Co-Designing Social Systems by Designing Technical Artifacts

A Conceptual Approach

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Abstract Technical artifacts are embedded in social systems and, to some extent, even shape them. This chapter inquires, then, whether designing artifacts may be regarded as a contribution to social design. I explicate a concept of general design that conceives design as the type fixation of a complex entity. This allows for an analysis of different contributions to the design of social systems without favoring the intended effects of artifacts on a system over those effects that actually show up. First, the clear-cut case of socio-technical systems is considered. Here, functions of artifacts can be planned fairly precise. In societies, in contrast, the actual functions of an artifact can hardly be predicted, which is due to strong self-organizing processes. Nevertheless artifact design can be shown to contribute to the design of the system also in this case.

1 Introduction

Different bodies attempt to design social systems. Among them are governments, political parties, media, and economic enterprises, and at the level of individuals: politicians, journalists and businessmen, and also proponents and followers of theories of Social Systems Design (SSD). Besides being formed by such intentional influences, society shapes itself to a large extent via non-intended, self-organizing processes. So the design of social systems, as far as it exists, is probably best described as a hybrid, resulting in part from intentional and in part from non-intentional processes. The dichotomy of intentional and non-intentional design is well known from other areas, paradigmatically from the design of technical artifacts on the one hand, and from the design of biological organisms on the other. With respect to technical artifacts, the design process is an intentional one in which goals are followed. In contrast, there is no intentionality involved in the processes that shape the design of organisms: biological evolution is non-intentional. As outcomes of the different kinds of design processes, there are at least two different kinds of design: one of the kinds is intentional design, as the design of an artifact, which may be laid down in a construction plan,

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provided that conventions exist about how to interpret and to realize the plan, which again is an intentional process. Biological or natural design forms a second kind and should clearly not be understood as referring to intentions. According to neo-Darwinian biological theories, the design of an organism is laid down mainly in its DNA.[1] I take it that the term "design" is used correctly in both cases, despite the lack of intentionality on the side of organismic design.[2] This means that the different cases are assumed to have some important commonality. We seem to refer to a core meaning of "design" that is conserved in both uses of the term. To capture this core meaning, I will develop a concept of general design that includes both intentional and natural design. This will be done in the second section of my chapter.

The concept of general design shall be applied to social systems. It seems most workable to start with well-defined systems. In the third section of my chapter, I will therefore take a look at the design of socio-technical systems. These are systems like factories and similar enterprises that clearly have a prominent technological component. The paradigmatic example of such a system is a coalmine, which was investigated by members of the Tavistock Institute when they first introduced the concept of a socio-technical system. Such a system is made up of the machines, the workers, the administration, and their more or less institutionalized interactions (Trist and Bamford, 1951; Emery and Trist, 1960). The machines may serve functions in the system that would hardly be realizable without them; but the functions alone do not make up the system. Though many contemporary sociological approaches neglect the significance of the materiality of a system,[3] functions crucially depend on a bearer. To make my point, I must refer to early functionalists like Malinowski, Merton, and Parsons, who emphasized the role of the material components of social systems: "no organized system of activities is possible without a physical basis and without the equipment of artifacts" (Malinowski, 1941, 68).[4] However, talking about the functions of the components of a system requires an explication of the concept of function. Usually,

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[1] The neo-Darwinian research program relies on genetic determinism. The perspective had to be broadened by reference to epigenetic contributions to inheritance (cf., e.g., Jablonka and Lamb, 2005). In current biological research programs that integrate developmental with evolutionary processes, the focus is shifted from inherited design to developmental processes, which are now conceived as being at the center of the generation of biological form (Müller and Newman, 2003).

[2] Since biological design is to be conceived as non-intentional, the concept of design discussed here has no affinity at all to the notion of "intelligent design", which has been made the topic of many unfortunate political debates.

[3] Functionalist accounts of social systems that follow Luhmann consider systems as being constituted of communicative interactions only, not of material components (Ropohl (1999) develops a formalized version of an act-focused sociological approach). Likewise, Searle, in his intentionalist conception of society, does not count artifacts as components of societies, though speaking about the assignment of functions to them (1995, 13–23). His ontology of social reality embraces only the following three "elements", as he calls it: the assignment of function, of collective intentionality, and of constitutive rules (1995, 13, 29).

[4] The importance of function bearers is reconsidered in some recent approaches. Callon and Latour's Actor-Network-Theory and Pickering have a strong focus on material agency (e.g., Callon, 1986; Latour, 1988; Pickering, 1995), but their frameworks are hardly suitable for looking for similarities between social and other systems.

the function of an artifact is regarded as being grounded in, or elsewhere linked to the goals of the designer. This seems to be too strong a requirement, since one also talks about functions with respect to components of biological organisms, where no reference is made to any intended goal. The concept of biological function is often based on that of design (e.g., Kitcher, 1993), and the non-intentional concept of general design allows therefore for a definition of functions that can be applied to the intentional case of technical artifacts as well as to possible non-intentional cases of functions in societies.

The structure of a socio-technical system and the functions of its components may come quite close to what was intended by those who had designed it. Therefore, a socio-technical system may be regarded as a designed one without much deduction. The situation may be different for larger social systems, like societies, to which I will proceed in the fourth section. Societies are planned to a much lesser extent than socio-technical systems. Nevertheless, the structure of a society will rely to a considerable extent on planned factors, since it is influenced by the constitution of the society, by laws, institutions, etc. Moreover, the structure of a society will be influenced by the design of the machines used by its members and by the design of the socio-technical systems that are embedded in it. As Merton states, "[n]ew applications of science to production by the engineer … are inescapably social decisions affecting the routines and satisfactions of men at work on the machine and, in their larger reaches, shaping the very organization of the economy and society" (1947, 567). Some of these influences of artifact design on society and some functions of artifacts in society may be intended. Nevertheless, additional, non-intended effects will occur in many cases. Therefore, if such larger social systems are at least in part designed systems, which will be shown in section four, we are confronted again with non-intentional – or at least partly non-intentional – design.

2 The Concept of General Design

There is no canonical conceptual framework that allows us to deal equally well with the different sorts of design that are related to different classes of functionally organized entities. I aim for a unified rather than a separating view: it seems to be plausible that, if we have three or four classes in which function and design go together in a similar way, then a commonality on the conceptual level can be expected. If we do not rely on such commonalities, we forego the chance to learn from one field with respect to the other.

Non-intentional design, being the more general case, can be found in biological systems. Most concepts of biological design focus on the design process (Allen and Bekoff, 1995; Buller, 2002). That reference to the design history is essential is often taken for granted in the case of artifacts as well (e.g., Lewens, 2004, 51–52).[5] At first view it seems obvious to refer to the design process: all important

[5] A different view is put forward by Houkes et al. (2002) but since this approach is applicable in the realm of intentional design only, it is too restricted to account for the partly non-intentional design of social systems.

decisions with respect to the final product are made within this process, and here is the place where goals are considered that have to be met by the product. Consequently I had to refer to the design process in the last section. However, any account that was to *identify* design with the process of designing would have insurmountable shortcomings. First, two convergent design processes may yield the same result. There might be many different ways to come up with the identical design of a technical artifact, like a chair or a combustion engine. The order of many steps in the process may be inverted, processes may branch or some process may bypass another. As long as the processes converge, the result will be identical, and the result matters with respect to the designed entity, not the way by which it was reached. Only the distinction between design and design process allows us to speak about identical results being reached in different ways. Second, we say that the design of, e.g., a car may be modified. This does not mean that the process of designing may be modified in a retrospective manner; even a Huxleyan ministry of truth can only mock a changed past rather than really change it. What we mean when we talk about a modification of a design is that a new design process starts from the results of a previous one, resulting in a different design. So, again, the design of an entity should not be identified with the process of designing. Instead, it has to be conceived as the outcome of the design process (Davies, 2001, 61–62; Krohs, 2004, chap. 4; Krohs, 2007). But what is the outcome? Sometimes, it is assumed to be the structure or internal organization of a complex entity (e.g., Lauder, 1982), but if the design really was the internal organization of the entity, we would also have to talk about the design of the solar system and other organized purely physical entities, because the organization of a non-designed entity does not necessarily differ very much from the organization of a designed entity. Consider cloud streets or sand ripples in the sea as highly organized but non-designed structures, or compare the organization of the solar system with that of a (perhaps very particular) carousel. So design should neither be identified with the process of designing, nor conceived as the structure or organization of a designed entity. Design rather seems to be something that mediates between these two.

If we consider that in technical designing the design may be finished even before the construction of the first prototype, we may regard as the design the result of the design process that fixes the designed entity, or, more precisely, the type of the designed entity. We have to refer to the type and not to a concrete entity since the design is realizable more than once, using different tokens of the component types prescribed in the construction plan.[6] According to this account, the design fixes the types of the components of a complex entity, and it lays down how parts of the respective types have to be assembled to construct an entity of the type that is specified in the design. This explicates a concept of general design.

Design as type fixation of a complex entity involves the type fixation of its components and the fixation of how to arrange them. There has to be a link

[6] Accordingly, the term "prototype" is confusing since it often applies to an experimental, but nevertheless concrete, entity. In this sense, the prototype is a proto-token rather than a type.

between type fixation and token. In the case of intentional design, this is a convention, as can be seen from the code used to fix the type of a screw. In the case of biological design, this link will be, e.g., the genetic code, linking DNA structure to amino acid sequences. So even in the case of a non-intentional design process, here an evolutionary one, we may speak of design in the sense of type fixation. Therefore, conceiving design as the type fixation of a complex entity allows for a unified theory of design, applicable to intentional and to non-intentional, i.e., biological cases.[7] The non-intentional case is also relevant with respect to the design of societies, so I will come back to it in the fourth section of my chapter.

Let me point at the difference between a designed and a non-designed entity with respect to the differences in the way in which the components the entity consists of are assembled. A non-designed entity, if it has a stable structure like an atom or a solar system, comes into being by a process of self-assembly. All the components are in place because of their individual physical or physicochemical properties. We may therefore speak of property-determined components. In a designed entity, in contrast, the components are in place not because of a physicochemical selection for their individual properties in a self-organizing process, but because their type is fixed in a design. If the type of a screw is fixed as, say, M6x1x15 made of brass, the screw in the complex entity will be of this type because it was chosen according to the type fixation in the construction plan. Neither are the physical properties of such a screw sufficient to bring it in the place it fits into, nor would anything but the type fixation prevent a screw from steel instead of brass being mounted. In most cases, even a slightly longer screw would fit; hence it is not the individual properties of a component but the design that fixes its type.[8]

3 Design of Socio-Technical Systems, and Functions of Artifacts

I have introduced the concept of general design with reference to technical artifacts and, as an example for the non-intentional case, to the design of biological organisms. Now the question is whether the concept may be applied at the level of

[7] A more detailed account of this concept of design is given in Krohs (2004; 2007).

[8] There are many cases in which not all the parts of a designed entity are type-fixed. In addition to type-fixed components, such an entity may have property-determined parts, such as the molecules of the air in certain gas springs etc. Seventy-eight per cent of the gas molecules will be of one type, twenty-one of another, even without a type fixation. In many other cases type identity may occur without being a sufficient reason to ascribe type fixation. Some kind of sediment may consist of almost type-identical particles, but they accumulated just because of their individual physical properties that led to selective sedimentation under conditions that happened to occur. There was no design prescribing this type. The particles of the sediment are property-determined, not type-fixed.

social systems as well. Instead of considering whole societies, I will stick for the moment to the more clear-cut case of socio-technical systems. Besides being of interest in their own right, these systems may be regarded as a model of selected aspects of societies and form themselves components of societies. A socio-technical system may realize quite accurately the structure and functions that it was set up for. We may conceive such a system as being designed in the following way: The systems designers have fixed the types of machines that are used and have defined which qualification the individuals who are running the machines must have. Moreover, the designers have prescribed which communication- and decision pathways are to be used, etc. The components of the system are type-fixed: type-fixed devices, type-fixed man-machine interfaces, "type-fixing" jobs for workers (vacancies are filled only with persons of the qualification wanted), and type-fixed social institutions. Moreover, the proper arrangement of all these type-fixed components is laid down and may be used to set up, run, and adjust the system. This means that a socio-technical system is a designed entity as defined in the type fixation account of design presented above.

Type fixation within a socio-technical system occurs on different levels. On the highest level, the type of the system as a whole is fixed, e.g., being a certain type of coal mine or of a power plant. This involves a fixation of the types of the components of the system and of their arrangement. Some of these components are machines, and at least with respect to these, another level of type fixation is involved. They are themselves type-fixed complex entities and may be designed completely independently from their possible use in a certain socio-technical system.[9] The question now is whether and how the design of the machines contributes to the design of a socio-technical system they are components of: Do the type-fixed parts of the machines themselves constitute parts of the socio-technical system? And if so, are they type-fixed components of it? First, the design of the socio-technical system usually will not explicitly fix the types of the components of the machines. It will fix the types of the machines only, and these, being designed entities, will have type-fixed components. With respect to the first question we should say that it is obviously impossible that a type-fixed subcomponent, i.e., a component of a component, of a socio-technical system is present only in the machine, but not in the socio-technical system the machine belongs to. So the part of a machine that is part of a socio-technical system is itself part of the system. But are these parts type-fixed components of the socio-technical system? The design of the socio-technical system explicitly fixes the types of the machines only, not the type of their components; but by this type fixation, we implicitly refer to the design of the machines. Without the design that fixes the types of their, the machines', components, the machines would not exist. So one can say that the design of a socio-technical system implicitly fixes the types of the components of its type-fixed

[9] I will stick to the case of artifacts since I am interested in the contribution of intentional design to the design of social systems. In addition, biological type fixation is to be found with respect to the individuals working in the system, in as far as they are biological organisms.

components, and that the design of the machines is part of the design of the socio-technical system. This means that being type-fixed, in this case, is transitive: a type-fixed component of a type-fixed component of a system can be regarded as being type-fixed with respect to the whole system as well.

The type-fixed components of a socio-technical system, and again their components, are not only supposed to be present in a system; they have also to fulfill certain functions in the system. Only the functioning will show whether the design proves successful and therefore has to be judged when assessing a design. Again, the concept of function, like that of design, is highly controversial (cf. Allen et al., 1998; Buller, 1999). As I have pointed out, it may be linked to the concept of design. Accordingly, the concept of general design allows for a straightforward definition of the concept of function. We may simply combine a Cummins-like causal role account of functions (Cummins, 1975) with the design concept, and end up with the following explication: a function is a contribution of a type-fixed component to a capacity of a system that is the realization of a design (Krohs 2004; 2007). "Contribution" is to be taken with a dispositional meaning, as in Cummins (1975).[10]

So a function is the role that a component has according to a design, where it is not asked whether it was designed *to* have this role. As in the case of the design concept, this concept of function is applicable to functions of components of intentionally designed entities and to functions of components of naturally designed entities. Precondition is only the ascription of design in terms of type fixation.

We have seen before that type fixation is transitive in the cases under consideration. A type-fixed component of a technical artifact is likewise a type-fixed component of the socio-technical system to which the artifact belongs as a type-fixed component. Functions may also be transitive, but this does not seem to apply generally. Malinowski gives an example of how the subcomponents of components of social systems may effect a social system by referring to biologically designed components: "such processes as breathing, excretion, digestion, and the ductless glands [i.e., the hormone glands] affect culture more or less directly" (Malinowski, 1941, 68). Although we see this influence of the effects of components of higher components of a system on the embedding system, we should be careful to regard this as a transitivity of *functions*: The excretory organs of humans will not function as the excretory organs of society, nor does epinephrine make society ready to perform a flight reaction. Instead, the functional subcomponents will contribute to other capacities of the higher system, e.g., to agricultural production *via* the production of fertilizer, or to certain social dynamics. Similar considerations may hold with respect to the functions of components of technical artifacts within societies.

[10] This definition of function overcomes the two basic shortcomings of Cummins's concept: it is not applicable to purely physical entities, and it allows for a definition of malfunction since reference to design introduces some normative instance. It does not run into the definitional circle etiological accounts of function such as Millikan's (1984) must envisage when referring to design (Krohs, 2005). In addition, the concept allows for a definition of historically established functions, hence for reference to selected functions almost as Millikan's approach. Details will be given elsewhere (Krohs, 2007).

It might be more likely than in the organismic case that many functions of subcomponents really are transitive, but other type-fixed subcomponents may assume new functions in the socio-technical system.[11]

According to my account of function, components of a socio-technical system may have functions not as such, but only within the system. These are the contributions of the components to the capacities of the designed entity. For example, workers fulfill different professional tasks; machines serve different functions in a production process. These latter systemic functions of machines within the socio-technical system are functions of artifacts-as-wholes. These functions only emerge on the level of a system embedding the artifact. Though it is quite common to qualify functions with respect to an embedding system, some scholars also want to allow for the ascription of functions to context free artifacts. Achinstein, e.g., explicitly denies that an ascription of a function to an artifact refers to a system the artifact belongs to: "To understand the claim that the function of that mousetrap is to catch mice one need not identify or be able to identify … any system within which … this is its function" (Achinstein, 1970, 350). I explicitly disagree with his view and here follow Preston and others instead. Preston points out that artifact functions of one kind are directly based on their systemic role and that functions of the other kind, Millikanian proper functions, at least started off as systemic functions (Preston, 2000, 32). So Achinstein's mousetrap has its function only in a system in which somebody may use it – with or without success – for catching mice. If the device is not considered to be part of such a system, it does not have the function. One might try to evade this consequence by reference to intended functions; but if the device only *shall* have a function according to the intention of the designer and is badly designed and does not work, we may say that it does not have this function but has *only* the *intended* function to catch mice. So a merely intended function is not a function, like a forged coin is not money.[12] A statement about an intended function is a statement about a goal of a designer. He may or may not succeed in implementing the intended function as a function of a component of the designed system. The intended function of a machine could even be something such as doing work without consuming energy, despite the fact that nobody will be able to realize this function. The designer can fix only the types of the components and their relation with respect to each other, but not the functions. The functions will show up in the operating system. The function of an artifact-as-a-whole depends on what it does and how it is used in the system it is embedded in (for the use-aspect, cf. Houkes et al., 2002). Hence, just as functions of components of artifacts are defined with respect to capacities of the artifact as a system only, functions of artifacts-as-wholes refer to capacities of the embedding system.

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[11] Settling this question requires further elaboration, which cannot be achieved within the limits of this chapter.

[12] Within the conceptual framework applied here, the concept of an intended function may be explicated as follows: the intended function of a type-fixed component of a complex designed entity is the role that the designer supposed it to fulfill when fixing its type. Please observe that the designer's supposition does not imply that the component actually has the capacity to fulfill its role.

4 Elements of the Design of a Society

When considering well-defined socio-technical systems, we may be dealing with almost completely designed entities. The matter changes when the scope is widened to encompass larger sociological entities such as whole societies. Again, artifacts are important components of these systems; but we need to determine how far the design of technical artifacts co-designs a society. The concept of general design singles out two ways in which design determines a complex system: type fixation of its components; and determining the construction or assembly of the system. Only the first way of determination by design obviously applies in the considered case: A machine is a type-fixed component of a society in which it fulfills a role since it is (i) type-fixed by the machine design and (ii) conceived as a component of the society according to any approach that allows for the materiality of at least some components of social systems. In this way, the design of technical artifacts could contribute to the design of a society if the latter can be defined at all, something which still has to be determined. However, the second way in which a design specifies a complex entity is related to its assembly and the mutual relationships of its parts. This determination of the assembly usually works well in the case of intentional design, where it is laid down in the construction plan. In societies, in contrast, assembly is governed largely by processes of self-organization. Although this shows that the assembly is not governed by intentional design, it may still be based on non-intentional design.

Therefore we need a criterion for judging whether the assembly process of a system is governed by a design. Such a criterion can be found in the set of the systemic roles that are realized by the components of the system: The assembly can be regarded as the result of design only if the actual roles of the components are derived from a design and therefore may count as functions. In this respect, we can say quite clearly that many technical artifacts assume roles in societies that were never laid down in any design. Let me consider the new Airbus A380 as an example of the influence of artifact design on the design of society. It was designed to transport large numbers of people on a limited number of fixed routes. Availability of airport facilities, airline policies, and the preferences of prospective passengers will or will not result in the realization of this intended function; but in any case, designing the A380 has contributed to the design of societies. It opens not only new possibilities of mass transportation but provides jobs, induces activities in building larger runways, requires intervention into nature in order to build these runways, raises social opposition against these interventions and against taking long term risks with respect to environmental issues and to possible human and technical errors and perhaps against the influences of this kind of mass transportation on everyday life, etc. But the role of the A380 in society as it will be realized after delivery of a number of units is not yet known and cannot be planned completely. Designing such an artifact co-designs society, but does not necessarily end up with the intended result. Not roles of artifacts, but only the material components may be directly designed. The same holds for the design of institutions. Therefore, actual roles may not be conceived as functions of an artifact, which would require that they are determined by a design. But no instance can be singled out that fixes the roles that actually show up; there are important interactions in societies that are not designed.

Social Systems Design (SSD) nevertheless tries to determine a social system exactly on the level of such interactions and mutual relationships between components, and to institutionalize all acceptable interactions within the system. This seems only to work in small systems of cooperative individuals, e.g., in educational systems in a benevolent environment, where, in addition, the number of involved artifacts is very limited and interactions are almost completely social (e.g., Banathy, 1998). With systems that have a strong material basis it also seems to work in cases where the technical component of an organization can be factored out for other reasons so that the isolated "soft system" can be addressed (e.g., Checkland, 1981); SSD does not seem to work with respect to large systems such as whole societies (Laszlo, 2001). One of the reasons is the unpredictability of material agency. Pickering states that "[n]o one knows in advance the shape of future machines and what they will do" (Pickering, 1995, 15). Pickering's statement must be interpreted in the wide sense, which includes that one even can hardly know what present machines will do in the future. We may say that the less strictly an assembly of a component-wise type-fixed entity is determined by a design, the more incomplete is the design. Social systems, even in cases where their components are type-fixed, are thus less completely designed the more they are shaped by processes of self-organization as long as these processes are not already taken into account in the design.

"Design", in the case of societies, obviously does not refer to a single and coherent plan that rigidly determines the system, but merely to an inhomogeneous set of possibly isolated design elements. There are type-fixed components – among them artifacts, like cars, computers, and buildings. These artifacts assume certain roles in societies. Humans are also components, serving roles as family members, as professionals and as volunteers for different tasks. As in the case of socio-technical systems, we have to take into account many but not all of the places that humans occupy as places for individuals as components of the society. The places themselves are partly fixing the type of their occupants, which here means their profession. This type fixation contributes to the design of a society. Governments and administrations are type-fixed by their constitutions, as is the interaction with and among them using more or less rigid official channels. This list could be expanded almost without limits, but as many components as we might wish to add to this list, we will never end up with an account of a design that determines society to a degree comparable to the determination of a technical artifact or a socio-technical system by its particular design. There are at least four major differences:

1. The design of a society will always be incomplete. Not all components of the social system will be type-fixed and presumably only a small fraction of them is. Humans do not only exert type-fixed positions (instead, they will engage in

numerous different self-imposed tasks), nor are all their acts institutionalized (they will interact as well according to free and deliberate, though bounded, choice). And nothing else would be compatible with human freedom.

2. The type fixation that can be found in society will be a highly dispersed patchwork: the designs of related components of a society may originate from completely different sources and may be realized independently rather than in a coordinated way.
3. These pieces of design are subject to continuous change, which again may be uncoordinated: in newly designed socio-technical systems, which form components of the society, machines may be used for functions they were never designed for. In the case of type-fixing positions, the individuals who exert these positions may modify the type fixation and by this mediate a deviation of the society from its previous design.
4. Societies are, to a high degree, self-organizing instead of assembled according to a plan and may be dependent largely on contingent side-conditions. Therefore, the actual role of a type-fixed technical artifact will often deviate from what its function would be according to any design of a system it belongs to.

5 Conclusion

I have introduced a non-intentional concept of design that is defined in terms of type fixation. A designed entity is a complex entity that is type-fixed component-wise. This allows for a unified view on the design of technical artifacts, biological organisms, socio-technical systems, and, in part, societies (as well as of ecosystems, which I did not take into consideration here). Technical artifacts may be used as type-fixed components of designed socio-technical systems. Therefore, the design of a technical artifact, being its component-wise type fixation, contributes to the design of these systems. But technical artifacts are also components of social systems on the even higher level of societies. They may belong directly to a society as their immediate components, or indirectly as components of socio-technical systems. Therefore, artifact design influences the design – the type fixation of the components – of a society. However, societies are to a large extent self-organizing systems. In a self-organizing system, the design of the components determines the system only to a minor degree. It rather opens up possible outcomes of the self-organization process. Therefore, the type-fixed components of a society may contribute to its design, but the design of a society will only be a piecemeal and incomplete design.[13]

[13] That society is based on a piecemeal design, of course, does not mean that "piecemeal social engineering", which is restrained to ad hoc-reactions on emerging problems that are conceived as being more or less isolated (Popper, 1971), is the desirable method of social reform.

With respect to the concept of function, the incompleteness of any design of a society is confirmed. The concept of function was linked to the concept of design: the function of a component of a designed entity is the role – not necessarily intended – that the component assumes in the system according to the design. *Intended* functions are goals of designers that are not necessarily met by actual functions of components. So again, the design of artifacts merely co-designs society. Their actual functions need not coincide with intended functions, and many roles that a technical artifact may assume are not determined by the design of any social system, and therefore cannot be classified as functions. The design of societies is always fragmentary, may change piecemeal, and interferes with non-intended processes of self-organization. It seems to be impossible to design all the relationships between the components of a system. Failure of SSD in many cases is therefore not only – and perhaps even not primarily – a consequence of the complexity of the social system, but of the fragmentary character of the design of any society, and in addition of the neglect of the material components of social systems in the attempt to design functions directly, without focusing on their bearers.[14]

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