Introduction to the Handbook on Planning and Complexity

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1. Introduction to the *Handbook on Planning and Complexity*

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1. PLANNING AND COMPLEXITY, TWO OF A KIND?

You have to know about it before you can see it. And only when you realize what it is, does it gain meaning. This also applies to concepts such as ‘complexity’. Complexity is everywhere, it is part of nature and culture and therefore an intrinsic part of our existence. Only, you must *want* to see it. And to be able to see it you have to know . . .

Complexity is about ‘becoming’ and a world in flow. In a world in flow, change and transformation are constant factors. Complexity is therefore at odds with the world of ‘being’; fixed, frozen and unchangeable because it ‘is’. This idea of an unchanging world of ‘being’ is a perspective on reality that for more than 2000 years has dominated the philosophical and scientific debates in the West. As a result, it has become an almost insurmountable part of ourselves. Such a deeply grounded image of reality, which has been passed down from generation to generation, cannot simply be discarded. The world of ‘being’ reached its climax in the twentieth century, in which all-encompassing perspectives on our world, such as modernism, functionalism and materialism, were adhered to.

The underlying science is based on certainty, causality and objectivity. This science has unmistakably produced knowledge, understanding and social progress. Undeniably, it also makes us blind to other realities, including a world in flow. How is it possible that science and society allow themselves to be framed by a world that ‘is’, while being blind to the rise and fall, trends and crises around us despite these being clearly visible? And how is it possible that the coming and going of evolution and revolution are dismissed as anomalies? Is it so difficult to imagine a world in which the evolutionary and revolutionary processes of change are pre-eminent? Apparently, it is . . .

Spatial planning is the science of ‘purposeful interventions’ and traditionally intended to solve problems while controlling, managing and creating the daily environment. Planning is not the most obvious discipline to promote an alternative perspective on reality, which is about ‘complexity’, presenting a world of ‘becoming’ in which autonomous and spontaneous change are the leading processes. At first glance, there seems to be a conflict between what is envisaged with complexity and what planning stands for. A man-made, planned reality is miles away from a reality of autonomous and spontaneous change. Planning and complexity seem to represent an oxymoron.

On the other hand, it was precisely the planning discipline that in the early 1990s dared to break ties with the positivist, exact and quantitative sciences. A genuine paradigm shift took place: the ‘communicative turn’ in planning. The communicative paradigm was inspired by Habermas’ philosophy of ‘communicative action’ (1981), which stressed that meaning lies not only in facts, but also in mental constructions of reality that people create collectively. Through interactions with others, reality acquires meaning and can be understood: making sense together.

The planning discipline made a giant leap forward thanks to the communicative turn (Fischer & Forester, 1993; Healey, 1993; Innes, 1995; Sager, 1994), which resulted in a differentiated understanding of problems and approaches into categories that differ in degrees of 'static' complexity (Bartelds & De Roo, 1995; De Roo, 2003, 2012). The first signs of the 'communicative turn' in planning could already be seen decades earlier, with advocacy planning (Davidoff, 1965), equity planning (Harvey, 1973), societal consensus (Etzioni, 1968), public participatory planning (Ratcliffe, 1974) and transactive planning (Friedmann, 1973).

These initiatives were part of a search for alternatives that could counter the limitations of traditional planning and its technical rationality. Davidoff and others looked specifically at the limitations of 'the actor'. These limitations were, since Simon (1972), summarized as 'bounded'. The answer to the actor's boundedness was then sought in local involvement and local knowledge. Later on, power, resources and responsibility at the local level were added.

However, in those days there were also planning scholars who focussed not so much on the limitations of the actor but instead on the characteristics of the planning issue. Horst Rittel, a planning scholar from the University of Stuttgart and the University of California in Berkeley, proposed the concept of 'tame' and 'wicked' problems (Rittel, 1969, 1972; Rittel & Webber, 1973; Vasishth, 2008; West Churchman, 1967). Wicked problems represent a category of issues that are essentially unique, rather hard to define (no definitive formulation), connected to a wider field of problems and difficult to end (no 'stopping rules' is how Rittel puts it) since there is no clear and straightforward solution. Ackoff (1974) spoke of 'messes' to qualify these problems because these unstructured and ill-defined problems interact with other problems (Grunau & Schönwand, 2010). Rittel, Ackoff, West Churchman, Webber and others saw the relevance of the interfering and dynamic context, which is very much at odds with the traditional scientific attitude to observe the object, problem or situation in isolation.

These wicked, messy and vague problems (De Roo & Porter, 2007) have become the central issue of debate within the complexity sciences. The complexity sciences have put the planning scholar Rittel and his wicked problems on stage. De Roo (2012) reasoned as follows: while the planning community made a communicative turn, more or less ignoring Rittel's reflections regarding the critique of the technical rationale in planning, Rittel's concept of 'wicked problems' was very much appreciated within the complexity sciences and is referred to today in various disciplines of science (Conklin, 2005; DeGrace & Stahl, 1990). Rittel's wicked problems share the characteristics that the complexity sciences identified for a world in flow. In this world of flow it is time that matters, with processes of emergence, co-evolving trajectories and path dependencies that show situations that are 'out of equilibrium', progress in a non-linear way, are adaptive and open to self-organization, and are associated with periods of transformation and chaotic moments of bifurcation.

It would therefore not at all be odd if the planning discipline were to be susceptible to another turn, this time inspired by the complexity sciences, which might give it a second push to reinvent itself. This could potentially lead to a kind of planning understanding the 'dynamic' complexities of the environment in which we live. The characteristics that are associated with these 'dynamic' complexities are the primary focus of the complexity sciences and spatial planning could benefit from this (De Roo, 2018). The complexity sciences and their understanding of dynamic complexity could push planning beyond its paradigmatic rationalities, the technical and communicative, towards a non-linear understanding of planning.

2. DYNAMIC COMPLEXITY

What exactly is this 'dynamic' complexity? What does this concept tell us about the world that we are part of? And how does such a world relate to spatial planning as a science of purposeful intervention? To answer these questions, the following is important: you have to know about 'dynamic' complexity before you can see it.

For a long time, science chose another way of looking at the world: identifying its parts (analysis) through the study of fixed objects in isolation, resulting in an understanding of the whole (synthesis). This led to an obsession with facts, preferably expressed in numbers and figures (Capra, 1982; Damasio, 1994; Habermas, 1987). This obsession together with a static worldview impacted on the planning discipline in its initial state. If there was a dynamism at all, it was considered an anomaly that had to be tamed and brought under control (Stewart, 1972).

The crises that affected the Western world following the mortgage crisis in the US in 2007 were undeniably signalling the end of this reasoning, with planners and economists having no control over developments in the urban arena for numerous years (Stiglitz, 2002; Raworth, 2017; Kiely, 2018). This crisis could no longer be seen as an anomaly, because it had become too extensive and it was impossible to return to the original situation. Economists partially shifted focus on evolutionary economy, while planners showed a growing interest in *adaptive planning*.

Perhaps the time was right to take Rittel seriously. And not just Rittel, since a group of scholars stood up around the millennium stressing the relevance of non-linear modelling (Allen, 1997; Batty, 2005, 2010), self-organization (Portugali, 2000), static complexity and decision-making (Christensen, 1985; De Roo, 2003) and dynamic complexity and choice (De Roo, 2016, 2018; Portugali, 2011; Rauws, 2015).

A few years before the period of crises, in July 2005, the Association of European Schools of Planning came together for its annual meeting in Vienna, where a working group on Complexity and Planning was established. The working group's assumption was that non-linear developments and autonomous spontaneous change are perhaps as real as linear growth and intentional change. And they expected intentional change and autonomous change to go hand in hand in environments of 'dynamic' complexity. The members of the working group share the idea that 'dynamic' complexity only has meaning if you realize what it is and from then on it colours the world completely differently from how it was once seen.

The picture in a frame: it is a good metaphor for a traditional scientific perspective. Anything outside the frame is not part of the story that the picture wants to tell. The frame demands attention for the still object that it presents, which is separated from its environment and is to be seen in isolation. Deconstructing this frame would mean opening up to a contextual world that positions the isolated object in an interdependent relationship with its environment. Deconstructing the fixed and frozen scenery would mean letting time play its role, which would be just one step away from a world in flow. A world in flow is nothing but a balancing act, within which everything is connected, with dissipative and complex adaptive systems co-evolving while absorbing and passing on energy and information, allowing these systems to adjust to new circumstances, to eventually transform entirely and result in a dynamic patterning landscape. A useful metaphor to make some sense of this is *the meandering river*.

The meandering river is the steady outcome of a balancing act between global mechanisms of evaporation and rain (dynamics) on the one hand and landscapes and soil structures (robustness) on the other. The steady state that it produces is, however, temporal. It is a balancing act that is no more than a discontinuous process seeking equilibrium. The steady state is therefore not an outcome in terms of a definitive end. Instead, it is merely a temporary persistence or a balanced dynamism, with mismatches, frictions and breaks that every so often push the river far out of equilibrium. These mismatches become visible as waterfalls, flooding and so forth. Humans have tried to get a grip on rivers, damming and canalizing them, making them functional for agriculture, transport, or as a sewer, while cities turned their backs on them. This functional perspective is only recently changing due to a chain of events. Climate change has led to rather large fluctuations in volumes of water, which makes canals crumble and collapse and puts the local environment at risk. This threat is countered by allowing rivers some space to flow, which generates buffering capacity, benefits ecosystems, facilitates leisure activities and – admittedly – adds landscape qualities to cities. It is a world in flow and this world in flow demands a different perspective and a new kind of science.

The traditional kind of science, or 'normal' science as it is sometimes called (Kuhn, 1962), builds on the idea of an unchanging world of 'being' that has been passed on to us from classical times. In ancient Greece, people shared ideas about how the world works with each other through poems. Parmenides' 'In Nature' (fifth century BCE) is one of those poems and in retrospect a rather crucial one. 'In Nature' describes a world that is understood to be made up of two parts. One is the world of unchangeable objects, a world that 'is'. Out of this viewpoint neo-positivism has emerged, which emphasized the scientific belief that there is absolute truth, and this truth is based on facts and is within reach. The other is the world of values and meanings. This division of reality continued to dominate the philosophical debate for more than 2000 years. On and off, the orientation on objects was preferred over values. This culminated in the twentieth century in a one-sided view on objects, studied in isolation to be understood by analysing their parts, which were considered to be unchangeable, and supposed to be objectively perceived. It reduced the world of objects to their functionalities. Only towards the end of the twentieth century did the planning discipline and the managerial sciences embrace Parmenides' 'values' as an alternative view, by taking perceptions and interpretations seriously. The planning discipline incorporated them into its scientific perspective of reality, which is now known as the 'communicative turn' in planning.

What Parmenides and his poem 'In Nature' meant for Western science and philosophy is what Lao Tzu and 'the Tao' meant for the Chinese way of understanding the world that we are part of. The Tao (the road) is discussed in the *Daodejing*, a booklet of 5500 characters, written around the sixth century BCE. The core is a perspective on a world in which everything is in motion. This world is subject to cyclical dynamism. This means that co-evolution and transformation take place all the time. This dynamism is the product of a duality. Two opposite and interdependent poles, Yin and Yang according to the Tao, are responsible for a force field, a field with high and low pressures, between which a difference in potentiality makes the world flow. And from a world in flow patterns will emerge. Thus, the Tao shows a world that can be understood as a dynamic patterning landscape.

The complexity sciences also talk about this dynamic patterning landscape, although in slightly different terms than the Tao does. Within the domain of Western science, the Tao is considered to be esoteric, exotic and mystical. The Tao and its reasoning are best kept at a distance. Within the same domain of Western science, Parmenides' message of an unchangeable world that 'is' was turned into the philosophical foundation of science. Consequently, Parmenides' statement that the world is unchanging was taken very seriously. This is rather curious, if not absurd.

3. COMPLEXITY IS 'RELATIONAL'

The complexity sciences are a recent phenomenon in the history of science and philosophy (Waldrop, 1993), presenting a perspective on a changing world caused by open, out-of-equilibrium systems. Keller Fox notes that in the first half of the twentieth century the concept of 'open, non-equilibrium systems, in contrast to the more familiar closed, equilibrium systems of physics and chemistry . . . was already established in mainstream scientific literature' (2008: 60). The origins of the complexity sciences, however, can only be traced back to 'the late 1940s, coinciding with the rise of cybernetics' (Keller Fox, 2008: 63).

Cybernetics builds on a lengthy and sustained discussion about various appealing examples that oppose 'traditional' scientific reasoning and its belief in certainty. It was a discussion that only slowly gained momentum. Physics, for example, had embraced fundamental uncertainty in the early twentieth century but was unable to distance itself from the 'powers' of direct causalities and the certainties it promised. Despite the 'dynamic' notion of temporary 'steady states', chemistry persisted in stressing the relevance of equilibrium of chemical reactions. Despite 'floating' concepts such as 'homeostasis' and 'self-organization', biology was linked to a discourse that presented organisms as machines with regulatory and control mechanisms. However, during several isolated discussions within the field of cybernetics (Wiener, 1948), an attempt was made for the first time to come to a kind of science that was based on principles of feedback, circular causality and self-regulation. Such a science could explain the existence of temporally balanced states of systems within unstable environments.

'Dynamic' complexity could also explain why the world shows behaviour that seems to be at odds with the second law of thermodynamics: instead of an increasing entropy, the entropy is decreasing in various situations. In layman's terms: the second law states that all will collapse and turn into dust. This is in contrast to what people do, making every effort to hold on to whatever they are constructing, for example through maintenance, which prevents their constructions from collapsing. Cities, one of mankind's most astonishing achievements, would not have been possible according to the second law, unless energy is put into them. That is precisely what happened when we built cities, which we regard as continuous processes of development and innovation. Their structures stretch out into the world and have turned cities into nodes where the local and the global meet. These efforts against the second law of thermodynamics are not without consequences, however, as the footprints of cities show.

Teilhard de Chardin (1881–1955) is worth mentioning. He was a somewhat curious figure within the domain of science. This is not just because he was a priest who regularly got into conflict with the Church, but also due to his speculative, spiritual and mystical ideas about evolution and the role that humanity plays in it. Here he is relevant as the one who posited that 'human cultures are historically striving for cooperative, non-zero-sum situations' (Wright, 2000). Non-zero sums, or win–win situations, and the well-known phrase that 'the whole is more than the sum of the parts' are all at odds with the second law of thermodynamics. Instead, they refer to patterns of temporal stability that emerge from dust, chaos, incoherency and instability. These patterns of stability show coherency and temporal stability and can become stepping stones towards 'higher' levels of organization. These 'higher' levels of organization have led to us being humans, have produced cities and they are to be seen as robust layers for further development and innovation from which cities continue to transform and progress.

Human history can be considered the result of repetitive, multi-layered and interdependent patterns of stability (Diamond, 1997). Physical and social structures are produced as non-zero and positive sums, pushing developments to higher-level equilibriums. Consequently, Wright (2000) concluded that social evolution has a directionality, with coordinative and cooperative behaviour as its driving force. Social evolution differs from biological evolution, which is caused by mutations in genes and geographical divisions that lead to selection and different levels of fitness. Humans evolve socially because they can imagine a future that they consider attractive (an internally constructed reality). And humans are able to learn collectively (a response to external awareness). Both are strong incentives that give direction to development and innovation. Processes of collective learning are an important stimulus for social evolution and are visible everywhere, not in the least in the planning domain.

The evolving debate in planning from a technical to a communicative rationality is the result of such a learning process. The evolving debate in planning shows a trajectory full of ideas, proposals and approaches in planning of use in various situations. What is produced makes sense and represents a toolbox for planners to work with. The planning debate is also a representation of robustness from which new domains within planning can be explored. One of these domains is the non-linear world of complexity, which is central to this book.

The non-linear world of complexity touched planning in different ways in recent decades. One aspect that planners can appreciate is making a distinction between situations, in order to determine how differently to act under varying circumstances. Based on probability theory and statistics, the mathematician Warren Weaver (1894–1978) made a distinction between 'simple problems', 'disorganized complexity' and 'organized complexity' (Weaver, 1948). He considered the 'simple problems' to be straightforward and predictable issues, problems which Rittel considered 'tamed'. 'Disorganized complexity' relates, according to Weaver, to multiple connected issues (networks) that are to be dealt with on the basis of statistics. And 'organized complexity' concerns problems that Rittel called 'wicked' and that we now refer to as 'complex adaptive systems'. It is a differentiation of problems on the basis of degree of complexity, which is not that different from the 'theory of complex phenomena' that Hayek proposed in 1967 (De Roo, 2018).

Planners were often aware of discussions elsewhere, but the growing interest in self-organization in planning is recent. The psychologist Ashby made quite a contribution to this debate, which planners were unaware of, with his 'Principles of the self-organizing dynamic system' (1947). These principles make reference to the nervous system being a physio-chemical system that somehow can self-organize. These systems are open to input from their environment, to which they adapt. In 1965, Emery and Trist explicitly stressed the interdependence of such 'complex' systems and their contextual environment. These interdependencies not only depend on the open state of the systems – dissipative systems according to Prigogine (1955) – they also depend on the dynamics of the contextual environment, which varies from placid to turbulent according to Emery and Trist (1965). There is an interdependency between system and environment that is the result of the exchange, absorption and passing on of flows of energy, matter and information (Prigogine, 1955). In other words, the context matters and is often – if not always – crucial when addressing transformative change. This is precisely what complexity is about. And it is complexity that makes cities evolve and should therefore be important for planners.

After the turn of the millennium, the number of publications with reference to the complexity sciences and on complex adaptive systems rocketed (Schoon & Van der Leeuw, 2015). This acknowledges a 'shift or new scientific paradigm . . . from the landscape of classical or Newtonian/Cartesian science. The non-reductionist theories of this post-Newtonian paradigm stand in opposition to positivist assumptions that support a linear, atomist, determinist and equilibrium-based explanation of the world' (Preiser, 2019: 709; see also Chapman, 2016). Instead of a reductionist perspective, the complexity sciences consider the whole, not just the parts, and the context as relevant, hence the interest in holism and expansionism. How relevant is this point of view to planning?

But that is not all. In a Newtonian/Cartesian world view *time* does not play a role, but it is essential in the complexity sciences. In time, complex adaptive systems evolve and co-evolve, internally and externally, either slowly and in incremental steps or rapidly and with symmetry breaks, tensions, mismatches, shocks and all kinds of qualifications that give expression to developments that keep the system far from a state of equilibrium. The complexity sciences consider such a world view to be *relational*.

There is too much theoretical support to dismiss the complexity sciences as 'conceptual' or as 'proto-theory'. There is, however, not one clear and outspoken theory. Instead, there are various lines of reasoning focussing on more or less the same issue (Chu et al., 2003). Rittel's wicked problems is one of these lines of reasoning. What these lines of reasoning have in common is that they all relate to the notion of 'complexity'. While there is not one agreed definition of 'complexity' (Cilliers, 1998), most, if not all definitions, share an understanding of transformative and irreversible change that is represented by dynamic patterning (Gell-Mann, 1994; Lane & Maxfield, 2004; Langton, 1992; Lai & Han, 2016), at the edge of order and chaos (Waldrop, 1993).

This patterning is the result of complex adaptive systems drifting towards an external point of orientation, a common denominator, power law or attractor, while seeking some kind of balance (equilibrium) or best fit with its environment. These complex adaptive systems strongly relate to systems theory and are therefore part of the cross-disciplinary domain of the general sciences (with mathematics, information science and computer sciences, for example). 'Complexity' can be seen as a systems property. However, complex adaptive systems are different from traditional systems with their nodes and interactions. A complex adaptive system is seen as a coherent whole with interrelated robustness and internal dynamism, while it maintains an interdependent relationship with an environment that is in a state somewhere between order and chaos (states of non-equilibrium, out-of-balance) (De Roo, 2016, 2018). Because of this open relationship with the environment, information, matter and energy are taken in, absorbed and passed on (Prigogine, 1955). This enables the complex adaptive system to continuously reorganize and adapt itself internally to assure a good fit externally.

Complex adaptive systems are 'relational' in the sense that they exist in an interdependent and multi-level relationship with their parts and with their contextual environment. Hence the phrase 'the whole is more than the sum of the parts'. Complex adaptive systems are highly connected to their environment that itself is entangled with everything and all: 'you could not remove a single grain of sand from its place without thereby . . . changing something throughout all parts of the immeasurable whole', as Fichte said a long time ago (1846 [1800]). Fichte's statement appeared to anticipate Bak's research in 1999 on criticality in piles of sand. Bak's research showed that uncertainty and non-linearity are real in the domain of physics at the human scale. It was a relevant signal for the social sciences that they should no longer blindly accept the worldview of the exact sciences, its positivist framing of fixed and frozen objects and its belief in absolute certainty.

Due to this 'relational', interdependent and dissipative relationship, complex adaptive systems are highly sensitive, with all kinds of feed-forward and feed-backward loops that allow them to adapt to their changing external environment and to internally self-organize accordingly. Complex adaptive systems are therefore transformative, resulting in non-linear, emergent behaviour. Complex adaptive systems hold 'no a priori assumptions about key variables, emphasize non-linear causal effects between and within systems, and view system equilibrium as multiple, temporary, and moving' (Duit & Galaz, 2008: 312). At an aggregated level this non-linear behaviour adds up to regularities that are 'the result of the recursive nature of interactions and patterns of relations that constitute complex systems and their environment' (Preiser, 2019: 708). Complex adaptive systems are subject to 'deterministic chaos', which means 'their behaviour is not completely random'. These systems are 'predictable in principle since they are deterministic, but because of sensitivity to initial conditions practical prediction is difficult . . . when they are in a chaotic regime' (Mullin, 1993: xvi). While complex adaptive systems represent a world of uncertainty, these regularities allow some predictability regarding complex systems, and cities therefore, being sensitive to path dependencies (Boulton et al., 2015).

4. CHANCES AND THREATS

There is not much doubt about the complexity sciences being a major source of inspiration for spatial planning. Among others, they point out the importance of time, non-linearity, transformation and dynamics. That, together with the complexity sciences' explaining power about co-evolutionary processes and processes of self-organization, for example within the urban environment, make the complexity sciences relevant to planners. The complexity sciences show a reality that is flourishing without our control.

It is a world of discontinuous change, with transformative space and adaptive environments. This is not an anomaly; it is how the world works and therefore part of life. We better live by it.

This does not mean that spatial planning must take on board all that is being proposed by the complexity sciences, or must indulge in the associated conventions and reasoning. Instead, it is wise to remain critical about what is embraced and adopted by the complexity sciences. While the complexity sciences study autonomous and spontaneous change, this can never be the whole story, because intentional change made by *purposeful interventions* remains a necessity. And while complexity sciences have a preference for quantitative data and a strong interest in correlations, *intersubjectivity* has proven its value to planning and should remain key to planning actions and the planning discipline. In this book purposeful interventions and intersubjective interactions are considered relevant for planning, also in complex, highly dynamic and transformative environments.

4.1 Purposeful Interventions

Much is known by planners and decision-makers about how to control space and place, objects and situations and the environment and about how to coordinate the people involved. Much is known about approaches to purposefully intervening in situations that are more or less stable. Far less is known about how to deal with non-linear, dynamic and transformative space that is full of spontaneous developments, with disruptions, shocks, breaks and mismatches. What if such developments are not to our liking or, instead, are appreciated and should perhaps be encouraged? Is it possible to incorporate non-linearity, its breaks and its slow and rapid transformative processes into spatial planning? Would it be possible to consider an amalgamation of autonomous change and purposeful interventions that is relevant for choice, planning and decision-making? Would it be possible to aim for a complementary duality?

In this book, this complementary duality between autonomous change and purposeful interventions is considered key to framing socially complex situations. This framing of social complexity is meant to support navigation between autonomous change and the influence that humans (not just planners) want to have to anticipate or counter this change. Also part of this framing of social complexity is accepting purposeful interventions as being 'natural'. It is what humans do. On the other hand, it is debatable to constrain autonomous and spontaneous change as such, with the intention of staying in control, whatever the situation may be.

Much can be said about intended action being part of, being the cause of, or resulting in spontaneous change and vice versa, with spontaneous change triggering intentional and unintended moves and action leading to spontaneous change. Intentional behaviour is part of a social reality and not to be seen as opposite but as a consequence of or related to spontaneous change. Moreover, the idea that autonomous change without intentional and purposeful interaction is the route to take has proven to be a rather destructive idea. For example, an autonomous financial market does not work; it needs conditions and regulations. Another example is urban renewal, which will not easily start without some subsidy or institutional guidance and which is needed if the destructive forces that turned Detroit into a doughnut are to be avoided. The roundabout, on the other hand, is a good example of how to balance the controlling order of the traffic light (purposeful intervention) and the chaos at a road crossing due to a 'letting it all go' concept (autonomous change in a world of flows).

Humans bend their environment (at least to some extent) to their liking. This is sometimes entirely intentional, while sometimes the result is more spontaneous. The spontaneous result is often a product of a multitude of individual actions that appear to us as a dynamic pattern. In other words, social complexity could and should represent a complementary duality bridging spontaneous moves and intentional behaviour and strategies based on a mix of autonomous change and purposeful intervention.

4.2 Intersubjective Interaction

Contrary to spatial planning, the complexity sciences have not yet overcome their obsession with facts, preferably expressed in numbers and figures. Social complexity and social studies on dynamic complexity addressing social phenomena still have a strong object-orientation, which is highly unsatisfactory. There is a strong and one-sided appetite for correlations of all kinds of data, but only a limited interest in what these data can tell. This also applies to correlations that are made within the social domain, a domain that really needs narratives. In other words, when it comes to 'social' complexity, object-orientation dominates while there is hardly any appreciation for intersubjective values and meanings.

Planners previously dealt successfully with a fixation on facts and figures by taking the 'communicative turn', embracing 'sense-making' as a collective activity and stressing the relevance of values and intersubjective reasoning and by acknowledging the importance of social behaviour. The question that arises is how the planning domain will respond to this new kind of science, its complexity and non-linearity, with its particular language and alternative perspective on the world, but as well with its appreciation for quantitative data.

One wonders about the obsession with facts and figures that are associated with the complexity sciences. The complexity sciences lifted the ban on time to embrace transformative change and non-linearity. Planning, management and organizational disciplines lifted the ban on intersubjectivity to transcend the one true world of objects and situations 'out there' (from the perspective of the subject) and their empirically observed causal relationships. It is the intersubjective side to knowledge and the notion that understanding any situation and reality that we are confronted with includes values and the sharing of meanings. While the issue is understood well by the planning discipline, the complexity sciences hardly acknowledge that intersubjectivity is relevant.

The fact that the complexity sciences ignore intersubjectivity is not so much due to it being considered a non-issue; it is by and large due to science in general, trapped in the abyss called objectivity. Intersubjectivity and the communicative rationality are essential to humans understanding the world that they are part of, in conjunction with an orientation on the object or situation. Facts and values are mutually dependent. Facts are constructed in people's minds and facts are nothing if not valued, given meaning to and agreed upon. Object-orientation and intersubjectivity are interrelated in a complementary duality. The modellers in the second part of this book have a task in this respect, which they take rather seriously. They share with us their inspiring explorations and suggestions while seeking means to address quality over quantity, to stress the significance of human spatial cognition and behaviour, to frame behavioural dynamism, and to use social network interactions as an analogy to identifying an optimal outcome given the data at hand.

Not just the modellers but also the scholars with their theory-oriented contributions will have to make use of clear and convincing argumentation about how intersubjective interactions can relate to non-linear developments. This reasoning will be addressed in detail and explained by the authors in this book to inspire both the planning discipline and the complexity sciences.

There is a lot at stake because it could mean a return to a technical rationality and even an improved version could pose a serious threat of the difference between the communicative side of planning *with* people and a kind of planning *about* people based on facts and figures. And that would mean a tremendous step backwards for planning. Ultimately, it is the people who matter.

5. THIS BOOK'S CONTRIBUTION TO THE DEBATE

This book is not a one-sided affair and explores the best aspects of both planning and complexity. This exploration was carried out by planning theorists and modellers who are all involved in the complexity debate. All are inspired by complexity and see possibilities to enhance and innovate the planning debate. They do so by sharing their thoughts from a spatial planning perspective while reaching out to the complexity sciences. All authors are cautiously aware of the strengths of spatial planning. They encourage intersubjectivity together with the world of values, meanings, ideas and discourses, and consider this to be as relevant to understanding reality as is the object-oriented and fact-driven perspectives within science. They are aware of the situated and contextual characteristics of spatial and urban issues and know how to distinguish situations to which different approaches can be assigned, which is the differentiated perspective that planning has to offer. Consequently, these authors want to hold on to the strengths, qualities and innovations that the spatial planning debate has produced in the recent past.

The narrative that unfolds in this book starts with a focus on the theoretical aspects of planning and governance. Chapter-by-chapter, this focus shifts towards a model-oriented focus on understanding complex behaviour in space and place. The unfolding narrative is outlined below.

5.1 The Rationality of Adaptive Behaviour, the Mode of Governance and its Institutional Design

Chapter 2: Ernest R. Alexander is a highly esteemed and experienced scholar of planning and it is a privilege to have him as one of this book's authors. He is a leading figure in the debates on rationality and institutional design. Alexander took part in debates in which old paradigms were critically assessed and confronted with innovative counter arguments, after which new paradigms were introduced and provided with supportive arguments. These are all reasons as to why Alexander is given the honour of being the first author in this book to take us along in the debate on complexity and planning.

The underlying question for this book is to find out whether complexity is more than 'just' metaphorical. Alexander's core message is that there is a problem with literally transferring the evolutionary models of self-organizing and adaptive complex systems, as proposed by the complexity sciences, to human societies and their behaviours. He takes a critical stance against non-critical acceptance of ideas that are inspiring in themselves, but that are in practice often less clear-cut and deserve to be applied and evaluated carefully. Self-organization of cities and markets are examples of this, with markets being self-organized only to a limited extent. He is cautious about transferring ideas of the complexity sciences into planning. Therefore, he suggests using complexity first of all metaphorically. While the complexity sciences take their evolutionary model literally, it must be modified for planning to allow for intentional human agency and deliberate action.

Chapter 3: Inspired by complexity sciences and the patterning landscapes, multi-levelness and interdependencies, Gert de Roo and Camilla Perrone propose a multi-layered understanding of rationality. Their reasoning leads to several rationalities as frames of reference to cope with various kinds of planning issues. Presented are rationalities that work within as well as outside the governmental domain. They specifically address the numerous collective activities that currently take place beyond the government's command-and-control and that are not part of shared governance either. Nevertheless, these have an impact on the urban environment and are driven by rationalities. These collective activities are already substantial and are still increasing in number and therefore demand the attention of planners.

The initiatives are addressed within the planning debate as post-government and self-governance. The discussions about these initiatives are, however, still somewhat isolated from the wider planning debate. The question that arises is how these initiatives relate to the various other initiatives, approaches and situations that have the attention of the planning debate. And just as relevant here is how the complexity sciences can help to answer this question. The result is a multi-layered rationality model for planning and decision-making that connects the once appreciated but now heavily criticized rational actor at the individual level and the technical and communicative rationalities at the governmental level, with the work at the level of collective action positioned in between the rationalities.

Chapter 4: Christian Zuidema examines the systemic, law-like structures that link the technical and communicative rationalities in planning, as well as the area of planning and decision-making in between the two. Zuidema brings back to memory the almost forgotten, but highly relevant, contingent relationship. There is a contingency between the technical and communicative rationalities that gives expression to the transformative process when shifting from the technical to the communicative rationality, and vice versa. However, this contingency is not just a one-way route made up of object-related and fact-related issues. Zuidema makes an important point about these issues having an intersubjective aspect as well, which shifts or co-evolves in conjunction with object-related and fact-related issues. He refers to this dual contingent relationship as post-contingency. Zuidema states: 'Where contingency studies focus on the contingent relationship between environmental circumstances and the approaches to choose from, post-contingency also highlights the contingent relationship between environmental circumstances and the process of making choices itself.'

Chapter 5: The previous chapters focussed on the contemporary planning debate, from which dynamic change and co-evolutionary transformation were considered with respect to planning itself. In this chapter, Gert de Roo, Ward Rauws and Christian Zuidema focus on dynamic change. And the question they ask is what spontaneous and autonomous change means to planning. This question is answered by differentiating between the 'actual', the 'desired' and the 'potential' behaviour of planning. With reference to the 'actual', planning behaviour is seen as 'acting in response to change'; with regard to the 'desired', planning behaviour is 'addressing the possibility to change'; and then there is also the 'potential', referring to what planning can do, if taking into account the 'capacity to perform in moments of change'. These reflections introduce a new kind of planning that sets fundamentally different conditions that are essential to planning: adaptive planning.

Chapter 6: In the previous chapters a spectrum language has emerged that builds on two extremes: the technical and the communicative rationality, in between which the planning domain can be understood. This planning domain adheres to a law-like relationship while shifting from situations that are considered 'certain' to situations that are 'highly uncertain'. The result is a spectrum that represents the contemporary planning debate. This spectrum language is advocated further by Gert de Roo, Ward Rauws and Christian Zuidema as they assemble three more spectra, all incorporating various kinds of change, uncertainty and transformation. These newly proposed spectra define rationalities for various kinds of adaptive approaches. One of these adaptive approaches that is endorsed by spatial planning allows the environment to display adaptive behaviour. Other kinds of adaptive approaches refer to spatial planning responding to spontaneous and autonomous change within the environment. Regarding the latter, planning is no longer leading and, instead, responds to change. The result is several rationalities that support various kinds of adaptive planning.

Chapter 7: Kristof Van Assche, Raoul Beunen and Martijn Duineveld continue to explore the governance side of the debate. In a dynamic, non-linear and rapidly changing world, they regard community development as a crucial task for planning. Traditional institutional certainties are dwindling and being replaced by a context of governance that must be regarded as an interdependency of developing actors, institutions and power configurations. Consequently, the relationship between community development, organizational and institutional management and space transformation rapidly becomes the planner's core responsibility. It is a responsibility that goes together with re-rooting, reinventing and building the community. This task is not obvious and straightforward but requires possibilities and adaptive behaviour.

5.2 Considering Conditions of Non-linear Planning Trajectories

Chapter 8: Susa Eräranta adds to the discussion the emergent nature of actors interacting in a network environment. In the previous chapter, planning processes were considered a necessity for community building; this chapter explores the social dynamics within planning processes and the dynamic interactions between involved actors. Eräranta visualizes discontinuous flows of actors within organizational and institutional domains and shows complex dynamism that unfolds over time. This results in discontinuous, non-linear and emergent trajectories within planning processes that have consequences for knowledge creation and the active and inclusive understanding of decisions that are to be taken.

Chapter 9: Stefano Moroni and Stefano Cozzolino build on this by explaining that discontinuous, non-linear trajectories need to be conditioned, to allow a purposeful and fruitful interaction between planning and the complex social–spatial system, which is the environment that we live in. In dynamic environments with non-linear and transformative change, having a grip on content and process is not to be taken for granted. Instead, the conditioning of space and place is what could support planning and could become the frame of reference for further planning action. What Moroni and Cozzolino are looking for are conditions surrounding planning actions and behaviour that can make planning interventions as effective as possible.

Chapter 10: Juval Portugali, known for his research on self-organization within cities, brings to the debate the processing of information produced by the city and its citizens and absorbed by the city's institutions to condition and influence the city dynamics. Portugali was among the first to stress the city's complex adaptive behaviour. Cities are complex adaptive systems due to the people living there making individual choices and acting accordingly. Cognition, Portugali reasons, plays an important role in micro-level behaviour, which impacts on the macro level, often the level that planning institutions focus on. The interplay between cognition and institutions is an important mechanism in the complex adaptive systems that are cities.

Chapter 11: Beitske Boonstra turns the discussion upside down, not zooming in further at the micro level. Instead, she discusses the notion of self-organization and its relevance to planning from a contextual perspective. Using the example of mass migration and the European Refugee Crisis in 2015, she positions within the planning debate unexpected processes that are associated with major consequences. Mass migration generates processes of self-organization that should make planners rethink their role in situations with a multitude of actors. With reference to three approaches to planning – condition planning, adaptive governance and do-it-yourself urbanism – a critical assessment is performed to identify pitfalls and potentialities for planning to respond to contextual processes of dynamic change.

5.3 Models for Interactive Learning in Response to Change

Chapter 12: Timo Von Wirth, Niki Frantzeskaki and Derk Loorbach explore one possible answer to being ready for uncertainties that are due to contextual dynamic change: the urban living laboratory as a means of taking a transition management perspective to planning. In situations of dynamic change, co-creation and experimentation are concepts that are essential to the search for new modes of governance and appropriate interventions. This search can be carried out in urban living labs, taking the urban complexity as the breeding ground for designing, testing and learning about potential solutions to dynamic change. This new way of organizing the collaborative 'becoming' of cities takes place as experimental platforms on sites in cities, where actors from different contexts meet, connect and collaborate to enable learning and encourage actions.

Chapter 13: Moira Zellner and Scott D. Campbell have a mission in reframing planning's relationship with theory, interactive learning, the use of data and its relationship with the future. Like Von Wirth, Frantzeskaki and Loorbach, their concern is planning's lack of a theoretical basis for dealing with contextual change and dynamic uncertainties. To enrich the debate in this respect, they have taken three aspects that are central within planning – incrementalism, collaborative planning and big data – to confront them with complex systems thinking. Taking a complexity perspective makes it possible to critically assess current assumptions within planning, to deconstruct traditional reasoning and, instead, to reconsider their range and reach and to be open to new concepts and principles. Complexity thinking can enrich planning with multiple and cross-scale processes of iterations, feedback, re-examinations and revisions, which encourages discursive, deliberative and learning practices. These practices are not necessarily supported by the current fascination with big data, Zellner and Campbell warn. Big data remains meaningless without effective deliberation and a sense of context and is useful only as part of a process of interactive learning.

Chapter 14: Toru Ishikawa and Yasushi Asami continue to deconstruct traditional reasoning about space and place and join forces with other authors in this book by emphasizing the relevance of 'spatial thinking' to be subject to cognition and intersubjective understandings. Nevertheless, they argue about mathematics, physics and geospatial concepts tapping into 'spatial thinking' as well, as these can help to simplify information that is useful to spatial modelling. However, the spatial modelling that Ishikawa and Asami promote is not a simplification of reality as it 'is'. Instead, this modelling must be seen as a process-oriented representation of a reality that is 'becoming', with dynamic patterns and flows on the one hand and people's perceptions of public and personal spaces on the other. This modelling is then a means for interactive learning and supports planning *with* and *for* people.

Chapter 15: Michael Batty's contribution turns the narrative of this book upside down. Instead of establishing a non-linear understanding of reality that works *for* planning, Batty is interested in non-linear modelling to arrive at a design that works *within* planning. Batty has a long history in spatial modelling and has played a major role in introducing non-linearity and complexity into spatial analysis and spatial planning. With reference to artificial intelligence and quantitative data, Batty proposes an iterative process within a network of relationships to cope with a series of potentially conflicting factors that are all judged to be essential to come to the best possible design. His solution is to take the neural network as an analogy for the model to observe urban development, which may result in an optimal design. This is not the type of network where the designer is in control but one where factors are individuals or experts with their own views and perceptions about the best solution to the problem. Instead of an input of factors that the designer considers to be the best, patterns of routinized behaviour are chosen to become subject to analysis and to come to an understanding about how cities function, *develop* and evolve.

5.4 Models, Methods and Design Patterns to Understand Non-linear Change and Behavioural Dynamism

Chapter 16: Claudia Yamu and Akkelies van Nes also take modelling as their mode of reasoning. They promote the application of a fractal logic in urban planning. This logic frames reality as a multi-scalar and multi-fractal between which interdependencies exist, iterations are made possible and through which urban patterns are generated. These patterns become visible at various levels, ranging from a neighbourhood scale to a regional scale. This modelling strongly relates with fractal geometry and shows the emergence of urban phenomena. A multi-fractal morphological approach is introduced, called the 'Fractalopolis', a simulation tool to develop potential solutions for managing and avoiding urban sprawl, for developing and testing plans for urban development, for interlinked accessibility evaluations of road networks and more, while recognizing the complexity of the urban environment.

Chapter 17: Stefan Verweij and Christian Zuidema reason about the possibility of analysing planning performance within complex processes of change. They propose Qualitative Comparative Analysis (QCA) as a method to explain how planning processes perform in the light of perceived complexities in the contextual environment. QCA is an analysis tool that looks at planning behaviour, behaviour that is influenced by configurations of 'conditions' that together produce a certain outcome of interests. Not just reality but planning as such is considered, as well as a complex adaptive system that may be subject to analysis. More precisely, planning is seen as a complex adaptive system of organizational intervention that is process-related and builds on environmental variables. While these conditions are key to the explanations developed, they are also defined by stakeholders involved in the planning process. Consequently, QCA facilitates the operationalization of the complexities of the contextual environment within the planning domain.

Chapter 18: Nikos A. Salingaros considers it his task to incorporate all that was mentioned before to develop a university campus that relies upon solutions that come together in a robust and flexible framework. In contrast to spatial designs from the past, which resulted in definitive outcomes, the toolbox that Salingaros uses should allow the campus design to be a discontinuous process of evolution and transformation. His toolbox includes the ideas, means and tools mentioned above. To this, Salingaros adds Christopher Alexander's ideas and design patterns. This mix of design patterns leads to guidelines that result from 'biophilia, complexity, and neurosciences' and should lead to a campus that works as a place to live.

Chapter 19: Last but not least, Wander Jager and Claudia Yamu have the honour of presenting the final chapter of the book, for good reasons. They end the narrative of this book by stressing the relevance of behavioural dynamism. The way in which people adapt to spatial changes, either smoothly and quickly or hesitant to support them, adds to the complexity of the situation. Collaboration and co-creation are appreciated means to incorporate behavioural dynamism. Also, tools such as agent-based simulation models can support further understanding of behavioural dynamism and its integration within the planning process. Jager and Yamu explain how this works, by using a specific model called Consumat. The model looks at the dynamics of community behaviour from which it generates information that is meaningful to the planning process and contributes to a process of interactive learning among planners and communities.

It is not without reason that this book ends with behavioural dynamism because it is once more a call to take one of the strong pillars of planning seriously, i.e. the complexity sciences as a source of inspiration for planning. Jager and Yamu show that this is possible. Behavioural dynamism relates to collective behaviour and intersubjective interaction in planning and is also relevant within the domain of social complexity.

You have to know about it before you can see it. And only when you realize what it is, does it gain meaning. This book shows in various ways the relevance of complexity to planning and decision-making and to urban development, and the characteristics of complexity, such as non-linearity, emergence and co-evolution. The complexity of a world in flow, with transformations and dynamic change, is everywhere, it is part of nature and culture and is therefore an intrinsic part of our existence. And the moment you know that it is real, you had better be prepared and adapt to it . . . This world is our world and it is changing, continuously.

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