



Instituting facts: Data structures and institutional order



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ABSTRACT

The concept of the data structure is part of the accepted and relatively unexplored background of the information disciplines. As such, the data structure is treated largely as a technological artefact, helping to support but somewhat isolated from considerations of institutional order. This paper develops an alternative consideration of the data structure which focuses upon the constitutive capacity of such artefacts within institutional order. This viewpoint builds upon literature from the language/action tradition, the more recent work of John Searle on social ontology as well as the small amount of work which proposes the actability of data structures. To help provide some grip on the slippery notion of institutional order we consider it here in terms of the notion of business patterns. The term business pattern is used to refer to a coherent and repeating sequence of action involving humans, machines (including IT systems) and other artefacts (such as data structures) appropriate to some way of organising. The paper also describes a way of visualising either existing business patterns or envisaged business patterns through the pattern 'language' of pattern comics. We ground our approach using material gathered within a research study of a key routine enacted within a large manufacturing organisation. Within this routine a mismatch was experienced between what the data structures within the production IT system was telling production managers and what was experienced on the ground by production operators. We show how an actability worldview of data structures expressed in terms of business patterns offers a fruitful way of making sense of problem situations such as this. It also suggests important ways of thinking differently about the nature of design in relation to data structures.

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"Until I know this sure uncertainty, I'll entertain the offered fallacy." *William Shakespeare, The Comedy of Errors*

1. Introduction

A data structure is a term which is used broadly to refer to some systematic form for organising data (Tsitchizris & Lochovsky, 1982). As a concept, a data structure is clearly central to the interests of the information disciplines (Information Systems, Information Science, Information Management, Computer Science), since much of the infrastructure of information technology, for instance, is taken up with the 'mechanics' of data structures—storing, retrieving and manipulating data structures. However, the concept of the data structure itself is treated within much of the research and practise of the information disciplines largely as a technological artefact, helping to support but somewhat isolated from considerations of institutional order. As such, this view

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of the data structure comprises an important part of the accepted and relatively unexplored background to the conduct of investigation and explanation in these disciplines. In turn, this relatively unchallenged worldview of the data structure influences the way in which 'design' is both contemplated and conducted in relation to such artefacts.

In recent work, we have begun to explore the constitutive capacity of data structures in forming and reforming institutional order (Beynon-Davies, 2015a; Beynon-Davies, 2015b). To do this we utilise the literature of the language/action tradition (Goldkuhl & Lyytinen, 1982), social ontology (Searle, 2006) as well as the actability or agency of data structures (Agerfalk, Goldkuhl, Fitzgerald, & Bannon, 2006). Our key contribution in the current paper is that we offer a way of making sense of the re-positioning of data structures in terms of institutional order through the intermediate construct of a business pattern and the design artefact of a pattern comic (Beynon-Davies, 2014). We shall demonstrate how this design theory (Gregor & Jones, 2007) and associated design artefact (Gregor & Hevner, 2013) provides a way of both making sense of the constitutive capacity of data structures within existing institutional ontology, but also facilitating the design and use of data structures in constituting new institutional orders.

To help provide some grip on the slippery notion of institutional order we consider it here in terms of the notion of patterns of organisation—business patterns. Our concept of a business pattern is built primarily upon the literature of organisational routines (Becker, 2004), business narrative (Pentland, 1999) and socio-technical systems (Bostrom & Heinen, 1977). We further argue that business patterns consist of three coupled layers of action, which we refer to as articulation, communication and coordination. This conceptualisation exploits both speech act theory (Searle, 1970) and Searle's social ontology (2006) and is used here as a way of making better sense of the 'mechanics' of data structures in the constitution of institutional order. To help unpack the nature of action which comprises a particular business pattern, we propose a form of visualisation known as a pattern comic (Beynon-Davies, 2013; Beynon-Davies, 2014). This way of visualising socio-technical action, we maintain, has merit as a way of illuminating the role that data structures play as key actors in the accomplishment of particular institutional orders.

Our general approach within this paper involves isolating something considered fundamental but which is taken as a given. That which is considered fundamental but given here is that of a list of identifiers comprising a data structure. We then attempt, using speech act theory (Searle, 1970) and the theory of social ontology (Searle, 2007) as key anchors, to reconstruct the relationship between such data structures and institutional order by examining the critical role that both lists and identifiers play in constituting institutional action. By means of this approach we demonstrate how this reframing of the data structure has a number of important consequences for the way in which we approach data structures within the information disciplines, not only in terms of explanation but also in terms of design.

To help demonstrate the actability of data structures we use the visualisation of pattern comics to make sense of one small example of a business pattern explored by the author within an action research study. We consider lists and identifiers as atomic elements of data structures relevant to this order of routine action, which are articulated in various ways by different institutional actors. Such articulation is used to communicate different intents and contents to multiple actors and through such communication to facilitate coordinated action. We use this case to demonstrate how the visualisation of business patterns through pattern comics particularly allows designers to explore the place of data structures within institutional order, as well as their potential as change agents within routine order.

The structure of the paper is as follows. We start with establishing the fundamental nature of the data structure, using a list of identifiers as a primitive instance of such form. We then frame the notion of institutional order or ontology by exploiting Searle's notion of constitutive rules as generators of institutional facts. This leads us to consider the data structure as a speech act—as a form (locutionary act) created with the intention to in-form (illocutionary act) in the hope of influencing some actor to perform (perlocutionary act). This theorisation of the data structure sets the scene for our attempt to visualise the constitutive 'mechanics' of data structures. To do this we introduce the term business pattern to denote a socio-technical routine of action relevant to some delimited institutional domain. We further introduce the design artefact of a pattern comic to visualise three coupled dimensions of action important to making sense of the institutional 'mechanics' of data structures. Data structures as material forms have a number of specific characteristics which help explain their special status as actors within the constitution of institutional order. Bringing the actability of data structures into focus in this way leads to a different conception of what design means in relation to such artefacts. To demonstrate this, we consider the specific case of the re-design of the pattern of perpetual inventory checking employed within a large UK manufacturing organisation—the Royal Mint. We conclude with a summary of the lessons derived from our study as well as considering a number of limitations of our current work.

2. Lists as data structures

A data structure is both an abstraction and an instantiation. As an abstraction a data structure, such as a list, comprises a set of principles for both storing and accessing data. As an instantiation a data structure is given form. A specific instance of a list, such as a stock-location list, is used to represent things, and through such representation to help constitute institutional order. As an abstraction a data structure can be seen as a set of data elements, which in turn comprise a set of data items (Tsitchizris & Lochovsky, 1982). Hence, a list, as a data structure, is comprised of a set of data elements which we shall refer to as list-items. Each list-item will take the form of a binary relation (Frost, 1982) consisting of three data items in which the first and third data items are identifiers and the second data-item is some expressed relation between identifiers. For example, a 'stock location list' is likely to consist of list-items in which identifiers such as [26641] and [P10102] are associated through the relation [LOCATED AT].

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