Can Chinese legislation on informational privacy benefit from European experience?

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Part II

Can Complexity Theory be of any use?

Chapter 7

A heuristic display

Social ecologies react to the respective environmental niches they live in. Over time they prove either resilient against or sensitive to legal attention and other interventions and vice versa. That explains why different legal systems have emerged. We faced an example of the influences of different niches when discussing Chinese-EU-privacy/data-protection-law importation plans in Part I. At the end of that Part I accepted that even the combination of legal positivist and realist perspectives does not allow to create a picture that is complete enough to rationally advise the Chinese legislator on the EU data-protection law transplantation plan. To me it seems that contributions form multiple disciplines are needed, as proves standard procedure when complexity theory is invited in. It is emphatically not my aim to degrade the efforts that have been made by positivists and realists to face the problems mentioned in the realities of their occurrence.

In this Chapter I do not consider any individual law, treaty or institution to be my main subject matter. Instead, I look at the global cluster of personal-data users, as a whole. For better understanding that global, multi-level and multi-niche cluster of networked personal-data devouring and producing individuals and institutions, I need a systematic perspective. I consider it to be at the core of legal scientific ethos to strive for improved understanding of what legal rules and institutions will accomplish when decisions have to be made concerning unforeseen contingencies (by the legislator) and under incomplete or false information

Yet I must concede that neither the positivist perspective nor the

realist perspective is opening up to help us out, here. And nowhere is a real hope that the law will be able to go it alone when its subject matter is complex and adaptive. So my aim is to look for knowledge that will have added value.

Improved understanding of such situations has become focal to several multidisciplinary academic networks.[116] The scientific perspective that emerged in these institutions is often referred to as complexity theory, or simply `complexity,' and participants often work on problems that, for a solution, not only seem to require a diverse bunch of science, but also seem to require well founded and coordinated guidance by the law (like economic ``bubbles" or ``global warming" -- in fact like most of the Big International Problems of our times.

Because complexity theory is itself rather new, incomplete and spanning a diversity of disciplines, my efforts to understand its uses for legal scholarship and informed legislation are by necessity explorative and incomplete.

In the Chapter I first explain why I address the possibilities of complexity theory (Section 1) and subsequently sketch the networked character of the community that is addressed by personal-data protection laws (Section 2) and name it the PDC. In order to be able to decide on the applicability of complexity theory, I first list a set of essentials that define its subject matter, complex adaptive systems (CASs, Section 3). Then I analyze the PDC, and identify it as a CAS (Section 4), my most important result in this Chapter. In Section 5 I provide some considerations for further research into the exploration of combining complexity theory and legal scholarship, by mentioning some of the models/results/approaches that were developed by complexity theorists. Where I can relate them to legislative issues.

Why complexity theory?

First, I witnessed the complexities of enforcing data protection law to whoever uses (and thus: processes) personal data, since whoever

[116] As for instance initiated at the Santa Fe Institute (SFI), the Edge Foundation, the Michigan University Institute for Complex Sciences, The Institute for New Economic Thinking (INET) and the Nanying University Institute for Complexity. To us it appears a missed opportunity that legal scholars do not (or hardly) seem to belong and/or take part.

processes personal data tends to be connected. Whoever processes personal data is connected and thus co-creates (and is a node in) a network. There are lightly connected nodes in this network like you and me, but there are also huge, heavy connected nodes, hubs if you like, like Facebook, RenRen, the CRC database, Google and Baidu. All are connected together, through data flow. The behavior of the network as a whole cannot be predicted by studying the constituent nodes in isolation. Thus it may prove very difficult, perhaps even next to impossible, to govern the behavior of the system/the network around Facebook as a whole by regulating Facebook and all other nodes individually, *as if* autonomous, *as if* in isolation and *as if* equal for the law. Yet this seems to be our fate, for the law addresses autonomous and responsible individuals.[117]

Furthermore, I witnessed that data protection laws in Europe and in China are built on historically emerging, yet diverse, social constructs. And those historical arrangements constrained the processes of creating the contents of data protection laws. The resulting data protection law systems, therefore, are not only different (having followed different paths), but are also likely to be subject to the forces of path dependence. Path dependence is a well-known, yet difficult to capture phenomenon, mainly because it flies in the face of what is generally considered to be rational. It is also a phenomenon that is closely related to decision making under incomplete information in complex situations.

I also witnessed that data protection law's subject matter as a whole is adaptive to social and technological changes. The focus/main concerns of data protection law in Europe are co-evolving with the social background: before 9/11, for instance, the main focus of Directive 95/46/EC was directed to ``data collection and personal data processing." After 9/11, the main focus of subsequent data protection laws was directed to ``data retention" and to support and improve the Government's information positions (Directive 2006/24/EC). I also witnessed in this context that European data protection law continually needs to face changes in technology. The law has to depend on the data authority as an agent, to improve its ``fit" with technological

[117] Or their aggregate equivalent: legal persons (or institutions). And, as we shall see, the network discussed is emphatically not a legal person.

dynamics.

The research has raised the question whether data protection law is up to the challenges posed to it by its subject matter. The phenomena that I witnessed in my research, and that characterize the subject matter for personal-data protection can be summarized with six properties:

(i) networked/connected/dependent/diverse/autonomous individuals,

(ii) often aggregating in institutions, that now and then show

(iii) path dependent,

(iv) dynamic,

(v) complex and

(vi) adaptive behavior.

Looking around, not only China's policymakers but also European policymakers are trying to regulate connected, aggregate, path dependent, dynamic, complex and adaptive subject matters (or subjects) like for personal data protection and legitimate personal data use.

> *These characteristics happen also to be important properties of what has recently been established as complex adaptive systems - the subject matter of complexity theory.*[118]

And data protection law is not the only area of the law that is perpetually the subject of legislators that keep struggling to regulate complex and dynamic subject matter by adapting the laws. Looking through a purely legal lens at the data-protection subject matter may not be sufficiently effective -- like looking through such a lens may neither be sufficiently effective when considering the regulation/domestication of sometimes unstable complex situations.[119] Often, such situations nevertheless call for the law to intervene.

I am afraid that aiming for the transplantation of formal laws suggests that the law will be able to go it alone. I disagree and submit that looking at webs of situations wherein the law is only a functional

[118] See for instance: Miller & Page (2009), Mitchell (2009), Holland (2012)

[119] *E.g.*, as with welfare distributions, with environmental sustainability, with ethnic, religious, political and market fundamentalists, with legal cultures and with scientific paradigm.

part may help us find pathways to improve our understanding of what the law may in fact be capable of. Thus, I decided to investigate the possible fertility of the only additional, radically non-traditional and radically multi-disciplinary perspective that I think may fit the bill: Complex Adaptive System theory, or CAS theory.[120]

According to Mitchell (2009):13, a CAS is a system in which large networks of diverse components with simple rules of operation operate, a system without central control, a system that gives rise to complex collective behavior, a system that is capable of sophisticated information processing, a system that is capable of adaptation via learning or evolution. As the term suggests, CAS-theory is the collection of conceptual models built for understanding such CASs. The theory suggests that CASs, regardless of their particular subject matters, universally exhibit certain characteristics, of which the most critical ones include self-organization or emergence (Tussey (2005):148).

I believe that CAS theory can open a few windows for legal scholarship, by offering an additional perspective that allows to combine forces with the natural sciences, the social sciences and the humanities. Although CAS-theory gained more attention from the natural sciences, and from mathematics and computer science (see, *e.g.*, Mitchell (2009), Newman (2011) and Holland (2012)), it has also become attractive to and has been applied in the social sciences (see, *e.g.*, Anderson (1999), Beinhocker (2006) and Pagel (2012)).

In the legal world, there are several efforts of employing CAS theory for looking at the law/legal systems themselves and sometimes also at their subject matter.[121] Mostly, these efforts offer completely

[120] The Santa Fe Institute has worked since its founding in 1984 been working on CAS theory. On its website (http://www.santafe.edu/about/faq/) it explains what complex system research is about: "Complex systems research attempts to uncover and understand the deep commonalities that link artificial, human, and natural systems. By their very nature, these problems transcend any particular field; for example, if we understand the fundamental principles of organization, we will gain insight into the functioning of such systems as cells in biology, markets and firms in economics, and phase transitions in physics and human social systems. This research relies on theories and tools from across the sciences."

[121] The CAS-theory approach in law is far from mainstream, yet these examples are not eccentric exceptions either. As exemplified by, e.g., Jones

fresh information to legislators and researchers.

For example, Tussey has done a survey of the music industry from the perspective of complexity science, combined with organizational theory.[122] In her paper, Tussey issues a compelling invitation to look at (and understand) the music industry as a CAS, in which ``*legal, political, economic, socio-cultural, and technological subsystems converge, interact, and coevolve.*'' [123]

Another example is provided by Ruhl, who introduced CAS-theory into the legal field. He wrote several papers about the application of CAS theory to the legal system.[124] In ``*Thinking of environmental law as a complex adaptive system: how to clean up the environment by making a mess of environmental law*,'' Ruhl adopted CAS-theory to analyze environmental law and all the issues around and inside it. Ruhl found that, not only environmental law, but also the subject matters of environmental law such as ecosystems, technology, economies and land use arrangements are all CASs and share CAS-characteristics. Based on these findings, Ruhl criticized environmental law's methods as reductionist, linear and predictivist, ignoring the underlying CAS characteristics. Ruhl thereby suggested that to manage the impact of human society in the inherently chaotic, adaptive environment, the environmental-law system itself must adopt and possess dynamic qualities.[125]

The works by Tussey and by Ruhl show us that the ``marriage'' between CAS-theory and legal research are possible and can bear fruit. Yet, the possibilities of what CAS theory can offer to legal scholarship is by no means exhausted yet. What CAS theory can offer to legal scholarship is immense, I submit, yet it is hardly on the discipline's agenda.

(2008) (considering the implications of networks, complex systems, and nonlinear dynamics to the future of the law), Holz (2007) (applying CAS theory to judicial decision making), Katz *et al.* (2008) (identifying the conditions under which network effects are present in the development of the common law), Post & Eisen (2000) (on the fractal nature of law), Bloche (2008) (discussing USA health care law with its resulting implementation as an emerging CAS), Tribe (1989) (shedding light on the character and structure of constitutional analysis as a process), Axelrod (1986) (investigating the emergence and stability of behavioral norms in the context of a game played by people of limited rationality), Picker (1997) (uncovering the boundaries of legal rules and defining their proper limits have traditionally vexed students of the law).

[122] Tussey (2005).

[123] According to her analysis, digitization and global networking can be considered as disruptive perturbations of the music industry as a system, that thus shows a typical CAS characteristic. The main challenge that the music industry is confronted with is how to respond evolutionarily to the new environment. Tussey's prediction, based on CAS-theory, is not as pessimistic as many others. Instead, the music industry which is a polyfocal, multi-level, evolving, dynamic system, is adapting successfully to the digital environment and there is hardly any need to worry about its survival, she observes. Tussey predicts that *"new models of information creation and dissemination will naturally emerge over time from the millions of individual interactions among users and providers of content and digital technologies, for instance the emergence of the P2P file sharing is the outcome the interactions. The P2P technology has fed back into the music system and has produced emergent responses in the form of new online business models*" ((Tussey, 2005): 103-104).

[124] For instance to the co-evolution of law and society and its practical meaning for democracy, administrative law, environmental law, European justice and so on See Ruhl (1996a,b, 2008, 1997); Ruhl & Ruhl (1997); Ruhl (2009, 2005); Ruhl *et al.* (2007).

Data-protection law's subject matter: the PDC

As a starting point, I am going to describe the data protection law's subject matter as a human-created system within which all sorts of data users either cooperate or compete with specific references to personal data.[126] For the connivance of our following analysis, I ``arbitrarily'' tag the system as ``*Personal Data Community*'' (PDC).

For obvious reasons I will focus on data protection law as the control system of the PDC, although I believe that there are other control systems, such as technology, culture, the economy and the environment. For the moment I conceptually separate the law (and the other control systems) from the PDC, and imagine them all as its

[125] See Ruhl (1997).

[126] Systems could occure, either by nature, such as ecosystem(Levin (1998)) or earth(Steffen *et al.* (2006)), or by human design, such as music system(Tussey (2005)), international environmental law systems(Kim & Mackey (2013),Ruhl (1997)). (Tussey (2005))

environment. The reason is that I want to be able to ``theorize'' about the relationship between data protection law and its subject matter, which may easily become too complicated when the latter is regarded to be part of the former.[127]

I take it that the term *community* refers to any social network with shared common values.[128] Community in `personal data community' follows this definition. It provides an analogy that can serve as a tool for understanding data protection law's subject matter as a system: the PDC is the community that is constituted by all connected data users that share an interest in using personal data. The network *is* the system. Thus, by imagining the PDC as a system I pave the way for discussing it as a unit, as a single object.

Below, I draw a figure to help imagine what this object looks like. Herewith, I followed Lessig's lead[129] and represent the PDC/system as a dot. Figure 7.1 shows what the PDC/dot looks like in isolation.

[127]The current orthodoxy in the CAS in Law studies is that law exhibits some key characteristics akin to its subject matter. That is: both the legal system and its subject matter can be considered complex. I think this to be true, yet I also think that the relationships between the two may easily become confusing. In this article, I focus on better understanding complex subject matter and on how it relates to the law (that I imagine – for the analysis, applying the ceteris paribus mechanism – to be static).

[128]According to Wikipedia, Community includes two distinct meanings:

> 1) Community can refer to a usually small, social unit of any size that shares common values. The term can also refer to the national community or international community, and 2) in biology, a community is a group of interacting living organisms sharing a populated environmentWikipedia (2010).

Community in this paper took the first one.

[129]I follow Lessig's representation of an agent that is regulated in a regulatory field as a dot (Lessig (2006)).

Figure 7.1: The PDC-"dot" to be regulated

But the PDC is not as simple as it appears to be in Figure 1. In the initial conceptualization, all data users, both individual and institutional ones, together constitute the PDC. These (sub) units are not visible in the dot. Nevertheless, these sub-units include individuals such as data subjects and individual data users, but also data using organizations such as banks, governments, social groups (e.g. hacker groups), big or small companies (e.g. google, Facebook, twitter, RenRen) and other data-using stakeholders, as long as they are represented by an autonomous and responsible agent, as long as they are nodes in the network and as long as they share an interest in the use of personal data.

The PDC has many sub-systems, for example: European and Chinese (based on both cultural and territorial criteria). These subsystems are PDCs themselves. There are PDCs in the banking industry, PDCs in the Social Networking Services industry, PDCs in Security/anti-terrorism systems and so on. Further, as the social networking PDC shows, autonomous, responsible agents can be personal-data users as well as personal-data subjects.[130] Moreover, PDCs are constituted by units that may concurrently take part in several subsystems. I sketch an example in Figure 7.2 to show the internal structure of the PDC.

Prior to discussing the PDC as a CAS, it is necessary to stress that the PDC, as discussed in this Chapter, is a web of webs (a network of networks, a PDC of PDCs) with personal data users at its nodes,

[130]For instance, in the social networking world:

> "*person A may comment about what person B did in school that day, while person C reads the post but says nothing. Person D may post a photo from dinner about person E which gets a thumbs up from person F. On these facts, there are no distinct "users" or "data subjects"* " (Swire (2012):138).

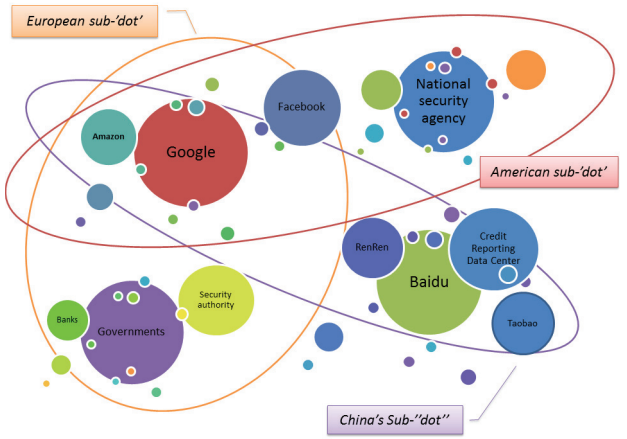

Figure 7.2: Dots (like the PDC) have internal structure

users that are responsible for the instruments employed for storing these data locally, and that are responsible for the local mechanisms that import, process and export such data over its edges or links.

When I assume as a working hypothesis that data protection laws constitute the main control system for the internal and the external behavior of the PDC and its sub-PDCs, I can already now postulate that it will be really important to try and understand how PDCs are formed from sub-PDCs (emergence) and how sub-PDCs are formed by other sub-PDCs (reproduction). And how PDCs influence their sub-PDCs and *vice-versa*.

And what the law has to do with it, and the other non-legal regulatory forces, as in our current story this has not yet been touched upon. But before doing that, I discuss complex adaptive systems as such.

A framework of CAS essentials

Before explaining the PDC from a CAS perspective in greater detail, I turn to a brief overview about CAS essentials.

CAS theory's emergence Philip Anderson published his extensively cited *More is Different* in 1972.[131] It is widely considered to have provided a cradle for CAS theory. Although CAS theory began to seriously surface in the 1980s, it took another decade for the activities in the Santa Fe Institute to begin and crystallize into a niche theory and -research approach. The Santa Fe Institute, which is the dominant contributor to the field, was founded in 1984 by a group of physicists (including Anderson and Gell-Man), economists, and others interested in studying complex systems in which the agents of those systems change.[132] In 1994, John Holland gave a famous presentation titled 'Hidden Order' and subsequently published a book under that name (Holland (1995)). In the book, he offered a comprehensive picture of CAS theory as it was at the time. Thereafter, CAS theory began to stand out as a new and productive paradigm for multidisciplinary work. Nevertheless, its main contributions took many years to be digested and received by researchers in many fields. In the past decades, multiple subject matters in the universe have been re-observed from the lens of CAS theory. Its observable facts are across the whole spectrum of the universe, including systems of sub-atomic particles, protein systems, eukariotic cells (and systems of such cells), *weather systems*

> Chan explained that weather is a complex system which is fundamentally unpredictable. Very small changes in initial conditions in the weather system can lead to unpredictable consequences, even if everything in the system is causally connected in a deterministic way. The current state of the weather is no predictor of what it will be in a couple of days time because tiny disturbances can produce exponentially divergent behavior (SeeChan (2001)),

immune systems

> Grilo thought immune systems, ecological systems as well as many others, are difficult to control or describe

[131] Anderson (1972).

[132] Brownlee *et al.* (2007)

using traditional computational methods. Two main difficulties are ensued when modeling such a system. The first problem arises from nonlinear interactions among system components. The second is issued when system's units can evolve, or change their specification, over time. Systems with these properties are sometimes called Complex Adaptive Systems (See Grilo *et al.* (2002)),

ant colonies

Ant colony is a canonical example of a complex adaptive system. In this system, each individual ant has a decision role. Each one also interacts with the other ants. A lot of that is local interaction. What emerges from their behavior is an ant colony (See, Kay & Schneider (1995)). Also see ``An interview with Michael J. Mauboussin by Tim Sullivan," in the Harvard Business Review, on Embracing Complexity,[133]

social systems,

such as the global macroeconomic networks within a country or group of countries. In "Unit-based computational economics: modeling economies as complex adaptive systems", the paper outlines the main objectives and defining characteristics of the unit-based computational economics methodology which is identified as evolving systems of autonomous interacting units (See Tesfatsion (2003)).

In, *From simplistic to complex systems in economics*, Foster applies CAS theory to economics and tries to evaluate and compare it with standard approaches that are based on constrained optimization. Foster recommends that the prevailing simplistic theories, based in constrained optimization, can better be replaced by 'simple' theories, derived from network representations in which value is created through the establishment of new connections between elements.[134]

[133]See http://hbr.org/2011/09/embracing-complexity.

[134]See Foster (2005).

In another paper, *Why is economics not a complex systems science?* Foster discussed why a complex system perspective can hardly develop in the mainstream of economics (See Foster (2006)).

In *Rethinking the financial network*, Haldane adopts network theory (with other evidence) to explain the emergence of two characteristics in the financial network over the past decade – complexity and homogeneity. And he subsequently offers his diagnosis of the troubles under the economic crisis of the time. Haldane -- who is the Chief Economist of the Bank of England -- bases his diagnosis on CAS theory (See Haldane (2009)),

language

Briscoe suggests in *Language as a complex adaptive system: co-evolution of language and of the language acquisition device* that the reciprocal evolution of language learning procedures and of language creates a coevolutionary dynamic system (See Briscoe (1998)).

In *Language is a complex adaptive system: Position paper*, the authors re-interpreted language to be a CAS as languages have every feature a CAS should have. Their approach reveals commonalities in many areas of language research, including first and second language acquisition, historical linguistics, psycholinguistics, language evolution and computational modeling (See Beckner *et al.* (2009)),

organizations

In *Organizations as complex adaptive systems: Implications of complexity theory for leadership research,* Schneider and colleagues presented leadership in a Complex Adaptive System (CAS) may affect the organization indirectly, through the mediating variables of organizational identity and social movements (See Schneider & Somers (2006)).

In *Health care organizations as complex adaptive system* by Begun, Brenda and Dooley, the authors identi-

> fied a series of key differences between complexity science and established theoretical approaches to studying health organizations. They found that complexity theory can broaden and deepen the scope of inquiry into health care organizations, and that it can expand corresponding methods of research, and that it increases the ability of other theories to generate valid research on complex organizational forms (Begun *et al.* (2003))

and *cyberspace*

> Phister thinks cyberspace has exhibited the traits of a CAS, since networks and information systems that are being constructed today are complicated. Integrating these networks together into a global Internet yields an extremely complicated environment (See: Phister Jr (2010)).
>
> Andrus pointed out that the rapidly changing circumstances in which intelligence communities operate take on lives of their own that are difficult or impossible to anticipate or predict. The only way to meet the continuously unpredictable challenges ahead of us is to match them with changes of our own. We must transform into a community that dynamically reinvents itself by continuously learning and adapting as the national security environments change (See Andrus (2005)).

CAS theory has emerged, developed and grown up around the study of such different systems.

CAS characteristics Contrary to the conventional way of thinking about systems (as having equilibrium searching mechanisms and dynamics), CASs show a few key features not always acceptable to conventional approaches. We have to choose, for even in the CAS-theory communities there does not exist real consensus on the comprehensive set of characteristics that define a CAS. I think that it is possible to harvest a useful framework with CAS characteristics from Maguire's literatures ``Complexity Science and Organization Studies"(Cilliers (2002)).[135]

I summarize the characteristics that I harvested in Table 8.1. The table concurrently summarizes the elements in the framework that I use to decide whether a system is a CAS (or not) and to indicate what CAS-theory may have to offer to whom and under what conditions.

Systemic	A CAS is a whole, has a boundary, aggregates agents	*that are:* networked, diverse, signaling, metabolizing, CASs themselves (often)
Dynamic	A CAS is adaptive yet it is sensitive	*by:* (co-)evolution, learning; *to:* critical transitions
Complex	A CAS shows emergent behavior	*often:* without central control, path dependent, non linear

Table 7.1: CAS characteristics summarized

The three main characteristics concern *system* (being a whole, aggregating agents or parts that operate, and may be aggregates themselves etc., etc.), *dynamics* (changing over time, by learning and/or evolution) and *complexity* (showing emergent behavior that is without central control and resists to being modeled with linear math). In the next Section I discuss why the PDC has these characteristics.

Understanding the PDC as a CAS

In this Section I discuss how the PDC shows the characteristics of CASs and how this awareness may be useful to legal scholarship.

[135] In this book, CAS is featured by 1) consisting of a large number of elements; 2) that elements interact dynamically; 3) that interactions are rich, any element in the system can influence or be influenced by any other; 4) that interactions are non-linear; 5) that interactions are typically short-range; 6) that there are positive and negative feedback loops of interaction; 7) that they are open systems; 8) that they operate under conditions far from equilibrium; 9) that they have (and their behavior in influence by their) histories; 10) that individual elements are typically ignorant of the behavior of the whole system in which they are embedded. (See Maguire *et al.* (2006) at page 166).

Each of the characteristics mentioned in Table 1 is discussed in a Subsection below. There I first highlight the characteristic in the light of one or more of the example CASs mentioned earlier and subsequently argue why the PDC has the characteristic too and why this is useful for legal scholarship.[136]

CASs are systemic – so is the PDC

According to Merriam-Webster's Collegiate Dictionary, generally, a system is ``a regularly interacting or interdependent group of items forming a unified whole: as a gravitational system, thermodynamic system, digestive system, river system, a computer system, capitalist system."(Merriam-Webster Inc. (2004)) A CAS is also a system following this definition, but much more complicated. As Meadows defines, a system, in the context of ``CAS", is

> ``a set of things—people, cells, molecules, or whatever—interconnected in such a way that they produce their own pattern of behavior over time. The system may be buffeted, constricted, triggered, or driven by outside forces. But the system's response to these forces is characteristic of itself, and that response is seldom simple in the real world."(Meadows (2008):2)

This type of system description considers identity, invariants and stable interactions in equilibrium to be focal. This is a manner of looking at the world that clearly helps us understand. One might even stipulate that we need such descriptions to support our comprehension by temporarily fixing a moving world into a series of snapshots of which we analyze the elements. This approach is so successful, that we tend to reverse the argument and assume the world to be in a state of equilibrium (or to be working towards such a state). But this would be ill-advised, as my discussion of the dynamic and complex characteristics of CASs shows.

When I look with the ambition to describe what CASs are, I have identified the systemic requirements for being a CAS to include being

[136] I hesitate to use 'legal theory' or 'jurisprudence' here. I am not quite sure that these disciplinary niches will consider my work to be within their domain.

a whole, networked aggregation of diverse agents, that signal, that operate simple rules, that may be CASs themselves.

Any CAS is a whole To be able to consider something to be a CAS, it must have identity; it must be possible to consider the thing to have a boundary and some internal coherence. I think that immune systems, ant colonies, economies, languages, organizations and cyberspace do not need additional evidence for establishing their capacity to have boundaries.

Local weather systems are not self-evidently wholes with an identity. Yet, this may be accommodated in several ways. One of them would be to consider a weather system to equal an atmospheric domain that has an isobar (a line connecting points of equal pressure) as its boundary. Within such a system, several subsystems may exist and interact with each other.

The PDC is a whole

In the Second Section of this chapter, I already discussed the internal structure of the personal-data community as a whole (a ``dot") that has internal structure. The body of the PDC contains a large amount of data users (in fact: all connected personal data users, world wide). The whole is the network. Its boundaries are determined by any ``no further links to responsible individuals" situation.

Kaliya Hamlin drew a personal data list in a mind map to show the diverse uses (and thus the diversity in values) of personal data.[137] According to Kaliya, the contents of the mind map are derived from a long list in the *Rethinking Personal Data Pre-Read Document,* published by the World Economic Forum in June 2010.[138] I replicate the list in Figure 7.3.

[137] See http://www.identitywoman.net/personal-data-list-in-mind-map-form

[138] See also: P Klaus Schwab & Hoffma (2011).

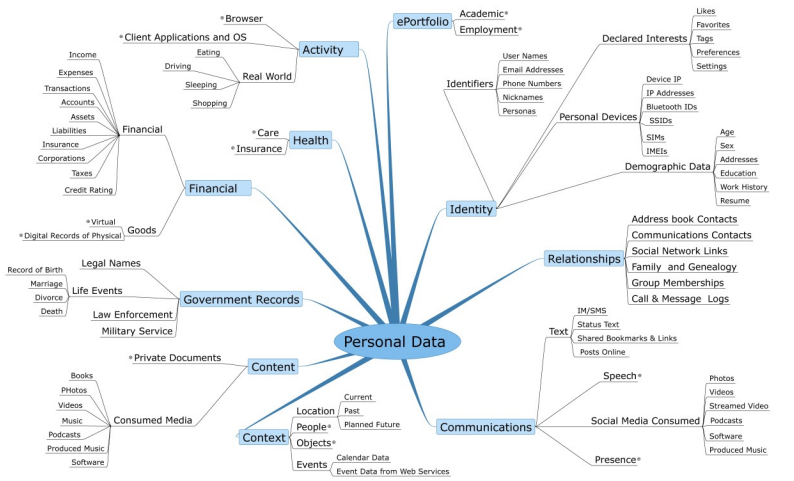

Figure 7.3: Diversity of personal-data use and -values by Kaliya

The complicated mind map in Figure 7.3 shows us how diverse the data users are in the PDC. It is beyond our abilities to give an exact number about how many data users exist in the PDC. But, they vary to a significant degree, in terms of their objectives,[139] data types,[140] legal nature[141] and so on. Among these data users, some are relatively widely scoped (e.g. Google) while others are more specialized, focusing on particular problems such as the Military and the Police.

I submit that the PDC is a system, having identity, but also having internal structure in the form of collections of interconnected institutions, service providers, individual users and so on, composing a multi-layered network with hubs and overlapping communities.

[139]For instance, Google collects personal data in order "to develop new ones, and to protect Google and our users...(and) use this information to offer you tailored content – like giving you more relevant search results and ads." See, Facebook's Privacy Policy, access via https://www.google.nl/intl/en/policies/privacy/. World Health Organization collections personal data for normal web site usage and personal identifiable use. See, WHO's privacy policy, access via http://www.who.int/about/privacy/en/

[140]For example, financial institutions pay more attentions to personal data related to economic information, while others, such as health institutions, may concern with health data.

[141]Some data users, like Google, Facebook and Tecent, work for the benefits of companies, while the others are non-profits organizations, such as governmental data users.

Why considering that the PDC as a whole is useful

It is useful for legal scholarship to consider that the PDC is a whole because legal scholars tend to think in jurisdictions. The concept of the PDC provides an image of subject matter for regulation that does not coincide with the classic conditions that accompany the notion of nation-state related jurisdiction. Recognizing the related anomalies as relevant may well be a necessary condition for facing their consequences.

CASs are complex – so is the PDC

Ottino (2003) stressed, since systems are formed by networks of interactions, that the first that must be done when discussing complex system is to distinguish complex from complicated systems. Complexity emerges only when ``the collective behavior of the parts together is more than the sum of their individual behaviors" (Newman (2011)). The relationships in the system are not simply the aggregations of the individual static entities, but like ``a cat's cradle of interactions"[142] between dynamic units. Complex systems are not controlled centrally and resist their behavior to be modeled linearly.

The PDC self organizes

Any CAS operates at least partially without central control

Complex adaptive systems have internal structure (may show multiple levels of aggregation) and a dynamic history -- they emerge, live and survive, in a co-evolving environment.

The PDC operates without central control

[142]I borrowed the term from Haldane,"*Rethinking the financial network*". Haldane thought financial network is CAS. "*Complex because these networks were a cat's-cradle of interconnections, financial and non-financial.*" His paper inspires me a lot. It provides a fresh insight for looking at financial systems and to treat financial crises (See Haldane (2009) at page 23).

Among the diverse data users that constitute the PDC, no pure or ideal agent represents the system as a whole. One can argue that Facebook is the flagship in the social network ecosystem. But Facebook is not the ideal agent in charge of the whole PDC, and neither is its structure representative for the structure of the other agents that make up the PDC. It is fair to say that giant services like Facebook and Google are keystone agents that have disproportionally large effects on the PDC they are a part of. For instance, China's Facebook RenRen is strongly and unidirectionally influenced by Facebook.[143] Yet I prefer to say that these keystone agents strongly influence their sibling agents (at the same level) than that they control the whole ``dot." In terms of network theory,[144] they are ``hubs" in the small-world[145] networks that connect those agents in the PDC that represent the social networking ecology.

The PDC clearly exhibits the feature of self organization. Various units come to the system voluntarily and even without leaders from inside or outside the system. For instance, the development of the Facebook social networking technology by an undergraduate student, and then the rapid emergence of the Facebook community is a result of self-organization within the PDC. The appearance of the Facebook community was not designed or commanded. The local, individual actions and communications of technology providers, businessmen, service providers and individual users of social networking did produce the patterns that became the Facebook community. In fact, there are many PDC ``sub-communities," such as around search engines, file sharing, online chat services and Wikipedia. These all emerged in the PDC in a manner similar to the one described for Facebook. Peltoniemi & Vuori (2004) said, as mentioned above, that emergent properties are the result of self-organization. Thus I assume that emerging phenomena are the result of self-organization. Consequently I accept that the PDC shows the third characteristic of what makes a CAS.

Why considering that the PDC operates without central control is use-

[143] Zhang & Schmidt (2013).

[144] See, for instance, Barabási & Albert (1999).

[145] As discussed by Watts & Strogatz (1998) and Barabási & Frangos (2002).

ful

It is useful for legal scholarship to consider that the PDC emerges and operates without central control because this may become a systemic risk to legal systems. It is essential to legal practice that human individuals can be identified as being responsible for behaviors in and by the CAS. It is our contention that the ``responsibility drain" as implied here is currently in full swing for the law's grip on PDC behaviors.

The PDC cannot be modeled as linear

No CAS can be modeled as linear

The feedback loops in a complex system result in non-linear behaviors. Nonlinearity means that the behaviors based on relationships between system units I wish to measure are not mathematical proportional: outputs may be disproportional to inputs; small inputs can produce large outcomes; and large inputs can produce small outcomes ((McDaniel Jr *et al.* , 2009):193). The inputs of a CAS flow through a multitude of feedback loop that tend to produce nonlinearly related outputs (Ruhl (1997):946). And as complexity theory allows for the analysis of all CAS behavior as being dynamic (or as having time related feedback loops), complexity theory allows for the study of phenomena that cannot be modeled with mathematics that yield solutions.

The PDC cannot be modeled as linear

The previous analysis has shown that the PDC can be described as a decentralized system which comprises a web of interdependent data users. But is the PDC's behavior non-linear or is its behavior simply that of a system with a complicated internal structure? The characteristic that helps establish a system as a complex system is its having non-linear feedback loops between its diverse units.[146] As I analyzed above, a complex system that has these non-linear characteristics often shows a capacity to self-organize into emerging aggregate agents.

The feature of emergence exhibits itself very clearly in the PDC.

[146] Feedback loops exist in complex systems when information flows in the network follow paths that work circuitous, as in direct or indirect loops (Ruhl (1997) at page 948). For a more detailed discussion of the nature and characteristics of feedback loops (see, Tussey (2005)).

Different patterns of phenomena or behaviors emerge from the interactions among agents, rather than being designed into the system.[147] In fact, even the PDC itself is an emergent community, produced by the individual activities of local agents without a clue about what their collective behaviors would look like or lead to. The PDC emerged from the local interactions of agents, particularly technology providers, service providers, institutional users, consumers, businessman and other stakeholders, pursuing their own interests. These interactions produced (led to the emergence of) vast and networked communities through which personal data (and much, much more) can be transmitted fast and easy. This PDC is neither invented nor designed by any individual agent. Rather, it emerged from interactions of a large amount of ``constituent'' agents that reacted to opportunity and need.

I thus conclude that the PDC has the characteristic of nonlinear feedback loops what are the hallmarks of a complex system, since the inputs of the PDC flow through feedback loops and produce nonlinearly related outputs (Ruhl (1997):946).

Why considering that the PDC cannot be modeled as linear is useful
It is useful for legal scholarship to consider that the PDC cannot be usefully captured in simple linear models because this may prevent legal scholarship from falling into the type of trap that has lured large communities in economic scholarship astray.[148] Legal scholars may well have hesitated to join forces (and scientific stories) with disciplines like economics and physics because considering the subject matter of legal scholars -- autonomous decision making and relating that to individual responsibility -- has long been considered resilient to scientific investigation. Only in the last three decennia there have

[147] See also Rouse (2008):38.

[148] Happily machining away from their models the mathematical difficulties that would ensue when accepting that diverse, dynamic and context dependent forms of autonomy and responsibility are at work in the decision making of the agents in the systems observed. In stead, these scholarly communities preferred to face the continuous falsification of their mathematical models by simplifying agents into being unidimensional "rational economic men" and by concurrently making the models more and more mathematically complex. See Bowles (2006) for an extensive discussion.

become generally available methods[149] of and machinery[150] for simulations that allow for further investigation into behavioral models of diverse, dynamic and context dependent forms of autonomy and responsibility. Simulating the behavior of agents with distributed types of rule sets they follow has become a hall mark of complexity science. [151]

I thus conclude that the PDC has the characteristics of self organization and non linearity, the characteristocs that make a system complex. In Figure 7.4 I give a sketch to show what the PDC might look like if described as a networked complex system.

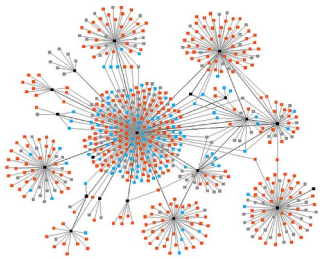

Figure 7.4: Hubs in a small-world network

CASs are dynamic – so is the PDC

CASs change over time, by learning and/or evolution or co-evolution. It has been observed that the number of personal data users is increasing every year, every month and even every day. For instance, in

[149] Agent Based Modeling – see Schelling (1969) for an early example.

[150] See http://ccl.northwestern.edu/netlogo/.

[151] For instance, the "Living Lab" at Leiden University provides promising initiatives and applications of agent-based models to test policy decision options. In their presentation, Yuan Yuan Zhao and Professor Katzy took the German Solar Panel Industry as an example and showed that computational policy simulations could be used to inform policy choices. See, e.g., www.centre4innovation.org

February, 2014, Facebook announced a new iPhone app called ``paper." The app could [...] ``to supplement its computers in recommending articles and blog posts on a dozen topics." The app would be an artificial (or intermediate) personal data user, since it delivers the articles and videos that it expects you to like, based on the analysis of your personal data as collected by Facebook (Goel & Somaiya (2014)). Thus, the PDC changed and its network increased in size.

Any CAS does (co)evolve and/or learn What distinguishes CASs from other complex systems is their capacity to adapt. According to Tussey (2005) at page 109:

> ``... adaptation most often results from coevolution, in which the system responds to changes in other systems with which it interacts, and those systems similarly respond to changes in the primary system ..."

According to Kim(Kim & Mackey (2013):8),

> ``...CASs as complex systems with the ability to adapt to changes in the external environment as a result of experience via conditional action and anticipation."

Adaptation of a CAS implies that a CAS has the capacity to co-evolve with its environment. No single CAS does exist independent from its environment. Each and every CAS is closely linked to its environment. And a CAS does not only exist within its 'environment', it becomes intimately related to it. Thus, most CASs have bidirectional relations with their environments: as the environment changes, the CAS needs to change along in order to ensure an adequate fit; and when the CAS changes, the environment is changing along to. This is a continuing process: as its environment is changed, the CAS needs to change with it, and vice versa, and so it goes on and on.[152] Perhaps, co-evolution can be seen as a process wherein CAS and environment try to re-tune their reciprocally dependent fitness in the dynamics of unfolding time.

This co-evolutionary process will show *as if* both the CAS and its environment are learning. But in its biological origin there is in the

[152]See also Capra (1997) and Holland (1995).

evolutionary process no conscious process like learning involved. I submit nevertheless that CASs that have consciously behaving agents can learn, and thus influence their fitness consciously -- and thus may tilt the coevolutionary process towards their perceived interest.

The PDC does (co)evolve and/or learn The PDC is as open as other CASs to coevolve in response to internal dynamics[153] and environmental stimuli. It continuously tunes itself in order to find states of adequate fitness.[154] The PDC is itself a result of ongoing social interactions. The environment provides pre-existing constraints, provided by culture, law, technology and so on. These constraints determine the space wherein the PDC can find adequate co-evolutionary forms.

When describing the constraints of provided by the environment, I follow Lessig's lead.[155] Lessig's work modeled how cyberspace is regulated and, as a part of that, on modeling how law might regulate cyberspace. What I will borrow from Lessig is the model he created to analyze regulation from the perspective of the subject that is being regulated.[156] His model helps us to examine the relations and interactions between the PDC and its environment.

In his book, Lessig represented the thing that is to be regulated by constraints as a ``dot."[157] He identified four constraint-delivering forces: law, market (or economy), architecture (or technology) and norms (or culture). The resulting constraints trie to regulate the dot. Lessig presents the constraints in a Figure.[158] I replicate it in Figure 7.5.

[153]Of course, if a CAS has CASs as its constituting agents, it is concurrently the environment to these constituting agents and will also co-evolve with them.

[154]See also: Tussey (2005):120.

[155]Lessig (2006).

[156]Very much a realist perspective, at least initially.

[157]This is the dot I discussed in Section 2.

[158]Lessig (2006):123.

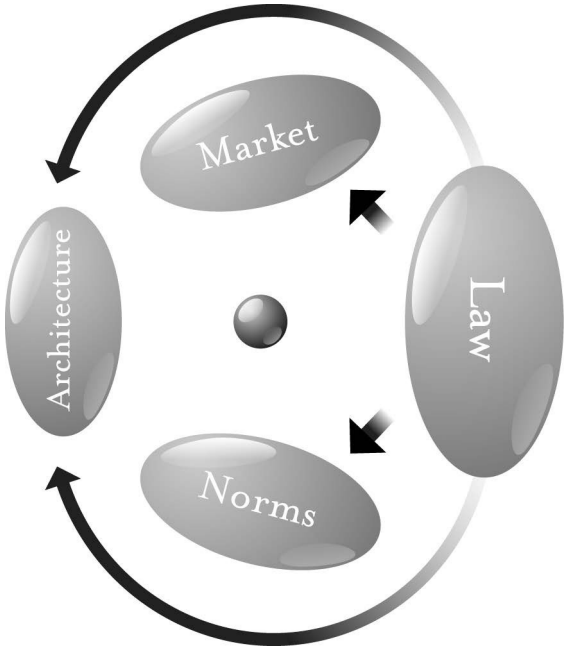

Figure 7.5: Lessig's regulatory forces interacting.

I trim Lessig's regulatory forces and direct them to our PDC, and representing them as the environment with which the PDC co-evolves. An important regulating force mentioned by Lessig is what he calls ``regulation by architecture."[159] I assume them to be the regulatory forces that stem from environmental and infrastructural conditions that in the context of behavioral choices most often have to be accepted as stable, like the legislative system, the Berlin Wall, or the IPv4 protocol. However, these architectures are sensitive to change -- be it in their own ways. One might consider a ``dot" to be thrown into an environment that shows a structure that constrains its behavior, but into an environment that is itself a moving target -- that even can possibly be moved by the dot itself.

Co-evolution of the law, the legal subject and the environment be-

[159](Lessig, 2006):127

comes problematic when the political system that can adapt the formal laws is too slow in its operation. Understanding what the problem is (and how to address it) would be useful. In Chapter 4, I adopted Incomplete Law Theory[160] to explore the dynamics of what I can now call the environment wherein the PDC must live. In the Chapter, I started from technology-constrained data protection law and ended by exploring the dynamics of technology and its wide, architectural influences on legal arrangements. My observations and further evidence suggest that the most striking constraints for PDC- and PDC-agent behaviors do arise from the dynamics in technology. Agents, such as companies, are concerned with technological changes and these changes affect the agents' behaviors. Indeed, changes in technology have real consequences. And although their characteristics remain architectural in the sense of Lessig, their dynamics have sped up to a level where traditional legislatures cannot keep up with the pace required. It may well be, that some reactive change in the legal system as architectural environment is required.

Additionally, the PDC is influenced by the other elements in its environment. For instance, the mutation in social-economic backgrounds which were brought on by the 9/11 tragedy did feed into the "dot," which brought changes to the behaviors of units in the PDC and led to a ``tug-of-war of conflicting interests" between national security values and privacy values: the protection of national security values implies that inroads have to be made into the protection of the right to be left alone.[161]

Moreover, in the PDC is not an uneventful ``dot" itself. Instead, it is an ever-changing one. Strategic changes of one unit may strongly affect the strategies of other units in it. As argued in Chapter 5, I analyzed the interaction between Facebook and its Chinese counterpart RenRen and imagined RenRen and Facebook to compete (for instance on data protection issues) in a single commercial arena (as provided

[160]As described in Xu & Pistor (2002a).

[161]In Bignami's "European Versus American Liberty: A Comparative Privacy Analysis of Anti-Terrorism Data-Mining", this conflict of interests is analyzed more in detail. By comparing the legal arrangements over data protection issues in America and Europe, Bignami showed the fierce conflicts between privacy and national security, which led to the changes on the environment of the USA PDC. (See Bignami (2007)).

by the web). The mere suggestion of such competition suggests that we may presently witness the tantrums that will unavoidably accompany the conception, birth and emergence of a unified global complex adaptive judicial system for governing the web as a unified market.

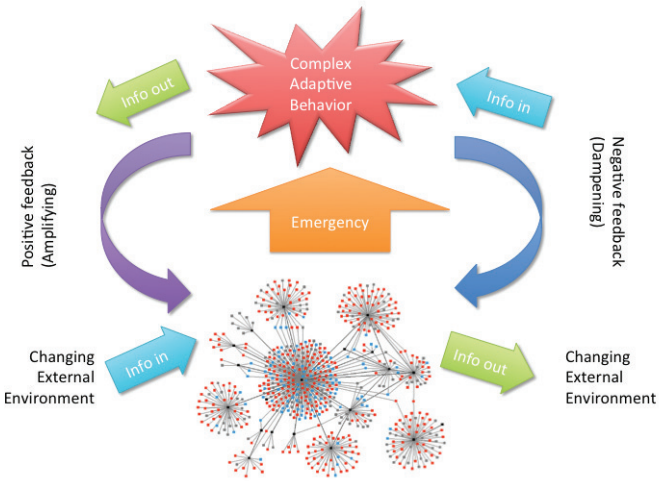

Figure 7.6: The PDC as an ecology

Within the system, the different units aggregate, cooperate, interact and develop with a specific reference to personal data, while without the system it co-evolves and competes with other related systems. These outside relations of the PDC, construed as a CAS, can be mapped out as depicted in Figure 7.6.

Why considering that the PDC does (co)evolve and/or learn is useful
To legal scholarship it is useful to distinguish (co-)evolution on the one hand and learning on the other, especially when considering subject matter the level of social ecosystems. (Co)evolution refers to a blind mechanism that happens to lead to adaptation. Learning (and teaching) use conscious mechanisms that result from conscious behavioral choices and result in social and scientific cultures (that help preserve, adapt and reproduce local knowledge bases).

I think that it is useful for legal scholarship to respect the distinction between the mechanisms of (co)evolution and learning -- even when these tend to get into a confusing tangle. Legal scholarship is founded in accepting the concept of conscious behavioral choice,[162] and not in accepting subconscious behavioral choices (sensitive to nudging) as definitive. As such, legal scholarship's primary domain is related to learning, to the learning of behavioral choices that do not subjugate to subconscious impulses. The issue of where the boundaries of the disciplines meet in these issues is important, and can only be understood in cooperation with multiple disciplines.

The PDC as a CAS – summing up

Our goal of looking at complexity theory is to find out whether interpreting the PDC as a complex adaptive system does improve our understanding of the data protection law's subject matter. I established

- that the PDC is of systemic nature, showing several levels of aggregation and thus providing not only handles for interdisciplinary communications, but also providing several extra handles for monitoring the multi disciplinary consistency of our findings. An important aspect brought to the fore by looking at agents in levels of aggregation makes explicit that the possibilities of scientific prediction of the behavior of agents that do not have consciousness is something quite different from the prediction of the deliberate behaviors of the subjects of the law, of economics and of the social sciences;
- that the PDC is a dynamic system -- on the one hand through the non-deliberate mechanisms of (co-)evolution and on the other hand through the deliberate mechanisms that I classified under learning; and: as a complex adaptive system, I expect that the PDC may have to face the risks of critical transitions (and that legal arrangements may be designed to minimize such risks);
- that the PDC is a complex system, that operates without central control and in a manner that cannot be caught in a linear model

[162] Consequently it does not consider (co-)evolution to be directly in its domain. However it can enter its domain via conscious behavioral choices that influence evolutionary processes.

> -- these aspects are the corollaries of agents that follow context dependent conditional rules in a network of direct and indirect feed-back loops. As a consequence, scientific understanding of the PDC has to remain very incomplete, yet is becoming larger through new practical possibilities for serious agent based modeling using serious computation capacity.

I consider these findings to have added to our understanding of the subject matter of the data protection laws.

I began by suggesting to look at data-protection laws' subjects (and their environment) as a complex adaptive system in the hope that this will also allow us to provide a unified account of seemingly unrelated phenomena as characteristic CAS-properties in a single system.[163] Our research does also fulfill this hope. I added to our understanding of the PDC through combining our current knowledge with knowledge and experiences from different examples of CASs, and from different disciplines. Basic knowledge about CASs informs us that the PDC comprises a complex web of interdependent nodes (units or agents) that link to one another and that make some of them emerge as ``hubs." These stylized but explorative considerations can be woven into a perspective that understands data protection law's subject matter as a CAS.[164]

[163]See also (Beckner *et al.* , 2009):3.

[164]In fact, both the PDC network and the data protection law surrounding it are CASs. The same framework I adopted to analyze the CAS-characteristics of PDC could be applied to the data protection law too. In previous Chapters, we witnessed the difficulty of attempting to design static legal regimes to regulate the PDC. We are inevitably stuck in the co-evolution of law and the systems it regulates. Efforts to build rigid legal regimes to control thus are destined to fail eventually as the social system under regulation evolves in ways that work around or exploit the legal system. Data protection law itself is a CAS bound in a co-evolutionary, multi-system "system of systems" so it is going to be adaptive over the long run if it is designed with adaptation as a primary attribute. For the issues of the CAS-characteristics inherited in law, Professor Ruhl has done a lot of promising research on this and readers could know more about this hidden nature of law in his books.

Peering from a complexity-based perspective

The goal of introducing the CAS-theory is to improve our understandings of how the data protection law's subject matter operates (section 4). Previously, I witnessed how a CAS perspective might move data protection law into new and interesting directions. From the perspective of CAS, I recognized that systematic nature of the PDC, the complexity of the system, and the necessity of recognizing its co-evolution aspects. The PDC hence can be understood as a CAS. However, challenges follow with findings.

A pressing question comes to the fore: does our CAS-analysis push the PDC out of control and thus beyond the reach of useful governance by law?[165] I will answer this question in the negative. As Clark (1999):1 argued: this kind of system can be led, influenced and enabled in a variety of ways. Among these ways, legislation and legal enforcement are also included. As a matter of fact, CAS-theory has become more and more prominent because it helps to understand and influence what otherwise could only be qualified to be systems of unapproachable *complication*. Consequently, when considering legal arrangements for a PDC, the legislature is wise to bear in mind the inherent CAS characteristics of it. Data protection law cannot treat the PDC as anything else. As a "*society's problem-solving mechanisms*,"[166] legal arrangements are seeking to regulate a CAS. In these cases, Ruhl mentions that ``*it is very difficult to solve problems in such systems unless you think like a complex adaptive system*"(Ruhl (1997): 51).

Undoubtedly, this approach may present insurmountable hurdles for policymakers. Yet, policymakers of data protection law can draw a number of lessons from other CAS projects in areas such as econ-

[165]In fact, Law making and law enforcement is a multi-level affair: they are, for instance, often directly linked to unit behavior, yet have the ambition to nudge the emergent, overall behavior of the PDC as a whole towards improvement. I consider a distinctive characteristic of how the forces of laws are understood and enforced to be the assumption that they are backed by reason.

[166]See Ruhl (1997): 51

omy,[167] epidemiology,[168] biology[169] and finance[170] to inspire their exploration of the subject matter. It is against this background that I expect that regulation over data-protection issues stands to benefit from being informed through the lens of CAS theory, integrating the contributions of a diverse bunch of scientists and scholars.

Therefore, in this section, I provide some tentative policy heuristics that build on recent advances in our understanding of the PDC and that incorporate findings and methods from disciplines that have paid more attention (and also contributed more) to CAS-theories than the legal discipline.[171] I only know of these methods yet in a sketchy and incomplete way. I offer them as personal insights that need further research and interdisciplinary attention. More specifically, I extract some heuristics for the design of legal mechanisms that, in my opinion, may become significant for the support of rational policymakers considering the adaptation of laws. These heuristics concern (i) the monitoring of the effects of legal intervention, (ii) understanding the environment, (iii) attention for incentives (mechanism design), (iv) ``hub" control and (v) leeway for learning and adaptation.

(i) Monitoring the effects of intervention

When any group of ``things" is considered to be a system, it is formulated from the perspective of the system being a whole, rather than from each individual participant's perspective. Discussing the PDC is no exception. Since it is an interconnected system, policy makers could seek to promote the continuing health of the PDC by maintaining some aggregated measure of balance among them. When considering legal interventions, policy makers will realize that they are trying to intervene in a global interconnected system, which means that any intervention may have consequences in the whole of the PDC, at

[167] Arthur (1999)

[168] McDaniel Jr *et al.* (2009)

[169] Levin (1998, 2000)

[170] Haldane (2009)

[171] In this context, I mention as examples models and modeling as developed in engineering, the sciences and economics, network analysis, computer science, biology and genetics and some other cross-discipline methodologies, like computer simulation.

unexpected locations. Thus, it is important to investigate what benefits a legal intervention into the PDC will have as seen from a systematic perspective.

To assess the benefit of legal interventions means to measure. When I discuss the measuring aspects of ``moving targets" like the order in the PDC, measuring may focus on stable equilibria as related to the regulatory `attractor' forces of legal arrangements. According to Page (2012)

> `` ... if under a wide variety of assumptions the system goes to equilibrium, then we can have some measure of confidence that comparing equilibria is sensible. If, though, it is extremely difficult to produce equilibria, then equilibria may not be the appropriate solution concept"(Page (2012):16).

It is not easy to evaluate the result of legislative intervention. As Page also mentions

> `` ... one way to evaluate mechanisms might be to consider a variety of initial conditions and a variety of possible behavioral rules and to examine what arises given those combinations" (Page (2012):16).

Suggesting to estimate the value/benefit of legal intervention regarding PDC behavior in terms of equilibria seems in contradiction with our earlier argument about the PDC being a complex adaptive system. But as I do think (know) that neither the long-term future, nor the long term behavior of CASs can be predicted accurately, the heuristic that suggests to estimate the value/benefit of legal intervention only makes sense for short-term predictions. These predictions can be interpreted against actual behavior in order to establish whether CAS behavior `follows' the model and for how long. Such predictions may work like weather forecasts - when I know enough about the forces that work the system's behavior, I may actually gain some short term predictions that can be trusted.

For this approach, models of Markov processes can be used to evaluate the benefit of legal intervention.[172] Dependent on parameters specified, Markov processes converge to a fixed equilibrium,

[172] My discussion of Markov processes is based on *Chapter 5, Markov Pro-*

independent of what the initial state of the system is. A major assumption is that transition probabilities between states remain constant. Evaluating the benefit of a legal intervention can be further simplified by constructing two Markov models for the PDC' s ``health states," one with and one without the intervention.

My main point is that estimating and measuring the value/benefit of legal intervention requires to create models and measures, and to test, use and interpret them consciously. And, most important, that linear models (of which many are available and well understood) like models in Markov processes can be *useful* for short-term monitoring of CAS behavior, yet will be *dangerous* for long-range predictions and evaluations of complex adaptive systems.

One of the reasons that long-range predictions of the behavior of CASs is dangerous relates to the fact, that such predictions, even if the working mechanism are completely known and deterministic to be extremely sensitive to initial conditions.[173] This means that complexity theory warns us that transplanting EU data protection law to China is highly unlikely to produce the similar results in China when compared to the effects in Europe.

(ii) Understanding the environment

I found that the PDC is adaptive. This helps us realize that understanding the environment that underlies and surrounds the PDC remains of importance. The impacts of other constraints in the environment, neither on/from the ``dot" nor on/from each other, should be underestimated or forgotten altogether. I simply assume that institutions that receive regulatory forces always have the potential to feed back to the regulating institution. *E.g.*, the PDC that is regulated by law may propagate constraining forces as a feed-back to the legislature (or, more down to earth, Facebook may, in the face of the personal-data protection laws that threaten to regulate it, propagate feed-back forces by lobbying the legislature).

In terms of CAS-theory, the environment that co-evolves with

cesses by prof. Scott Page (yet unpublished manuscript, I assume), available at: http://vserver1.cscs.lsa.umich.edu/~spage/ONLINECOURSE/R10Markov.pdf"

[173] See for instance Mitchell (2009).

the PDC, includes at least Lessig's interacting regulatory forces. I think that the subject for regulation, the PDC, and all four regulatory forces that Lessig identifies (laws, norms, market, architecture) have links and feedback links to all other units. In Figure 7.7, I have painted this picture. What emerges, is that all units are in a network.

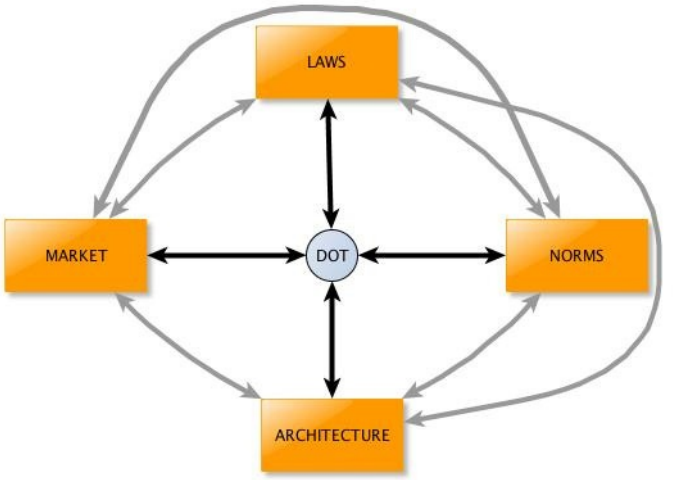

Figure 7.7: Lessig's regulatory forces and their "dot" as an ecology.

Feed-back loops are the hallmarks of ecologies. In other words, Lessig's approach to modeling the regulation of a ``dot" gives rise to an orderly picture that clarifies a lot of the structure of the ``regulatory ecology" wherein a PDC is a ``dot."

However, as I have seen in Section 2, imagining the PDC as a ``dot" is an oversimplification. The same goes presumably for the other nodes in the network of Figure 7. And, as indicated, I expect that such oversimplifications may be at least partly addressed by applying a CAS-theory approach, because in this approach legal scholarship will be forced to consider what chain-reactions may cascade through the regulatory ecology as a result of the publication of a single policy

decision. (Of course, the same is true for the other nodes.)[174]

The findings on the influences of the environment on the PDC does supports the conclusion made in Chapter 6 that transplanting EU data protection law to China is highly unlikely to produce the same results. The environment that underlies and surrounds the PDC forms the initial conditions for any data protection law. As mentioned, one CAS property is "sensitivity to initial conditions," meaning relatively small changes in the conditions of a CAS can lead to disproportionately large differences between the original and altered systems at later times. Over time—perhaps soon or perhaps much later—those two systems could diverge tremendously as a result of that one seemingly trivial difference, so that one would never know that at some point in the past they were almost identical. And the legal cultures in the EU and in China are not even close to being identical at the outset.

And it is important to bear something else mind. Legal systems and subsystems are parts of the PDC's environment and can themselves be CASs as Ruhl (2008) convincingly argues. In other words, both the PDC network and the data protection law surrounding it are CASs. This emphasizes the difficulty of attempting to design static legal regimes to regulate the PDC. We are inevitably stuck in the co-evolution of law and the systems it regulates.

Moreover, once transplanted to China's PDC environment, even if in exactly the same form, EU data protection law becomes part of its new home CAS and will instantly begin co-evolving in an environment that does not resemble the EU's PDC environment. Because of sensitivity to initial conditions, these environmental differences will inevitably take the transplanted pod of EU law into different directions, lead to co-evolutionary responses in the Chinese PDC that the EU PDC would not have produced, etc. Even relatively small differences between the EU and Chinese PDCs could produce vastly different trajectories, hence the large differences in the EU and Chinese.

[174] An example may be read in the issuing of the Commodity Futures Modernization Act of 2000 (by the legal node) that was based on highly esteemed economic expertise (by the market node) and that caused great harm to each and every node in the network by marking the onset of what would become the financial and economic crises of 2007/8.

(iii) Hubs are special

Here, I pay attention to another perspective on networks, that helps to ensure appropriate control. For example, we may learn from experiences in epidemiology and the role of small-world network theory for deciding on who to vaccinate in order to prevent a pandemic. Analogously, when Haldane (2009) complained that the financial network's super-hubs challenge the stability of the whole system, he accepted a good lesson from HIV controlling strategies, particular from the Australian experience on epidemiology. Australia is successful in controlling the rate of HIV and AIDS incidence in its country.[175] Why? According to Haldane (2009) the short answer appears to be government policy:

> ``*Australian policy has been grounded in biology and systematic thinking, with evidence-based and preventative policies. Education and prophylactic measures have been widely available. But there have been targeted initiatives for high-risk groups – for example, sex workers and drug users – through subsidized needle and syringe exchanges and free condoms. The results of this program are clear in the statistics*"(Haldane (2009):25).

Haldane found that the Australian approach could be translated to the financial system: it is crucial to target high-risk "super-spreaders" in the financial network.

This gives important lessons to consider when striving for personal data protection too. As I mentioned above, Facebook, Google, Apple and other giant units are such huge forces in the PDC global network. They are the leading powers in the network since they create their own standards and influence the outcomes of the PDC. This kind of units in the PDC to be super-hubs. Super-hubs are also the high-risks to data protection law's enforcement just like 'super-spreaders' in financial network and high risk groups in the HIV contamination network. Inspired by Haldane's work, I suggest to introduce more specific requirements and to monitor them on these super-hubs. The

[175] According Haldane's data, By 1994, rates of incidence in the US were six times those in Australia. By 2003, the per capita prevalence of HIV in the US was ten times that in Australia (See Haldane (2009)).

logic underlying the suggestion is to support the immunity of the PDC as a whole at the expense of 'inoculating' and monitoring, the super-hubs.

Moreover, I have shown that the PDC comprises a complex web of interdependent units that link the nodes to one another and that make some of them emerge as ``hubs", and even ``super-hubs". Hubs are ``super-connectors." They emerge often in small-world networks. And as discussed before, in the PDC, the units, and units-based sub-systems or sub-subsystems interconnect in networks where data, services, dependencies and other forms of information flow, in a manner that allows to consider the resulting system analogous to natural ecosystems where energy, waste and other materials are passing through different nodes, through the local infrastructures. As mentioned, such systems tend to form small-world networks that show the emergence of ``hubs." This enhances their communicative efficiency, but concurrently increases their vulnerability to hub-directed attacks.[176] And much of the behaviors of and in such ``dots" do, when inventoried, show a ``power-law" distribution rather than a ``normal" distribution.[177]

For policymakers, this is an important lesson. At present, policymakers try to the control the PDC's units as much as they can. I do not mean this is wrong. But the approach may leave policymakers navigating in dense fog when assessing the dynamics of the PDC because of the diversities of units. In order to better control the PDC, more attentions should be paid to regulating the hubs. This means the assessment on the efficacy of data protection laws should be atomistic: node by node, or super-node by super-node. More fundamental, the information about the links to one of the nodes should be collected as much as possible. These data are central to understanding the PDC's dynamics.

(iv) A role for agents' incentives

Data Protection policymakers can possibly benefit by analyzing the problem of behavioral incentives. The sketch mentioned hereafter

[176] Barabási & Frangos (2002)

[177] Barabási & Frangos (2002)

is based on and largely extracted from Maskin's paper for his Nobel Prize Lecture (Maskin (2008)).[178] In the paper, he offered an general model of implementation theory, which can be applied to provide recommendations on how to best set the rules (e.g., for data protection) as a function of the data subject's demands and the nature of the relevant personal data community. In this general model, the mechanism design for data protection law is simplified into the following three points:

1. *Desired outcome*: what I mean by desired outcome is naturally dependent on the context. For legal arrangements, seeking to regulate data users' behaviors, the desired outcome is compliance with the law by regulated agents (Maskin (2008):1).

2. *Mechanism and mechanism designer*: A mechanism is an institution, procedure, or game for determining outcomes (Maskin (2008):2). Not surprisingly, who gets to choose the mechanism -- i.e., who is the mechanism designer -- will depend on the setting. In the case of legal arrangement over data protection issues, mechanisms include law, enforcement institutions, and others (Maskin (2008):2). For mechanism designers, I normally think of the legal agencies, both lawmakers and regulators, who enact law and also enforce it. However, as legal arrangements always leave discretionary powers to the PDC, also the PDC can be considered a relevant mechanism designer.

[178] As Page concluded:

> The mechanism-design literature characterizes an economic or political institution as consisting of six parts: an environment, a message space, a space of outcomes, a response function (or behavioral rule) for individuals, an outcome function that maps behaviors into the space of outcomes, and a social choice correspondence: a set of idealized outcomes given the environment. This analytic framework proves sufficiently general to encompass most institutional settings, including exchange economies, networks of banks, and legislative bodies. It can also help to organize our thinking about how complexity arises, why complexity matters, and what we might do to harness complexity for our betterment.(Page (2012))

In this article, I just offered some very superficial knowledge about mechanism design. In the future, I may work on more comprehensive trials to adopt the mechanism design approach to predict complexity.

3. *Problems in mechanism design*: In a world wherein regulated agents do strictly behave according to legal arrangements, optimal rules of data protection would be straightforward: Glachant (1998) suggests that the lawmaker then has only to pass a law mandating this outcome. The role of data regulators then will become senseless too. Yet, we do not live in such a world. Glachant (1998) suggests that lawmakers and regulators do not know which outcomes are optimal in advance, that they have to proceed more subtle and indirect, than to simply prescribe outcomes in a linear fashion.

The problems are exacerbated by the fact that the regulated agents do have their preferences and may not have the incentive to behave in a direction that the law points to (Maskin (2008):4). The gap in incentives is one of the most widely studied aspects using mechanism design techniques and models. Mechanisms must be incentive compatible (Maskin (2008):4). In the context of data protection's mechanism design, much of the work is directed at answering the three basic questions Maskin (2008):4 lists:

1. When it is possible to design incentive-compatible mechanisms for attaining the desirable outcome?

2. What form might these mechanisms take when they exist?

3. When is finding such mechanisms ruled out theoretically?

Although the three questions appear to be simple, it is not an easy task to answer them solely by legal methods. Nevertheless, mechanism design researchers invented multiple models to address these three fundamental questions. Such models may appear as new and sophisticated policy instruments that can combine with both the requirements for studying CASs and the legal instruments to meet the desirable goal of data protection.

(v) Incentives vs learning

We know that CASs encompass non-linear feedback loops. Thus linear models for direct regulation may easily fail. What might be done

to influence or nudge the PDC's emergent behavior? Part of the answer lies in improved anticipating of responses and outcomes, and part in improved control on hubs.

First, to predict the behavior of a CAS contradicts the finding that even the best efforts of the sharpest minds cannot make accurate long-term forecasts about a CAS (Jervis (1997) Watts (2012)Page (2012)). Nevertheless, I agree with what Page argued that some characteristics of outputs and some institutions could predict better outcomes than others, if proper models are adopted and are interpreted cautiously (Page (2012)). Quite similar arguments may be brought to the fore when considering the models, methods and techniques known as ``mechanism design" and ``game theory." These areas are vast. Maskin (2008) provides a useful introduction, and Page (2012) links the basics of mechanism design to the intricacies of CAS-theory. The problems are huge, certainly for a law student, and wide open to further investigations.[179]

One thing is clear, though. Mechanism design and game theory provide models where both agent incentives and information asymmetries are important for understanding and modeling behavioral strategies. Again there remain issues about assumptions that are at the core of these models, often culminating in what requirements are posed on the consistencies in individual preferences and on the `rationality' considered inherent in individual behavioral choices. Nevertheless, like Markov models, the models of mechanism design may be

[179]Mechanism design and complexity theory may at first act in a way that defeats each other's purposes. As Page pointed:

> The former focuses on the equilibria of systems. The standard mechanism-design perspective on institutions can be summed up as follows: institutions produce equilibria; better institutions produce better equilibria. A complexity perspective, while not denying equilibria, admits other classes of phenomena, such as cycles, randomness, and complex dynamics, that can produce large events such as stock-market crashes and the collapse of markets.(Page (2012))

It is not to negate perspectives, although we link the two theories together. Instead, Page (Page (2012)) Axelrod (Axelrod *et al.* (2000)) and Beinhocker (Beinhocker (2006)) have successfully adopted the mechanism design approach to organize thinking about "how complexity arises, why complexity matters, and what I might do to harness complexity for our betterment" (Page (2012)).

moulded into useful tools for researching aspects of CAS behavior.

Yet I think that legal scholarship needs to establish and protect its own identity boundaries by explicitly defending its proper position as addressing autonomous behavior by responsible agents. Where social scientists are on the look-out for knowledge that will nudge such agents into behaving in a way that they want, often unconsciously, legal scholars are interested in knowledge that will support responsible agents to make autonomous behavioral choices, while aware of law and cultural norms -- of knowledge that can be learned.

And a legislator will presumably be best informed, when both types of knowledge and their interactions are made available.

Summary

The CAS theory may help to improve law, specifically data protection law's ability (in the long run) to regulate the PDC units' behaviors and to manage the outcomes of units' behavior's aggregates. Certainly, many other methods such as case study, qualitative, experimental-sort studies are relevant in the study of a CAS. I just try to propose a posture that takes into consideration the fact that the subject matter of the legal arrangement is a CAS, and, as such, the fact presents significant challenges to the endeavor of arrangement design. The strategies proposed in this section do not aim to create a blueprint for legislative work or to recommend imposing legal order synthesizing these strategies. Rather, the effectiveness offered by these mechanism design models could help policymakers to improve their sense of judgement when trying to solve the problems of data protection law.

Conclusions of Part II

In this Part, I investigated, through combining the PDC with the knowledge and experiences from different classes of CAS, whether data protection law's subject matter, as a network of data users, exhibits the characteristics of a CAS and what these imply for the future of data protection law.

The explorative review in Section 3 has provided indications about which kinds of subjects can be understood as CASs. Subsequently, through using some key CAS-properties and relating them to our PDC and its ecology, we are ``informed" that these characteristics apply to the PDC and that thus the PDC can be understood as a CAS. From the CAS perspective, the human-created PDC is a large and dynamic system of interacting data users networked in a particular pattern of organization from which arises the ability to adapt to internal and external changes by self-organization, emergence and co-evolution/learning (Kim & Mackey (2013); Holland (1995)).

Our findings brought challenges to legal arrangements over data protection issues, since these try to tame a CAS. Evidence taken from case studies published in this issue as well as other sources suggested that data protection law's subject matter is (possibly) quite different from other law's subject matters. It faces critical transitions all the time in practice.[180] Thus -- as we continuously have to regulate situations that the legislature could (and did) not imagine when framing the law[181] -- the purposes of data protection law, the reasons for its existence and the modalities of its regulation are requiring methods quite different from those that focus on the interpretation of material laws.

I suggest that future data protection law may be fruitful implemented, which build on CAS-theory's recommendations, since Ruhl has minded us the problems presented in a CAS only can be addressed unless you think like a complex adaptive system (Ruhl (1997)). Thus, the problem needing attention is to adjust data protection law to tally with its subject matter. But how?

Multidisciplinary CAS-theory can help legal scholarship to better inform the legislature on expected risks and outcomes of legislative interventions that address CAS-``dots." In this Part, I suggested some strategies that can be adopted to help legal researchers capture complex adaptive phenomena in the PDC when arranging or regulatory frameworks. These strategies include: (i) the evaluation of expected benefit of legal intervention, (ii) understanding the environment, (iii) the special functionalities of hubs, (iv) understanding

[180] Some induced by innovative and exploding technical (e.g., The 'Cloud'), social/business (e.g., Google, Wikipedia, Twitter, Facebook, SMS, internet banking) and governmental services (e.g., data retention).

[181] Lessig (2006) considers these situations to be legally inherently ambiguous.

agents' incentives and (v) considering the forces of incentives vs learned behavior.

The picture of the data protection law's subject matter as a CAS is an ongoing rather than completed construction. Notwithstanding that our understandings of CAS theory is in a state of evolution, our efforts thus far have already served to deepen our comprehension of many problems that troubled data protection law. And they have operated as checks against some of the mistakes of current data protection laws. It is against this background that I expect that regulation over data-protection issues stands to benefit from being informed through the lens of CAS theory.

Again: I think that legal scholarship needs to establish and protect its own identity boundaries by explicitly defending its proper position as addressing autonomous behavior by responsible agents. Where social scientists are on the look-out for knowledge that will nudge such agents into behaving in a way that they want, often unconsciously, legal scholars are interested in knowledge that will support responsible agents to make autonomous behavioral choices, while aware of legal and cultural norms -- of knowledge that can be learned. A legislator will presumably be best informed, I think, when both types of knowledge and their interactions can be made available in a coherent framework. Complexity theory is a serious candidate for providing it.