the evolving challenges of contemporary life. Their condensation into new function-types must remain the aim of such speculations.

6.1.2 SUBSTANTIAL VERSUS SUBSIDIARY FUNCTIONS

To elaborate a general concept of function, it is crucial to distinguish *direct* vs *indirect* contributions to social purposes (social interactions). The functioning of an architectural artefact that contributes to a social use or purpose only indirectly, via its encompassing unit, needs to be distinguished from such architectural artefacts that by themselves directly address a social use or concern.[20] Architectural theory needs to conceptualize the difference between, for example, the function of the posts that make up the balustrade and the social function of the balustrade itself, for example, its latent provision of a comfortable place to lean against, linger and look about. To express this difference, the theory of architectural autopoiesis distinguishes ***subsidiary*** functions from ***substantial*** functions. The substantial functions of architecture are always self-sufficient communicative actions, interactions, situations, events, scenarios or systems. At this point it is important to identify the architectural units that are capable of carrying substantial functions. The question arises whether architectural elements or components below the level of a room or territory are capable of sustaining a social function. The answer is no. All design disciplines produce artefacts that frame social interaction. Within the domain of architecture – as distinct from product and fashion design – the artefacts that frame social communication are ***territories*** that establish a difference between inside and outside.[21] Thus only territories have substantial functions. Therefore, the example of the balustrade is pertinent only to the extent to which the balustrade has

20 Social uses are always communicative actions or interactions: working, conferencing, learning, shopping, dining, hanging out etc.

21 See Volume 1, Chapter 2.5.5 *The Specificity of Architecture within the Design Disciplines*.

been designed to define a place, and does indeed define a self-sufficient territorial unit that can routinely frame social interactions. This might usually not be the case with balustrades, except perhaps if the balustrade describes a semi-circle to produce a niche and is perhaps further augmented with a wide handrail to lean upon etc. Such a niche or balcony overlooking a lobby is indeed a territorial unit that can sustain a substantial function, ie, the activity of overlooking the events unfolding in the lobby space. The niche communicates an invitation to reside there in this way. If the niche is occupied, people passing by will understand and respect this. (In this sense the niche communicates a single occupancy rule.) The niche might also invite two or three friends to gather there for a chat. The niche thus has two substantial functions sustaining two distinct types of social interaction: solitary lingering and chatting. Both are latent rather than manifest functions. (A flat, nondescript balustrade might have the capacity to host such events. Since, in this case, such events are not expected or considered in the brief and design of the balustrade they are mere capacities and not functions.) Strictly speaking the balustrade itself does not have its own substantial function. It is subordinate to the niche as frame. It contributes to the framing effect of the niche by means of various subsidiary functions: the function of supporting the weight of the communicating bodies, the space-delimiting function and the provision of an inviting aesthetic or atmospheric identity. Thus we can distinguish three types of subsidiary function: technical, organizational (space-delimiting) and articulatory functions. Each subsidiary effect or function contributes, in its own way, to the creation of the niche and its framing action. The strictly technical aspects, as external constraints, can be taken up by the engineering disciplines. However, even if the responsibility for the technical feasibility of these aspects is renounced, the architect must be able to discuss and integrate the technical requirements.

The distinction introduced here allows explicit differentiation between the merely subsidiary functioning of a staircase as device to reconnect a space that has been severed into levels, and a situation where the staircase is expected to address its own substantial function as a communicative space that has its own social significance. In the first instance the staircase has only a subsidiary function. In the latter instance the staircase has a substantial function. We might also envision a situation where a staircase serves both a subsidiary function, for example, reconnecting a severed programmatic unit, as well as a (latent) substantial function, for example, giving space and occasion to desired communicative encounters. The example of the staircase thus implies that an architectural artefact might, at the same time, but with respect to