Chapter 4: A preliminary terminology

In this chapter we take a step back from the description and analysis of systems and the history of their development to consider the wider nature of the problem we are addressing and the scope of our enquiry. To achieve this we must also provide working definitions of some of the key terms we will be using and to map out some of the disciplinary contexts that have contributed to the approach we are presenting. Following chapters will provide much greater detailed definition and analysis.

This book is about the *architectural discourse of socio-technical systems*. In particular, we examine systems that provide the information infrastructure to support the delivery and governance of health and social care, in complex mixed economies which involve public, private and charitable agencies. The term "socio-technical" was coined by Trist and Emery in the middle of the 20th Century. It was originally concerned with the combination of human agency and technological means in the context of the industrial workplace. As we observed in the first chapter, the pervasive nature of media, information and communications technologies, to which we will now add automation which has now spread from the factory to the home the highway and indeed, to all aspects of life. We have been using the acronym: AMICT to refer to this inclusive category of information related technologies. The consequence of this march of technology is that all aspects of social and cultural life as well as economic activity now fall within the ambit of the socio-technical and we must re-examine some of the assumptions that underpin this term and of a number of others of which we assume we have a shared understanding but which we will need to use with particular care and precision in this exploration.

We will start by examining the conventional approach to the meaning of "technical system", or, more precisely, an open technical system, as a collection of mutually interconnected components which we observe and represent, existing in and interacting with an environment. The relationships between such components are functional in that the outputs of some form the inputs to others and the relationships between inputs and outputs, whether internal or involving the environment, exhibit some causal regularities; they are, to this extent, systematic. This description which, for the moment, we will consider from a narrowly determinist technical perspective, does not preclude complexity or chaotic and inherently unpredictable overall behaviours but is, nevertheless, concerned only with the observation and explanation of state and behaviour. Technical systems of this sort can, in principle, be explained in what Dennett refers to as the physical stance, that is to say that, in the contexts of its "physical constitution … and the physical nature of the impingements upon it" and we can use our "knowledge of the laws of physics to predict the outcome for any input." Even when our predictions become probabilistic, such an approach can, as Dennett observes, be extremely cumbersome and expensive. As an alternative, we can have recourse to the concept of purpose and

adopt the design stance. This explanation of systems is based on the assumption that their structure and behaviour are the outcome of some design or, in the case of natural systems, evolutionary process.

The inclusion of a social element in such systems, however, means that some of its components, that is to say, elements that are considered internal parts, are people. Again we must be very explicit and precise in our terminology: by "people" we mean members of the species Homo Sapiens Sapiens. This is the organism that (a) knows that it knows (b) knows that the other members of its species know that they know and (c) that knows they know it knows this and acts accordingly. This is the root of inter-subjectivity, language and of human society. These aspects of the socio-technical system are amenable to explanation in the intentional stance, which entails "treating the object whose behaviour you want to predict as a rational agent with beliefs and desires and other mental stages exhibiting what Brentano and others call *intentionality*."

 We are not adopting the intentional stance for reasons of mere efficiency of description and explanation, however, the term "socio-technical system" implies that purely mechanistic or functional accounts are insufficient to say all that needs to be said about the interactions and relationships that comprise some of the components these particular systems. If we are to consider people as components (and denizens) of systems we must incorporate the concept of cognition and of mind into our conceptual framework. Here we are distinguishing between the functioning of a brain, as a set of phenomena observable by scanning and the experience we have of consciousness, of thinking and of communicating; this is to say we adopt a phenomenological as well as an empirical perspective.

We take minds to be the platforms for the emergence of "selves", that is to say, individual and collective psyches which produce the internal phenomena we experience as drives, motivations, judgments, empathies and intentions as well as externally observable individual and collective actions and responses. We cannot exclude the concept of the awareness of self and of others in the design and interpretation of socio-technical systems and an expressively adequate architectural discourse of such systems requires a significant extension to the functional-determinist framing of purely technical systems with which we started this discussion. So, in our consideration of these systems, we are forced to include intentionality and the relationships between intentions, actions and out comes or consequences, explicitly and to treat them with a similar rigour and precision as our treatment of the more familiar systematic concepts of function, capability and capacity.

Before we continue our examination of the concept of the socio-technical, however, we must first be clear and explicit about the meanings we are attaching to three other terms, namely: "architecture" or more precisely, "architectural discourse", "infrastructure" and "information". Each is used in many different disciplinary contexts and has subtle, or sometimes quite significant differences of meaning across them. At this stage, we will adopt a philological approach to explore some of these variations of meaning and usage. This focus on language and communication will be a characteristic of the approach we are taking throughout the book. It is also a

notable feature of Ackoff and Emery's approach[1] in which they take various groups of terms which they state are "often used interchangeably in the literature" but which can be applied more rigorously to establish and maintain a set of significant and useful underlying conceptual distinctions. Often these distinctions can only be clarified by making explanatory levels explicit in order to avoid reductionist confusions. By "explanatory level" we mean the position within the sequence of epistemological stances that commences with logic and mathematics, through physics, chemistry, biology and physiology to the "higher" set of conceptual framings of autonomic responses, cognition and mind, ego-centric and allo-centric psyche and ultimately to the socio-cultural. It is precisely this sequence of disciplinary framings which is partitioned in Dennett's three stances alluded to already.

Much of the puzzlement and confusion we find in policy making and management of care, and in the design of information systems to support caring services, can be traced to the use of the same terms at differing levels within this sequence and the miscommunications and misunderstandings which inevitably result. The clearest example of this is to (reductively) consider "care" to be the delivery of a defined process and the consumption of certain resources rather than as the outcome of relationships and, as we will see later in this chapter, the fruition of shared intentions.

Architectural Discourse

"Discourse" relates to both the processes and products of the use of language and here we are particularly concerned with pattern languages[2] and diagrams as well as texts and speech. When a language is used purposefully some of its elements remain stable while others inevitably evolve and are transformed. If we consider language to be alive in this way, then our concept of discourse has to be a dynamic and reflexive one: we must continue to re-evaluate what we are saying and meaning as part of our basic method.

The qualifier "architectural" presents us with a greater terminological challenge. It appears in many different contexts and with a wide range of meanings and connotations. We can consider these from the three quite distinct perspectives of (a) the Arts and Humanities, (b), Engineering and Natural Sciences and (c), from that of Critical Social Sciences. In the first of these, the emphasis is on aesthetic and utilitarian considerations. Here, architecture is concerned with the relationships between the structures and processes associated with human constructions and productions of all sorts and the affects and effects they produce in us both individually and collectively. From the perspective of the humanities, these constructions may belong to the plastic or performing arts, the built environment or to literature.

In Engineering and the Natural Sciences the emphasis in architecture is on specification and explanation. Here the purpose of architecture is to be precise,

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[1] On Purposeful Systems, Russell L Ackoff and Fred E Emery, Tavistock Publications, 1972

[2] Cf. Christopher Alexander

consistent, unambiguous and effective about all the observable aspects of proposed designs and constructions or of presenting phenomena. We speak of the architecture of constructions such as bridges, buildings or computers and also of the architecture of naturally occurring things, particularly complex biological ones such as cells, organs and complete physiologies which, as we have observed in Dennett's design stance, we have a tendency to analogise as having evolutionary "purpose". The former is a prescriptive use of the term while the latter is a descriptive use and it is important to maintain the distinction between these two uses of architectural representations and discourse.

In critical Social Sciences, architecture is usually seen as an aspect and consequence of power and control. Asserting the role of architect places others in the roles of client/problem owner, implementer or user, demarcating and allocating rights and resources accordingly. In these contexts, it may be associated with the display of status and values, producing the affects and effects of the view from the humanities while, at the same time, allocating responsibility for engineering and design.

We explicitly do not position our use of the term architecture at any single point in these traditional disciplinary spaces but return to basic etymology for what we believe is a more useful insight into the problems we are exploring here. The word architecture is based on two roots each of which has two meanings: "archi", refers not only to chief or leading but also to the preceding or prior. The term "techne" refers to material or stuff and also to the exercise of skills and know-how, that is to say, "technicalities". So, as well as the concept of the chief or most important work or material we have the idea architecture as that which is required to be addressed *before* we begin to exercise arts and crafts or get down to the technicalities and consider ways and means. In this approach, we must relate to all of the different nuances of meaning across all of the disciplines and interests that have a stake and also consider the preconditions of a discourse that has the potential to relate them all together. The issue here is that in any realistic and, therefore, complex, ambiguous and contended human enterprise, many different skills and technical domains come into play as do different perspectives, priorities and values.

Systems of care and its governance

We identified the focus of our attention as *infrastructural systems that support the delivery and governance of caring and developmental services*. Here is another set of terms which require at least preliminary definitions if we are to be precise and to avoid misunderstanding. The approach presented here has been developed over a considerable period of action research and consultancy in health, social care as well as in education and development and was particularly, but by no means exclusively, concerned with the design and use of information and communications systems and services. This has been undertaken in the context of mixed economies which bring together various networks and combinations of public, private and charitable enterprises working sometimes in competition, other times in partnership and yet others in relationships of procurement and commissioning, governance and control. It is this heterogeneity, and the fact that our work was associated with the processes of formation of new inter-organisational relationships rather than in conventional

hierarchical structures, that has forced us to adopt the reformulated concept of socio-technical architecture that we describing.

We will now consider the term governance, and the related ones of operation and management, as we intend to use them in this discussion. The usual connotation of governance is one of control on the basis of explicit rules, standards and procedures; this, for example is the usual connotation of the term "information governance". While this is unavoidable, and it is not appropriate to try to invent some other term in this context, we must be very clear about the level of abstraction we are applying in our use of terms such as "operation", "management" and "governance". We take the fundamental distinctions between these roles and responsibilities to be the following:

a) Defining and maintaining or modifying the mission, ethos and principles under which an enterprise (i.e. a purposeful socio-technical system) will operate and evaluating whether the current rules and procedures, and the outcomes they are producing, continue to meet them, are the rights and duties of governance. This corresponds to defining and maintaining the intentions of the enterprise.

b) Ensuring that the current rules and procedures are able to be, and are being, followed and gathering, organising and presenting the relevant evidence or accounts accordingly, is a matter of management.

c) Knowing and following the rules and procedures is an operational duty.

Thus, governance asks the questions: Is *this* what we intended, do we still intend *this*? Management provides the exhibits and data which are the subjects of these questions. Governability is a property of an enterprise and implies that it is operating in a context that enables and supports the conversations of, and between, management and governance.

There are, however, many different ways of distributing or allocating these abstract rights, responsibilities and duties to individuals within an enterprise. At one end of the spectrum they can all be shared by everyone, while, at the other, we can have the traditional bureaucracy where they may be demarcated and distributed over many hierarchical levels in which operatives are managed externally by the imposition of rules, procedures and targets and managers, in turn, are externally directed. The former situation does not necessarily represent an absence of, or alternative to, governance or management but may be an example of self-management and governance and this can be made very explicit and visible, as part of the mission statement and ethos of the enterprise, or can remain implicit. The ability to make use of this abstracted approach becomes essential when we consider the notion of an enterprise or institution which has the purpose of delivering care and we argue that, if such institutions are to remain ethical, effective and viable there must be at least some elements of self-governance and self-management, by carers and the cared for, of their caring relationships. This represents an example of responding to a rhetorical aspiration about ethos such as: "we expect our carers to display love, dedication and vocation" by mapping these terms onto the exercise of elements of self-governance and self-management as a preliminary stage to the definition of operational

procedures and practices. As such, this represents an example of the "archi"-"techne" we have been discussing; it is a process of signification which asserts that "love", "dedication" and "vocation" count and how this counting is to be operationalised in processes of self and shared evaluation such as participation in an embedded "learning community". It is a move that bridges a rhetoric of governance – as we have defined it here – to the design of concrete regulatory and operational systems and the explicit distribution of responsibilities over functions and capacities. It is in strong contrast to the more usual approaches of going straight from rhetoric to the technical processes, that is to say, from rich pictures of "requirements" directly to designs or the demand for standardised use cases as the concrete input into a functional design process assuming that the processes of governance can be regarded as completely separated from those of specification and design.

We will consider the relationship between rhetoric and systematisation in further detail to develop this key argument about the nature of care and this will lead us back to the consideration of intentionality. When we bring together the two terms "system" and "care" we generate a phrase which we must take to be ultimately, and paradoxically, oxymoronic. Whilst care, as a human relationship, certainly involves processes and mechanisms which must be planned, performed and managed in systematic ways, we maintain that care, as such, cannot be completely reduced to a process or mechanism. The intentionalities of care are an irreducible part of what counts, for the carer and the cared for, as care. Even if they do not agree, their respective intentions and interpretations are still significant determining factors in the characterisation of their relationship. What the parties mean to do is important as well as what they actually do, or fail or choose not to do, and what the actual consequences turn out to be. Another way of stating this is that the inter-subjective nature of care, as a human relationship, is inescapable: an exclusively functional approach is not enough: care belongs to the same class of concepts as leadership, which, according to Ackoff[3], is an aesthetic activity. This is in contrast to the conventional concepts of business process or scientific enterprise where intentions, values and meanings are taken to be standardised, are well understood and can safely remain implicit in an architectural discourse which can be limited to the functionalist-determinist framing of use cases and business logic. In the simpler settings if intentions or meanings become ambiguous and contended they are subject to clear authority and are decided, in the world of business, by the board of directors, the shareholders and the market while in the world of science and the academy, truth and value is established and decided, at least for the time being and in the current paradigms, in peer reviewed journals. Such external or hierarchical arbitrations are problematic when applied to the intersubjective relationships of care. If they are the only recourse that is made available then the outcome is at best policing and surveillance and at worse, oppression and abuse. Thus, in the case of systems of care, we have arrived at an upper boundary of standardisation and of systematisation: they represent contexts which include elements which cannot be

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[3] **A SYSTEMIC VIEW OF TRANSFORMATIONAL LEADERSHIP Russell L. Ackoff**
http://frank543.homestead.com/Ackoff_on_Leaders.pdf

quantified and measured as outputs but must remain outcomes that are, and can only be, the subject of the ongoing sense-making and evaluation of governance.

Functions and conversations

We have identified the problems associated with a purely functional analysis as the starting point for a systematic architectural discourse in the context of the socio-technical. Before we can offer a working definition of a system and environment of care, we must identify an alternative root concept which addresses the methodological challenges we have discussed. The key requirement we place on this concept is that it embodies and maintains the link between specific shared intentions, which are embodied in norms and institutional conventions, and situated actions and interactions (or, using the precise philosophical term, extensions, a term which refers to real things or behaviours that can be observed and measured). As we have introduced in the discussion of chapter 2, the concept that has proved most appropriate and useful here is that of "conversation[4]" but, again, we must be clear about the level of abstraction we are adopting if this term is to do the work we require of it. We will be developing more detailed analysis and some more formal "conversation theory" in later chapters, but at this stage we must be clear that we typify a conversation by naming a set of roles, such as doctor – patient, and providing a normative definition of them and their relationship in terms of significance, mutuality and the distribution of resource and initiative. Thus, in our doctor patient conversation, what is at stake for the patient is health and wellbeing whereas what is at stake for the doctor is associated with a sense of purpose, professional standing and making a living. The norm is that the doctor takes higher responsibility for the wellbeing of the patient than vice-versa and, thus, both the significance and mutuality of this conversational relationship are asymmetric. The dynamic and emergent nature of this concept of conversation is underlined by the observation that the doctor's conversational intervention might be to urge the patient to change his or her attitude to taking care of themselves: a conversation may be about, and modify, itself as well as about presenting situations and processes. The conversational asymmetries are reflected in the fact that the doctor has to be qualified and certified and have access to the required clinical knowledge, skills and resources but, in terms of initiative, the conversation is usually initiated by the patient in primary care, and closed by mutual consent or by the doctor.

We have presented an example of modelling in terms of conversations in previous chapters and have examined examples of the sort of work that conversation theory does in the consideration of the secondary use of clinical data generated in the conversation of care. Such uses represent the composition of conversations. We can take the example of a research hospital where the doctor - patient conversation may

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[4] One set of philological roots for the term conversation dating back to 1340 are from Old French conversation and from Latin: conversationem (nom. conversatio) "act of living with," prp. of conversari "to live with, keep company with," lit. "turn about with," from L. com- intens. prefix + vertare, freq. of vertere (see versus). Originally "having dealings with others," also "manner of conducting oneself in the world;" specific sense of "talk" is 1580.

be composed with an experimenter – subject conversation. Comparing the significances and mutualities here exposes a conflict of interest which is resolved through the introduction of another set of roles, responsibilities and conversations with the ethics committee and the introduction of some new information items or "instruments" such as the approved protocol and the consent form. This separation has been institutionalised rather rigorously since the 1970's when a series of scandals involving the abuse of patients without their full knowledge of the implications of the procedures or their consent, in the context of medical research, led to this sharp demarcation between learning and delivering in the clinical enterprise. The more recent concept of the "Learning Healthcare System[5]" represents an attempt to bring these two sets of relationships and processes closer together in the face of the needs for research and innovation particularly in the context of the complexities of multiple, long term conditions and co-morbidities and community health. This is a clear example of the need for an improved architectural discourse which goes beyond the conventional determinisms and rationalisations and innovates new sets of complex dynamic relationships.

We now consider the implications of introducing this sort of analysis of intentionalities on architectural practice particularly in the area of the application of AMICT which we treated from the historical perspective in the first chapter. Current, applications oriented approaches are based on the consideration of required functionalities, of the nature of the resources that are allocated to perform them and of the capacities which need to be delivered in response to estimated and experienced demand. These three systems perspectives, function, capability and capacity, have, for the most part, proved an adequate basis for the architectural discourse concerned with the relatively simple and unambiguous contexts of commerce and science and the creation of what is often referred to as "enterprise solutions". Here, as we have observed, we can safely limit our considerations to the domain of extensions while intentions can be assumed and left implicit. We have argued that the design of "systems of care", however, represents a somewhat contradictory enterprise: on the one hand, we must systematise because we have responsibilities to build, legislate, manage and deliver vital service in the real world with, and to, real people. There are important things at stake which must be accounted for. On the other hand, however, the systems which are the subject of our co-design, legislation, management and service provision must ultimately remain open and free to develop and innovate, if we are to have grounds for claiming that what they are supporting is care rather than merely monitoring and policing a set of externally predefined and imposed rules and targets.

The concept of Infrastructure

The original concept of the communications service which we discussed in the first chapter evolved to the point where there was a clear recognition of the boundaries of responsibilities above and below a horizontal conceptual demarcation between

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[5] *www.**learninghealthcare**project.org/LHS_Report_2015.**pdf***

infrastructure and the structurations[6] that it enabled and supported. We will now use these concepts to address the problems of the limits to the systematisation of care and the construction of caring systems and environments.

The term "infrastructure" is another one that is used in many distinct disciplinary settings and has many corresponding meanings which are related but not identical. The key aspects of the concept of infrastructure as we are using it here are:

- It represents available and reusable resource and capacity which supports multiple instances of some more or less standardised type of activity for a community of users under a set of norms and conventions.

- There are some degrees of freedom in the detail of the supported activity which leaves room for innovation in use. This is in contrast to the application oriented approach which is intended to support only the mandated use cases, business processes and logics.

Systematisation of infrastructure can be taken as part of, or consistent with, acts of support of the activities that are being made possible at the corresponding structural level. In contrast, systematising at a structural level is, inevitably, an act of constraint and control at, and of, that level. A consequence of this distinction, articulated in the second bullet above, is that the systematic deployment of infrastructural capacity creates the possibilities for unforeseen structures or behaviours to emerge: innovation remains possible. These freedoms generate a requirement to inform ongoing governance as we have already discovered in our discussion of that term. Thus we have a process by which new and emergent structures and behaviours are examined and evaluated, promoted or suppressed, remembering that, in our use of the term, we have abstracted away from the issues of who gets to participate in governance and we include (partial) self-governance as a possibility and, in the case of care and wellbeing services, a necessity. This is equivalent to saying that governance is the "meta-structuration" of the outcomes of structuration processes. We will refer to this second order or meta-structuration as "fruition" which leads us to the following definition:

> A caring environment is one which is designed to bring shared intentions of care to fruition. It achieves this through the systematic properties of an infrastructure which supports relationships and the consequent conversations of care and informs the ongoing renegotiation of shared values, intentions and learning in the associated conversations of governance.

We emphasise again that this is in contrast to the structural systematisation of business systems and the concept of the conventional AMICT Integrationist application which has the objective of constraining the operations supported to the

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[6] We are using the term "structuration" in the usual sense that Gidden's has supplied but placing it in strict relationship with a concept of "infrastructuralisation" and identifying the consequent emergence of "meta-structurations" as governance. This approach sheds new light and generates new implications on the architectural discourse of the socio-technical which will be explored in the next chapters.

business processes and use cases that have been mandated as the policies and requirements to be implemented through the application system.

The distinction we are making here between infrastructural approaches and applications oriented approaches are not always so clear cut in reality. All systems of business or of care, are, to some extent, mixed. They exhibit different levels and intensities of process orientation and duties of care. They, and the platforms that deliver them, also comprise structural and infrastructural elements: both application and service oriented components. The problem we are trying to address here is a consequence of the history of the development and use of AMICT across these complex and evolving contexts.

Designing contexts of care

When the presenting challenge is to define systems, particularly information and communications systems, that are intended to support contexts of care, in the health, social or educational domains, problems often manifest themselves as difficulties of understanding and cooperation between the conventional roles of users and the systems architects and designers. The users see themselves as professional practitioners with complex, privileged and ethically bound relationships with clients, patients or wards while architects and designers, who are usually embedded in a systems supply relationship, see themselves as the creators and providers of technically and managerially determined responses to well defined organisational objectives. Particular difficulties, in these contexts, revolve around issues of the confidentiality of personal data as the record of the conversations and the interventions of care. In business and commercial contexts, the information gathered through the AMICT system is the wholly owned resource of the owners of that system, within the general constraints of personal data law; in commerce, granting the right to exploit such data, in the interests of the provider business, is a standard condition of being a customer in the first place even when this is couched in terms of "providing a better user experience". The continued application of these principles of operation in the context of social networking represents a significant and growingly contentious aspect of these developments in a networked age, representing the new and problematic demarcation between the socio-technical domain and the private domain.

Understanding such tensions and breakdowns is the objective of critical social science and anthropology where they are observed, analysed and explained in terms of power and control, social construction, eco-geographical situation or human group and individual psychology, motivations and behaviour. Our contention here is that there is an additional and deeper methodological problem. This is associated with the expressive adequacy of an architectural discourse which is limited to extensions when used in a domain where intentions are of central significance and cannot be safely or appropriately relegated to a second class category of "non-functional requirements". From the perspective of conventional systems design practice, the introduction of additional concepts and levels of abstraction into the architectural discourse seems, at first sight, to correspond to the introduction of new levels of the complexity in the systems design process. When these additional layers are concerned with "states of mind" or intentionality, they also seem, for engineers

and designers trained in a positivist, technically determinist intellectual frame, to undermine the scientific realist stance and its grounding in mathematical and logical rigour that they have been trained to rely on.

As we have observed, the formal aspects of conventional architectural discourse of technical systems encompasses only the concepts of function, capability and capacity and, as a consequence, its application necessarily reduces the delivered processes to those that can be managed by measurement and predictive functional modelling and analysis. This has been the stance adopted in "New Public Management[7]". To reiterate: our argument amounts to the following: while clinical and social care entails processes and requires management, if these are the only concepts expressible in the architectural language of the systems and environments that support it, then it is in grave danger of losing its humanity, and submerging all of its social aspects in mechanism and process. Our claim regarding the "neo-socio-technical approach" outlined here is that the inclusion of intentionality, as a first class concept in the architectural discourse, does not imply a sacrifice of architectural (or methodological) rigour or a retreat to what determinists regard as "empty rhetoric"; as we have seen, rhetoric has an essential role to play in leadership and the articulation of policy. Rigorous specificatory work can, and must, be done with regard to intentions and also with regard to the relationships between intentions and extensions. We must, as we have already stressed, understand the limits of what, at least, must be done and what, at most, can safely and appropriately be done in the systematisation of environments of care and, as a result, establish and maintain appropriate boundaries between reusable infrastructure and the live conversations of care that it supports. We hope to demonstrate that this approach offers new tools to address the real complexities of these application domains and provides the methodological platform for the constructive transformation of the conversations and relationships of AMICT systems creation, use and governance.

The technical infrastructure that supports the conversations and relationships of care and the management and governance of caring services is primarily concerned with information and we must now turn to this challenging concept to provide further clarification of our terminology and our interdisciplinary stance. "Information" is another word which has many different meanings in different disciplinary contexts and these require some precise mapping and clarification.

Information

In the engineering view, information is concerned with the handling of data: bits and bytes. In this perspective we can talk about exactly where information is situated and how and when it moves; we can measure the quantity of information present in any situation. But the engineering view of information can say nothing about meaning. Information engineering, in this sense, is "plumbing" and this generic plumbing provides a platform for the next view of information which is concerned with the use rather than the handling of information.

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[7] ref

In the informatics view, information is concerned with codes and their meanings or denotations in an external world. In this view, we have the concept of messages and documents as units of communicational activity. Here meaning is an explicit function of codes and coding structures, headings and mark-up which have been fixed or standardised externally and a-priori in terminologies and data models. Also in the informatics view we have the concepts and technologies of databases. These allow us to model and manage information about real world situations and provides the tools to ensure that such models and data sets remain internally coherent and consistent. The relationship between this internal representation and the external reality is, however, a consequence of the operation of a socio-technical system. This involves the next level of our discussion of information.

At the next, conversational level, which we have already introduced in this discussion, we consider the world in terms of the roles and relationships which form the contexts in which information is generated and interpreted. Here, meanings include intentional concepts such as obligations and responsibilities. The objects in which the traces of previous conversational moves or acts may be preserved and transported take the form of the messages and documents of the lower communications level. Thus, at this level, we can talk about an instance of a document as, for example, a discharge summary, in terms of its closure of a specific, temporary transfer of responsibility of care is part of a referral conversation between a GP and a Hospital Specialist.

Socio-Cultural View	Collective Identities, Values and Principles.	New meanings are negotiated.
Conversational View	Roles, relationships and responsibilities	Meanings include intentions.
Informatics View	Codes, terms and objects.	Meanings are pre-defined and concrete.
Engineering View	Bits – terra-bytes, channels and bandwidth.	Measurements but no meanings.

Fig 3.1: The different views if theories of information and the concept of meaning.

The final and highest or most inclusive view of information is from the perspective of society and of culture. Here information encompasses identity, values and principles and shared significations and meanings are negotiated and come to be accepted. The term "signification" here corresponds to the process by which something comes to count in a situation for the people discussing it. This is taking a constructivist stance which recognises that, in any social setting, and, therefore, any socio-technical setting, participants foreground and attach significance to certain elements which, inevitably means that others are relegated to the background or, indeed, fail to be recognised at all. A necessary requirement for the fruition of shared intentions, which we have asserted is a characteristic of systems of care, is a shared

signification of what counts as care in the situation not as an objective and foundational principle but as a cultural practice which is subject to re-evaluation and evolution.

We must now relate this multi-disciplinary framing of the concept of Information to the discussion of systems and, to do so we will make use of Krippendorff's[8] concept of determinability. He refers to four distinct levels of determinability of systems which correspond directly to the views of information we have identified.

According to Krippendorff:

> "Systems whose behaviour is deducible from a finite history of recorded observations are *observationally determinable.* This reflects the epistemological stance of detached observers who seek to discover systems properties by testing all possible hypotheses about that systems structure against the data it produces"

This corresponds to our Engineering View which measures but does not interpret and also to Danial Dennett's physical stance[9] which we have already referred to.

> "Systems that can be built and set in motion are *synthetically determinable*. This reflects the epistemological stance of designers who have access to the structure of a system having determined its makeup.[10]"

This corresponds to our Informatics View where design involves the production of an object or data model, a collection of business logics and use cases. In this view, applications are synthetically determined systems in which users are functional operators. In Dennett's framework, we have the design stance.

> "Systems that can be lived with or utilized by interacting or communicating with them competently are *hermeneutically determinable,* for example computers as well as people.[11]"

We might question the term "interacting" here as being too weak but endorse the term "communicating"; the implication is that we have made a qualitative move from the use case or the simple operation of an object as an instrument. In our framework, the interactions between hermeneutically determinable components is conversational and its determination involves meanings and purposes: we have arrived at Dennett's intentional stance.

> "Systems that can be understood by participating in them are *constitutively determinable*. The latter especially applies to social systems, constitutively involving knowledgeable human participants. They also include what second-order cybeneticians do.[12]"

Krippendorff's constitutive determination corresponds to the fully blown socio-cultural where the determinations of itself by itself are the acts and operations of the

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[8] Krippendorff, K. (2009). Ross Ashby's Information Theory: A Bit of History, Some Solutions to Problems, and What We Face Today. *International Journal of General Systems, 38* (2), 189-212. https://doi.org/10.1080/03081070802621846

[9] The intentional stance. *https://ase.tufts.edu/cogstud/dennett/papers/**intentional**systems.pdf*

[10] Krippendorff, K. (2009).

[11] Ibid.

[12] Ibid.

system(s) under consideration bearing in mind that we are adopting Ashby's stance with regard to the reality of the system:

> "It is important to stress that Ashby defined a system not as something that exists in nature, which underlies Bertalanffy's (1968) *General Systems Theory* and fuelled much of the general systems movement. He did not distinguish systems from their environment and generalize what makes such systems viable. Ashby always insisted that anything can afford multiple descriptions and what we know of a system always is what he called an —observer's digest.[13]"

All, systems, including social systems, are part of our conceptual framing and sense making of aspects and segments of our worlds rather than external existents. The semiotic registers which correspond to the different layers in our stack, represent distinct epistemological stances with regard to these systems. Collier observes:

> "Positivism typically deals in causes without meanings, explanation without interpretation; hermeneutics deals with meaning without causes and interpretations without explanations. Critical realism holds that meanings can be causes and interpretations can be a species of causal explanation[14]"

So, the lower two levels can be seen as positivist determinist approaches which provide a platform for the hermeneutic which in turn provides the platform for a range of interpretivist stances. What counts as systematic is different at each of these levels because the nature of the relationships between components and what, therefore, amounts to explanation, is distinct. The purpose of the architectural discourse of Socio-technical Systems is to coordinate work within all of these levels and sustain the conversations that must take place between them.

Our core argument has been that in current practice we generally neglect the conversational level and assume that intentions are unambiguous and uncontended and can therefore remain implicit. We build applications which we assume are observationally and synthetically determinable from the perspectives of both operation and governance. This assumption only partially sustainable in the relatively simple contexts of commerce and business but comes under ultimatly unsustainable strain when we consider systems that have the purpose of supporting relationships of care and well-being.

The purpose of introducing this particular layering at this stage is to enable us to locate a particular set of logically stable structure – infrastructure boundaries. Firstly we see the familiar boundary at the basic communications level: this is equivalent to a telephone service. This infrastructure makes the connections and delivers traffic while the corresponding structural layer that it is supporting is responsible for the actual messages and their content. We then have the boundary which represents the information service provided by our informatics systems. The boundary between layers in our "semiotic stack" reveal the possibility of a higher but still logically stable structure-infrastructure boundary: we will call this the "structured

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[13] Ibid.

[14] Andrew Collier: Philosophy and Critical realism pp345

communications" level. This boundary is sensitive to the context and purpose of the supported interaction and information exchanges and uses and to the roles of the interactants but remains agnostic with respect of the specific content: It not only knows that it is handling a message, in terms of an addresser and an addressee, but it knows their roles and context and also what the type and purpose of message it is. So, as we have seen in the previous example, at this level, we might know that the particular message is an example of a discharge summary from a secondarily clinician to a GP and that it corresponds to a particular previous referral message. But again, it is agnostic about the specific content.

Current practices in systems architecture does not support rigorous modelling at the conversational level, confining itself to the two lower levels. Meanwhile, policy, which should be articulated at the socio-cultural level in terms of the rhetorical assertions of principle, priority and values, often includes assertions which are in fact design decisions. The models presented in chapters two and three are offered as examples of rigorous modelling and analysis at this conversational level as an analysis of "problem spaces" or policy and have the purpose of mediating between the socio-cultural discourse and the processes of informatics and communications engineering.

So, there is architectural work involving systematisation to be done at each of the lower three levels and at the two boundaries that separate them. We argue, however, that conversational modelling and the definition of structured communications services, represent the "at most" level of systematisation of socio-technical systems because we cannot, in principle, systematise and script socio-cultural action and relationships; these must remain "live" conversations if the agency and autonomy of the participants is to be respected.

We will explain and justify this assertion by discussing a preliminary overall structure of the conversations and relationships of policy making, implementation and delivery, i.e. the architectural discourse of the socio-technical system of care. We will take the approach of defining it in a canonical form, that is to say as a normalised or standardised, logically well-ordered process. In reality, the architectural discourse can take complex twists, turns and iterations but, if the form that the process has taken can be explained and justified, in retrospect, in terms of the canonical form, we have grounds for claiming that it has, in fact, been completed and is well formed.

Ordering the architectural discourse

The logical sequence of activities which form the structure of the architectural discourse has its logical start in the conception of possibilities and the selection of objectives and priorities. We will refer to this as "envisioning" and observe that it rarely takes place in a green field situation: there are usually many boundary constraints, a complex historical setting and much sunk investment and legacy to contend with. The process of envisioning is one that entails signification, that is, as we have discussed, the selection and agreement about what will count and be of significance in the subsequent discourse and, by implication, what will be excluded. Since signification amounts to the selection and enumeration of the elements which

will figure in any subsequent systematisation, the envisioning process cannot itself be systematised at this level. Ultimately, there is no pre-existing, complete catalogue or encyclopaedia of what could possibly come to count because such a structure would itself represent a pre-existing systematisation. It would not be architecting a new system but changing an established one incrementally and under a regimen of control which has predefined the scope of possibilities. It is clearly a requirement on our concept of architecture that is supports innovation and, indeed transformation as well as incremental development[15]. Having said that, real life situations usually involve such control to some extent and the problems arise when this remains implicit, unrecognised and, therefore, without the consent of the actors.

Here, we are characterising envisioning as cultural action and justifying the assertion that, at this level, articulation is necessarily rhetorical. This has the important consequence that we have identified that well-formed policy statements should not use the language of implementation. Putting this in very concrete terms, the "policy" statement that, for example, we will place such and such a function on a currently centrally controlled resource in a national system[16], is, by its very nature, ill-formed and dangerous for two reasons: firstly this might compromise the technical integrity of the central resource and the policy maker, as policy maker, is in no position to make this assessment and, secondly, the underlying policy objective, in terms of values and priorities, has not been made explicit and remains hidden and closed to inspection or debate. If the underlying issue is that the overall coherence and dependability of a particular function must be guaranteed to a very high level because of its strategic importance and the catastrophic consequences of failure, the option of centralisation, in, for example, a single, normalised database structure or on an exclusively controlled platform, may or may not be a justifiable design response. But this is an argument of design not one of policy. Thus, the facilitator of the architectural discourse[17] may talk to the politicians about policy objectives, targets and costs but not allow them to talk about systems as such, and he or she may talk to the designers and implanters about costs, targets and systems but must not allow them to talk about what the policy should be or how it is to be interpreted[18]. The practicalities of facilitating engagement and productive participation in sense making and the co-production of complex socio-technical systems is discussed in detail, in a later chapter which is concerned with the Living Lab process and approach.

At this stage, to avoid the accusation of panglossian optimism we stress again that we are discussing the abstracted, canonical form of the architectural discourse which represents a rationality to be retrofitted to a real, complex narrative. It is a

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[15] note on Badiou's concept of Event and the platonic ontology of number? Schumpeter?

[16] All demographic services will be centralised on the Spine, for example in the current NHS infrastructure of England.

[17] Not how we have shifted here from the notion of "architect" as analyst-designer to that of facilitator of a set of conversations.

[18] We owe this formulation of the practical architectural principle to our friend and colleague Giampaolo Montaletti.

constructive and critical tool, to reflect on real discourses between policy makers, architects, designers and users and to help diagnose blockages and to improve the quality of exchange. It is not a direct prescription for action. We also stress that the architectural discourse we are discussing is concerned with large scale, socio-technical infrastructure which, by definition, is not safely amenable to bricolage or the possible subject of participative hacking. Its objective is, in fact, to create the bigger picture which renders informal bricolage and hacking, at the local level and at the point of need and use, both safe and productive and to foster, encourage and support the governance of such innovation. It is the equivalent of designing the telephone exchange in the knowledge that there is no need to script what can or cannot be said by subscribers in their use of the service.
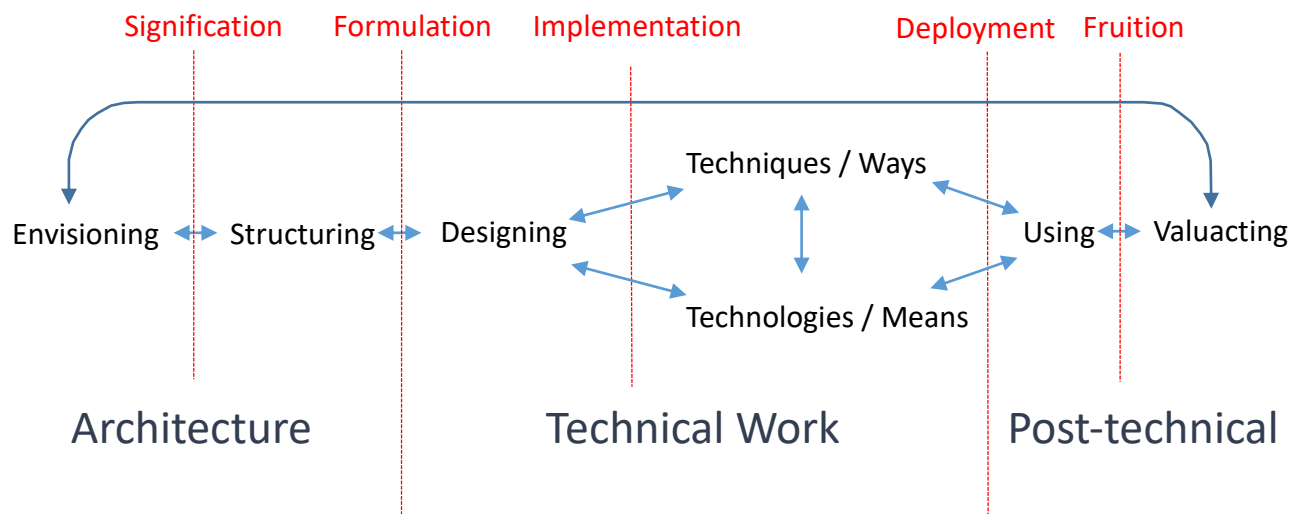

Fig 2.2: The canonical form of the architectural processes

At the next canonical stage, the initial significations are structured and, as we have explained, the unit of analysis and structuring we have adopted in this approach to the architectural discourse of socio-technical systems is that of conversation. Thus, the immediate response to statements of policy, as we saw in chapter 2, is the construction of intentional models which take the form of networks of conversations, and their associated instruments, which will eventually take the form of messages documents and other information artefacts, as abstract, objects. This corresponds to the analysis, composition and distribution of roles and responsibilities so that subsequent processes become a consequence and outcome of these design decisions concerning intentionality. At this level, we might identify an abstract "instrument of consent". The corresponding reality might, as again we saw in chapter 2, turn out to be a paper document to be signed or a confirmed mouse click in an authenticated network session; it may even be the absence of action in an opt-out scheme. Thus, as we have observed, the conversational model represents the problem or the requirements that must be responded to with an offered configuration of real communications and information engineering designs. The response to the conversational model and, in particular, to the instruments that are identified in terms of:

- their purposes,

- the acts that must be performable on them to address those purposes and

- the information carrying and preserving properties that this entails,

all considered in the cognitive and physical ergonomic and social contexts in which they will be enacted, is one of "formulation". This is a process by which design decisions can be made and justified on scientific and engineering principles as well as on ethical, legal, aesthetic and cultural grounds.

Implementation is the process by which design is realised through the exercise of appropriate techniques and the configuration and deployment of appropriate technologies: the "techne" that architecture has been prior to.

The post "techne" processes are deployment and use and this leads to what Lawrence Halprin calls "valuaction". This combines the notions of value adding, value extracting and evaluation emphasising their close interrelationships. The processes that mediate between use and valuaction are called "fruition", a term we have already introduced in our definition of a system of care. We now make clear the relationship between fruition and governance as we have defined them. The valuaction of previous fruitions usually provides the stimulus for envisioning new possibilities of the system and the environment, which represents the brown field site of the architectural discourse of socio-technical systems and we have come full circle.

The plan for the rest of the book

In chapter 5 we take the first steps in defining the theoretical underpinning of the new approach to the architectural discourse of the socio-technical, introducing the concept of architectural projections and developing the concept of conversation and conversational analysis in detail.

These concepts are taken forward in chapter 6 in an exploration of the underlying epistemic commitments and the theories of sense-making, change and development which underpin our approach.

In chapter 7 we develop a linkage between the different concepts of conversation that we have discussed, and positioned as the core unit of analysis in intentional modelling, and also develop the concepts of information and of semiotic register which we have introduced in this chapter.

Chapter 8 presents and justifies an ontology and graphical notations for the intentional modelling which was used in chapters 2 and 3 and presents a theoretical underpinning for the projection oriented approach.

Chapter 9 introduces the Newcastle Living Lab approach which represents an open source platform and tools for operationalising the approach to the neo-socio-technical architecture we have described. We will use a case study from a different domain of "care" which was situated in business support services and economic development. As well as providing an instructive illustration of the social and technical processes, this also illustrates the universality of the federated hub based infrastructure concept to support complex multi-agency service ecologies.