

Understanding the Roles of Signs and Norms in Organisations

- A semiotic approach to information systems design

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Abstract.

To apply semiotics to organisational analysis and information systems design, it is essential to unite two basic concepts: the sign and the norm. A sign is anything that stands for something else for some community. A norm is a generalised disposition to the world shared by members of a community. When its condition is met, a norm generates a propositional attitude which may, but not necessarily will, affect the subject's behaviour. Norms reflect regularities in the behaviour of members in an organisation, allowing them to coordinate their actions. Organised behaviour is norm-governed behaviour. Signs trigger the norms leading to more signs being produced. Both signs and norms lend themselves to empirical study. The focus in this paper is on the properties of norms since those for signs are relatively well known. The paper discusses a number of different taxonomies of norms: formal, informal, technical; evaluative, perceptual, behavioural, cognitive; structure, action; substantive, communication and control.

A semiotic analysis of information systems is adduced in this paper from the social, pragmatic, semantic, syntactic, empiric and physical perspectives. The paper finally presents a semiotic approach to information systems design, by discussing the method of information modelling and systems architecture. This approach shows advantages over other traditional one in a higher degree of separation of knowledge, and hence system's consistency, integrity and maintainability.

1. Norms and signs

Norms exist in a community and will govern how members behave, think, make judgements and perceive the world. The shared norms are what defined a culture or subculture. A subculture may be a team who know how to work effectively together, and their norms include a solution to their organisational problems. Norms can be represented in all kinds of signs, whether in documents, oral communication or behaviour, in order to preserve, to spread and to follow them. However, one cannot always put hands conveniently on a norm, as one might grasp a document that carries information through an organisation. A norm is more like a field of force that makes the members of the community tend to behave or think in a certain way.

1.1 The First Basic Assumption

We take the view that it is unwise to think of an information system as necessarily a computer-based system but far better to think of it as an organisation. Information technology is only able to play a limited role in an organisation by capturing, storing, forwarding and processing the signals. Organised human behaviour depends on a far richer form of communication than any machinery can account for.

An organisation, and therefore an information system, is essentially a system of social norms. This is simply to say that when people conduct themselves in an organised way they do so by conforming to regularities of perception, behaviour, belief and value. People do not always conform to every organisational norm, but the encompassing, informal culture will provide the norms that govern how far it is reasonable to depart from the norms specific to the organisation and also how other people will react to those departures. Any lack of suitable cultural meta-norms will limit how far it will be possible to organise at all. Behaviour which is not governed by any kind of norms is, by definition, intrinsically chaotic or random. We can of course have norms (tolerance or even admiration of eccentricity, withholding of judgement for a while and so on) that permit or even require random behaviour which is, of course, important in changing organisations especially when the organisations are trying to learn or solve problems. So far we have not found any serious objection to the proposition that at a rather detailed level any organisation can be described by specifying its norms.

The limits of organisation are continually being challenged and adjusted by forms of political activity. Our definition of organisation is focused on those behaviours that are regular or capable of being anticipated. Nevertheless, although political intervention is necessary to deal with crucial, unique events and to adjust the norm structure, politics itself is conducted within the constraints of cultural and organisational norms. This makes it natural to consider the politics of an organisation as an autopoietic process, where the renewal of the structure depends largely upon the forms and functions of the structure itself. Perhaps, therefore, our approach can make a contribution to understanding even the political margins of organised behaviour.

1.2 Norms and information

Once we know the norms of an organisation, we can deduce its information requirements because every norm has the general shape:

If CONDITION then CONSEQUENT

The condition part determines what information the norm-subject (an individual person or a group) requires to be able to obey it, while the consequent leads, sooner or later, to the generation of information for others either directly through sending messages or indirectly through the influence of the norm upon actions. If we know the various norm-subjects who are the agents in the organisation and we know the specific norms they should obey, then we can deduce what information individual or group agencies in the organisation will need and what they produce for others to use (Stamper 1980, Stamper and Liu 1994).

This approach to requirements engineering has been developed in the MEASUR research programme (Stamper 1994). The MEASUR approach enables us to identify norms in three stages. Firstly, the total system is partitioned into a network of *unit systems* by the method of *problem articulation*. Then, secondly, in each unit system, one analyses the shared perceptual norms which norm-subjects rely upon for establishing shared meanings, the

result being an *ontology chart* (also called semantic model, see figure 3 for example). The ontology chart maps the vocabulary and the temporal relationships between the percepts that those words represent (Stamper 1996). Then, to guide the third stage, one can associate the other norms with the start and finish of every item in the ontology chart. It is important to note that the concepts we are using in this research are clearly operationalised in this way. The relevant behaviours and agents are defined in the ontology chart and the entire range of relevant dynamics (and hence of norms) is provided so we know how the starts and finishes are determined. Software tools are available for modelling the part of the organisational system that can be formally expressed; these have already demonstrated their ability markedly to reduce the costs of organisational change where computers-based systems are involved (Liu *et al.* 1994). We expect to be able to deliver many of the results of our academic work in a practical form by using MEASUR.

1.3 Norms and behaviour

Two types of behaviour can be identified: substantive and semiological. A human agent can perform an action or can use signs to describe the action (though the use of signs itself is an action). Without involving signs, the agent is confined within its immediate here-and-now environment. Signs and the use of signs are the vehicles for one to extend actions to the past and future, and in spatial dimensions. Substantive behaviour may cause a change of the world with little or no use of signs, while semiological behaviour will make a change of the world through the mediation of signs. Two types of behaviour are often intertwined and nearly always in the social domain. For example, a marriage can be seen as a pattern of substantive behaviour of two people, but it is created by conducting a set of legal ceremonial constrained procedures and producing documents, which are essentially semiological.

Any social group, from an extended family to an organisation, that has the ability to sustain itself despite a turnover of membership, requires three kinds of norm-governed behaviour: autopoiesis, learning and interaction. *Autopoiesis* (Andersen 1995) is the self-referring behaviour that enables the structure to maintain itself. Without that internal coherence, the structure dissolves back into the broader, encompassing culture and ceases to be capable of *interaction* with other structures, sustaining an identity and being regarded in anyway as responsible. Interaction depends upon chains of norms where conditions depend on external states of affairs and lead, perhaps through many steps, to consequents which dispose group members to intervene externally, whereas autopoiesis depends on loops of norms concerned with internal states and actions. Group coherence demands channel capacity for autopoiesis, the loss of which accounts for the disappearance of extended family groups in western societies over the last century. But organisations must achieve a balance between autopoiesis and interaction to survive; this is why all major successful companies must interact with the business environment very closely to avoid the danger of self-absorption and to sustain their business positions. Learning, the behaviour of continual adjustment of its norms, lies between autopoiesis and interaction, enabling the group to observe its environment, reflect upon itself, change its norms so that it can behave externally differently and more appropriately in future. The transformation of many small and medium companies into leaders in their business sections exemplifies that. The role of leadership in striking the right balance is also illustrated by the recent political changes in Britain.

1.4 Norms and Organisational Change

We are using the concept of an organisation as a system of social norms to investigate organisational change, in particular the ability of an organisation to learn. Hedberg (1981) draws attention to the quite widely held view that organisations "have no properties aside from those which channel through people" before citing many reasons for choosing to treat the learning and knowledge of the organisation as separate from that of its individual members. We agree with his position and believe that it can be greatly strengthened by relating organisational change, and learning in particular, to the concerted changing of norms by the members of an organisation. Individuals can learn without the organisation necessarily learning too. Indeed a powerful and not uncommon kind of informal industrial action is to withhold individual knowledge (shared or not) from serving the organisation. For example, operatives may leave management to discover by themselves at a much greater expense that the materials the firm is using are in fact defective, though the operatives have already learned. Clearly, organisational learning could be improved, generally speaking, by reducing the likelihood of individual knowledge (cognitive norms) being separated from organisational knowledge. Hedberg makes the point that "organisations do quite frequently know less than their members." The norm model also takes account of the norms that govern communications among the members of the organisation. Therefore this problem of organisational ignorance in the midst of individual knowledge could be ameliorated by attention to the norms that permit or even oblige consultation and, of course, norms governing knowledge about who has what expertise. Any organisational change must always be experienced as effects on individuals but that does not invalidate the aggregate level of analysis implied by our norm-oriented model.

Although human individuals are the principal embodiment of social and organisational norms, we are increasingly automating the application of norms so that we should also think of the computer as an instrument for executing certain kinds of norms where it is more efficient but no less responsible to do so. Hence, we are also using the same norm-oriented model to explore some of the positive and negative impacts of information technology on the capacity of an organisation to change or learn. This is possible where we can trace a link between certain kinds of norms and the features of the computer system that need to be adjusted when those norm are changed.

This model seems satisfactory when one considers that an organisation in which no norms change is an organisation which, however active it may be, is one where organisationally it is static. Every norm in our model is also a perceptible element in our social reality with its own start and a finish, events that are quite explicit in the special case of legal norms which are enacted and ultimately abrogated. We can obtain very detailed insights into organisational change and organisational learning if we know enough about the structure of the organisation's norms and the manner in which those norms are created, amended and taken out of existence and, moreover, if we know the agents (individual or group) who have the power to bring about change. We then have a link into the study of those important, elusive aspects of organisation mostly concerned with major changes: the political aspects.

2. Taxonomy of norms

We believe that semiotics can bring to the study of organisations and other kinds of social structures a degree of precision that it has not so far enjoyed. To achieve this, the study of signs must be united with the study of norms. Doing so is to look more closely at the role

this methodological challenge if it is to claim to be an improvement on the conventional approach.

2.1 Norms classified by their formality

Norms do appear to lend themselves to a number of sharply defined taxonomies. One of the simplest relates directly to the automation of business procedures. To use a computer for anything more than a simple relay device for storing and forwarding signals, one must be able to instruct it in precise, mechanical detail what to do. That is the task of programming and it does, in fact, involve the embodying of social norms in the instructions given to the computer, otherwise it would not be able to do anything useful for the organisation. Norms that are handled in this way or are so exactly specified as to be capable of automation fall into one class. Then we have a class of norms that can be performed by people following explicit written norms or *rules* which they can be trained to perform in a rather mechanical way. But these are excluded from the first class because they do not exist in an explicit form that can be interpreted by a machine. The third class comprises all other norms that are known by people who can live according to them without their being able to express them in writing. These taxa are the technical, formal and informal norms.

Subdivisions are often made. Technical norms may be in a basic machine language or they may have to be interpreted by another program, or compiled into machine language, and so on. Formal norms are often classified according to the powers that make and administer them: treaties among nation-states, directives that may be created under the provisions of a treaty (European Union, for example), laws of a single nation-state which subdivide into primary legislation, statutory instruments and regulations all made by governments with maxims, precedents and principles created by the courts, the institutions created by a state with its own statutes can make further rules and regulations. (Note that these subdivisions apply predominantly to the class of *behavioural* norms that are introduced in the next section, but the same may be done for other types of norms.) Informal norms may be classified according to the degree to which the norm subjects are aware of them. Broadly those which may be consciously held and capable of being discussed are separated from those that are tacit, and learned, used and passed on at an unconscious level of thought; suitable examples of these are the norms of fashion and the norms that govern a ballet performance. Although norms may be shifted from one category to another, and exist in parallel forms in each category, they are, at any one time clearly locatable in the taxonomy.

These three taxa are related because *informal* norms are fundamental, because *formal* norms can only operate by virtue of the informal norms needed to interpret them, while *technical* norms can play no role in an organisation unless embedded within a system of formal norms. The importance of this idea for organisation theory is that it leads to our thinking of the informal human norms as the foundation of any information system which can then be refined, where appropriate, by adding formal norms. These formal norms constitute what we often call bureaucracy. The use of technical norms was narrowly circumscribed before the days of the computer which now, in principle, allows us to eliminate bureaucracy by taking over the work which people were performing by behaving more like machines than human beings. However, in practice, there is a danger of generating extra layers of bureaucracy because we find that every computer system envelops itself in a nearly impenetrable carapace of manuals or formal norms that link the technical to the informal. This embedding of technical norms in formal ones, and those in

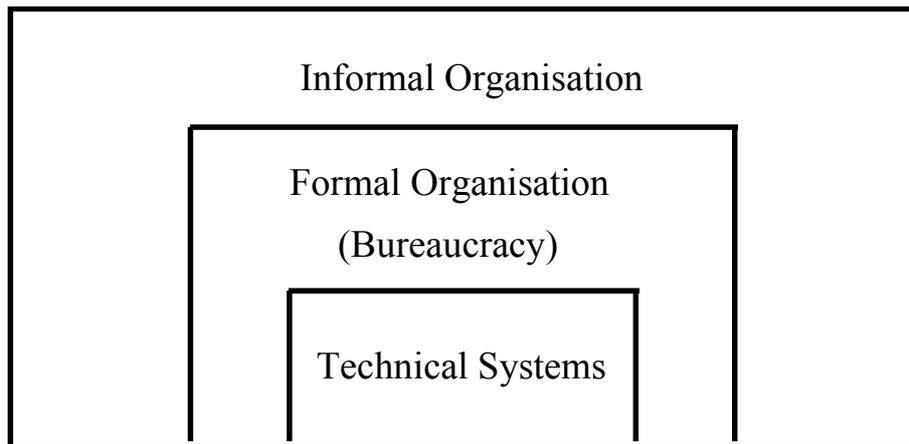


Figure 2. The embedding of computer systems in the formal and informal organisation informal norms is shown in Figure 2 which should be held in mind as an assumption behind all the subsequent discussion.

This taxonomy of formality helps us to understand a little about the role that IS analysis and design methods can play in making organisations more flexible or less. Sadly, the classical methods tend to increase the proportion of formality in an organisation without drawing attention to the possibility of meeting requirements by improving or extending the informal part of the organisation.

Organisational change which increases the proportions of formal and technical norms may induce rigidity. This may go some way towards explaining the poor return to value added by IT investments in administrative systems which Strassman observed (1980, 1990). If managers or other users want to adapt a computer-based system to changing needs, they can only do so after interpreting manuals that are typically lengthy and obscurely written. Technical experts are called into interpret this formal layer with extra expense and a fair change of misinterpretation. To remove this source of error, inefficiency and rigidity we need ways of specifying systems that users can easily understand and so establish direct control over the technical systems which perform organisational functions.

The organisations that learn most easily are often those able to work well informally. The relationship between an organisation's changing requirements and the technology to support its operations tends to be trivialised and distorted by methods which are focused only on technical norms (Stamper *et al.* 1994). Norm-oriented analysis and design methods avoid this lacuna and lead just as easily towards improved informal functioning as towards improved automation.

2.2 Social psychological taxonomy of norms

The longest established classification is probably that drawn from social psychology, partitioning them into perceptual, evaluative, cognitive and behavioural norms. These taxa are associated with four distinct types of attitudes associated with their consequents which are respectively:

- ontological - to acknowledge the existence of something;
- axiological - to be disposed in favour or against something in value terms
- epistemic - to adopt a degree of belief or disbelief; and
- deontic - to be disposed to act in some way.

The four kinds of norms and four kinds of attitudes may interact strongly but their separation is quite easy to maintain.

Perceptual norms in one respect are the most basic. They concern the ways in which we divide up the world into the phenomena to which we attach names. We can only represent norms explicitly when we have words to represent the perceptions underlying them, so, the first step in modelling organisations in terms of norm structures is to identify the perceptual norms used by the members of the organisation. In most cases all we can do is to select the words which people use to label their percepts but in some cases we can introduce explicit refinements or even definitions. Natural kinds, such as an orange or a tree we can treat as culturally or even biologically defined but scientific norms might be invoked to sharpen our perceptions of them in marginal cases but all norms have to appeal, ultimately, to commonsense, perceptual norms. In the case of social percepts, such as poverty or copyright, we may find legal norms providing definitions. The most basic perceptual norms always reside in the informal, cultural infrastructure on which all our organisations are erected. Once we have identified our perceptual norms, or have found the relevant words for our problem domain, we can begin to specify the other kinds of norms. Roughly speaking, as John Dewey pointed out, we can identify the perceptual norms with the words we use as fences around the pieces of “reality” that we need to hold and manipulate in our minds.

Evaluative norms are more basic than perceptual norms, seen from another point of view. Our systems of value are largely determined by our culture or sub-culture. Percepts are usually created to capture a boundary where evaluations change very rapidly. A table, for example, has two different boundaries. If you push something on the centre towards the edge you will reach a point where it falls off and perhaps breaks, that change marks the physical boundary. But a table also has a social boundary. It commands a space which is needed by the people who sit at it. In a restaurant, you will notice that a person passing your table will avoid the space it commands and a person at a near-by table will ask permission before moving *your* chair into the social space of their table. We may begin to perceive boundaries that should affect our expectations or behaviour long before we begin to honour the interior with a name: thus evaluative norms may claim to be the parents of our perceptual norms.

Cognitive norms tell us about structures and cause-and-effect relationships. Commonsense models of the world and expectations about how events in the world are linked together guide our everyday lives, these are the informal cognitive elements in our norm system. These norms can be recognised because their consequent parts affect our beliefs. Science is a massive system of explicit, high quality, cognitive norms demarcated by the evaluative norms of the scientific community who determine which cognitive norms are to be regarded as of scientific quality and which are not - philosophers of the methodology of science perhaps see themselves as quality-control managers (see Lakatos and Musgrave 1970) for examples of the passionate tone that even philosophers bring to the evaluation of science). There are plenty of non-scientific cognitive norms that influence business behaviour, for example it is not uncommon to find that people have quite incorrect expectations about the capabilities of certain ethnic minorities, the genders, the old or disabled. Cognitive norms play a central role in post-industrial society as Bell (1976) has argued.

Behavioural norms are perhaps the ones we think of most readily in connection with organisational behaviour because organising too commonly is interpreted as directing

people. This assumption informs most classical methods of information systems requirements engineering: as Ronald Lee has noted, deontic norms may be considered to be the programs that people obey (Lee 1988). We possess plenty of unexpressed, informal norms that are rooted in our biological natures but we elaborate and modify them with legal norms and regulations that refine our behaviour as scientific norms refine our cognitive knowledge. Cognitive norms prescribe what we should, should not or may do in various circumstances. Operating procedures, taxation law and so on are all good examples.

2.3 The changing of norms

Perceptual norms change rather infrequently but when they do the effect can be organisationally profound. For example, traditionally companies have been accustomed to conducting business by managing relationships with suppliers and customers. For a long time we have been accustomed to describing the "vertical" structure of industries stretching from providing basic raw materials cascading through processing, fabricating, assembling, distributing, retailing and eventually reaching the customer. The appearance of electronic global communications makes it possible for a company to conceive what are now called "value chains" through which intermediate products flow in a network culminating in satisfying clients' needs. A few companies have begun to build their success on this profound perceptual change which enables them to define value chains precisely and set about managing them. Changing perceptual norms can be devastating for IT systems because they have to embody what is known of these norms in their data schemas which are their very foundations. Imagine the convulsions in an information systems department asked to change from a simple customer-oriented marketing system to one based on value chains. It is most unlikely that a schema designed using E-R or NIAM could be adapted. We have already demonstrated the benefits of a norm-oriented approach at the perceptual level by achieving a seven-fold reduction in support and maintenance costs (Liu *et al.* 1994). The response to change drivers by redefining an organisation's core competence will increase the risks of IT systems being caught out in future by shifting perceptual norms.

Evaluative norms vary between cultures and any company which operates globally must take this into account. These norms tend to change slowly in the population at large and a marketing department must track these changes in customer sophistication and quality parameters very carefully. Within an organisation evaluative norms are fundamental for determining the culture. Generally, we find for example that the organisations that learn fastest are the ones which assign greater value to the wishes of the client. Adaptability is also improved when the knowledge and experience of all members of the organisation are brought into play because they are valued. The attitudes governed by evaluative norms probably have more force than others do in determining the boundaries of groups and in leading one group to actively oppose another. It is not surprising, therefore, that political and religious organisations are characterised by their central concern for norms of this kind. Nor is it surprising that a mission statement has to express, more than anything else, the values of the organisation, as a foundation for the members' perceptions, beliefs and actions.

Cognitive norms change with changing technology of products, processes and with improving knowledge of the relevant social and economic environment. "Relevance" is an important term in that sentence. Globalisation and other reasons for increasing causal connectivity will bring into relevance bodies of knowledge that earlier could be ignored.

Manufacturing organisations are characterised by their dominant use of cognitive norms. The virtual company is a response to these trends, being an organisation that, above all, has the cognitive resources to be able to orchestrate a range of other organisations through the use of the value-chain concept.

Behavioural norms frequently change through the external forces of new laws, either those enacted in the organisation's own national jurisdiction, or those encountered by exposure to laws in countries added to its market scope. The relationship between legal norms and organisational behaviour is not always simple. For example, new tax allowances to encourage capital investment were enacted in the UK on the assumption that innovative decision-makers would respond, however the individual innovators were insulated from this incentive by the company accountants who applied the new allowance to aggregate accounts, thus making it irrelevant to investment choices. In certain kinds of organisations (financial services and many areas of government, for example) behavioural norms are dominant

We can see that a range of different organisations may be characterised in terms of different mixtures of these four kinds of norms. Perceptual and cognitive norms are perhaps dominant in professional organisations. Evaluative and behavioural norms together probably dominate in custodial organisations, behavioural norms probably dominate in bureaucratic agencies of government, evaluative and perceptual norms perhaps are the most important in fashion industries and so on.

2.4 Taxonomy of substantive, communication and control norms

Another taxonomy distinguishes behavioural norms according to whether the behaviour they direct relates to one of three distinct kinds of tasks: substantive, communication or control. Substantive norms direct their subjects' performance in some physical task (perhaps the movement of goods); communication norms relate to the performance of semiological tasks; and control norms influence the subjects by evaluating their conformity to other norms.

The easiest way to understand this taxonomy is to think of a very small, intimate group where all the communications and all the exercise of control is accomplished through informal norms. In such a tight-knit team, we can assume that everyone knows everything relevant to applying the substantive norms via informal communications and everyone can be sure to obey the norms to which they are subjects, because of informal, peer-group pressures. In these circumstances if you want to change the organisation to perform some different task you need only to change the substantive norms and the revised communication and control will be handled informally again. However, certain changes, such as dispersing the group into several geographically separated locations will make it necessary to introduce explicit rules to ensure that certain information reaches all the relevant people. Similarly certain other changes, such as a breakdown of trust within the team, will make it necessary to be explicit and formal about certain controls. The introduction of formal rules about communication and control need only go so far as to repair the deficiencies in the informal subsystem. See, for example, Checkland and Holwell (1998, pp98-109) for an illustration on how rules and communication affect social and organisational processes.

This taxonomy at first appears to be excessively simple but in fact it applies recursively. So that communication or control activities can in their turn be treated as substantive activities, themselves subject to norms about communication and about control. As an

example of this recursive structure, consider the norms about voting on the auditors' report at a company's annual general meeting: these are communication (voting) norms about the control (exercising a choice) concerning the communication (report) about the control (audit) of the control (accounting system) handling the financial (control) messages relating to a company engaged in a substantive business activity. This many-layered, recursive structure is often found in costly bureaucracies.

Ultimately all behavioural norms can be regarded as substantive, requiring some physical action. This allows us to apply the taxonomy introduced earlier of informal, formal and technical norms. In most small organisations or teams, most norms are instantiated by an informal culture where openness and trust guarantee adequate communication and control. Bureaucracy tends to be induced where spatial, psychological, social and political barriers impede communication and raise suspicion. The efficiency and adaptability of organisations based on networks of small teams can be understood in this light because their informal mechanisms make expensive layers of explicit bureaucratic communication and control norms unnecessary.

2.5 Norms and power

Each taxonomy of norms can help us to understand some of the different kinds of power that exist. These relate to the different norm subjects who are responsible for acting according to those norms or for changing them. For example: Substantive norms relate to the command over resources (physical ones at the lowest level); communication norms relate to the command over the use of information (including the “gatekeepers” empowered in a corrupt bureaucracy); and control norms concern the exercise of evaluative norms (inspectors, auditors, judges etc).

Behavioural norms can be organised according to another taxonomy which has quite a lot to do with the hierarchy of power (Stamper 1980). Behavioural norms generate *commands* as they prescribe specific actions to a specific agent in specific circumstances. We can generate commands using *standing orders*: for example, "reject any order which is received when the customer may not be able to meet the bill." This is simple but it can be extremely inefficient and unduly complex if for instance we have hundreds of thousands of customers, when the process can be made more efficient by assigning credit limits. We may use formulae based on their known purchasing behaviour, but formulas that vary according to the category of the customer. We may have high, middle and low credit risk categories and a norm to place a customer in one category or another. This is called a *status norm* and it has no direct effect on the world of physical actions, but it does change the social world by establishing categories and how they are populated in a social sense, in fact, a new social percept. A status can then be used in the condition of a standing order to give us a much more compact and powerful norm structure. The third category of norms in this taxonomy is *powers of intervention*. If every norm always applied to everything we would soon be overwhelmed by complexity, but for each particular case, we decide which norms are relevant and which are not. The norms governing the exercise of this kind of discretion are powers of intervention. For example there may be quite strict rules governing when people can take their vacations, but a manager may be given quite explicit powers of intervention to invoke or inhibit the use of different norms in the interest of efficiency or fairness. Finally we have the powers to start or finish the existence of norms of various kinds. These *powers of norm formation* may be given to individuals but they can also be spread by various means across the community in the interests of democracy.

These four kinds of norms fall into clearly delineated taxa because they effect changes respectively in the physical world, the social world, the application of existing norms and the existence of norms themselves.

There are many other possible norm taxonomies for example the classification of perceptual norms according to their (philosophical) categories. Norms also have a semiological order depending upon whether they refer solely to physical things (zero order) or to signs about physical things (first order) or to signs about first order constructs (second order norms) and so on. This is related to the theory of types which Russell used to handle paradoxes caused by confusion over reference. In this paper we have concentrated mainly on behavioural norms but the cognitive, evaluative and perceptual norms yield their own valuable taxonomies. One of the purposes of our research programme is to find well-defined properties of norms, in this way, and to explore their value for understanding organisations.

3. Signs and Norms in Information Systems Design

3.1. *A Semiotic Analysis of Information Systems*

Norms and signs are inseparable. Our research belongs in the domain of organisational semiotics because we are attempting to understand organisations in terms of the signs and how, through norms, they are used to get things done. Understanding norms makes sense of signs in their two roles of establishing the existence of conditions that invoke the consequent of the norm and then communicating the result to other norm subjects. Note that this second role implies the treatment of all physical acts as potentially sign-acts, an hypothesis that, if acceptable, leads to a valuable extension of the theory.

Norms can be classified in another clear way according to their role in relation to signs and their functions. This taxonomy is particularly relevant to forming an understanding of the impact of information technology as both a cause of organisational change and either enabler or inhibitor of organisational adaptability. A semiotic framework (Stamper, 1996) is helpful for our analysis, a framework recommended by FRISCO (Falkenberg *et al.*, 1998) as a philosophical foundation for information systems work. We make use of this framework to divide the properties of signs into six layers each of which involves its own layer of norms:

- social
- pragmatic
- semantic
- syntactic
- empiric
- physical

which can be investigated independently, to a large measure, while being related by direct inter-dependencies with their neighbours in the order shown.

All signs depend upon physical phenomena so there is a layer of properties that are essentially those studied by the physical sciences (their mass, energy, spatial dimensions, duration and so on) and also their economic properties at the material level. The basic hardware issues of information systems belong at this level. The technological change-drivers arise from improvements in the physical properties of signs, where issues of the costs and efficiency of information systems are rooted.

The social level, at the other end of the scale, is where the values of information are rooted. Signs have no value unless they produce some social change. Unless a sign changes a person's attitude to their values, beliefs or obligations then it simply runs into the sand without effect. At the social level we locate the links between signs and norms, achieved by the perlocutionary acts that we perform when a sign actually produces a social change. The resulting attitude is effectively a social encoding of the sign in a mental state which disposes a person to act in some way. It may be useful also to consider at this level the physical acts which, sooner or later, result from these attitudes either in communication acts which are more of semiological than of physical interest, or in physical acts which can always function also as communications. In the part of our research concerned with the impact of IT on organisational change we are investigating the role of technology as an embodiment of norms and the effects this has on the maintenance and adaptation of IT systems.

For a physical act of signalling to result in the correct social consequence, the signs employed have to be organised correctly on each of the other layers of the semiotic framework. At the level of empiric structures the physical phenomena are organised into predictable and recognisable patterns, such as alphabets, which allow us to reproduce signals reliable to enable us to signal the changes that are taking place in the world. This is the level of properties studied by statistical communication theory which is associated with the name of Claude Shannon. Communication channels and their capacity are considerations at this level of analysis. Many of the change-drivers mentioned above clearly have their impacts at this level where variety, statistical uncertainty, message volumes and evolving communication networks can be studied within the domain of empirics.

When we have established these repertoires of reliable patterns and can use them with error rates that are low enough, we can then begin to build complex sign structures. At this level of syntactics we are interested in quite a different set of properties, those we associate with formal languages and logic and models and software, record syntax and database structures and so on. In many important respects, globalisation depends on our new-found ability to build complex and reliable structures that may be distributed globally and used to coordinate actions by enterprises in different countries or continents - such distributed syntactic structures are only now becoming available during the 1990's.

These three first levels - physical, empiric and syntactic - have been receiving most of our attention in the IT domain. They are mainly concerned with efficiency issues and those people who normally think of information systems as essentially computer-based systems are likely to be contented with those levels of analysis. They are important, of course, but quite inadequate for understanding organisations as information systems. For that we are more interested in the relatively neglected human information handling functions.

Semantic functions, for example, make up the subject matter of the next level. We need to know how meanings are made and maintained and used in our communications with other people. Managers, of course, are far more interested in what other people mean than in the communication protocol used in sending a message. Our approach to meaning treats it as a relationship between signs and human behaviour, which helps us interpret changes to what people value and perceive as changes at the semantic level. We have already cited new concepts such as value chains as semantic change-drivers. But there are many others, such as the derivative financial products that seem too little understood by the banks that trade in them, in the sense that their behaviour has not adapted to the use of these new concepts.

Also, the inertia caused by computer schemas when business semantics change has already been cited.

If we can express our own and understand other's meanings, our signs are then well enough organised to express intentions: this is the domain of pragmatics. Signs which are used to get things done need to be accompanied by some signal of intention, as Austin (1980) pointed out in his essays "How to do Things with Words" which brought this level of analysis into being. The resulting speech act theory (Searle 1969) is in the process of development but by no means complete. Speech acts include the *illocution*, by which an intention is attached to a *proposition* to create a *message*, the act of *addressing* the resulting message to someone so that it becomes a *communication* and the building of chains of communications into patterns of *conversation*. Speech act theory is not well enough developed, as yet, for the study of organisation because it needs also to take more fully into account the semantics of the messages and the disposition of responsibilities and powers among the norm subjects. Without considering these factors, effective communication cannot be understood, nor organised interactions and the related change-drivers. Problems at this level include negotiations across cultural boundaries, conducting commercial relationships in the context of changing laws, more sophisticated relationships with customers and suppliers and, very importantly, electronic data interchange which introduces automation at the level of pragmatic norms.

3.2 *Requirements Modelling*

Method engineers are seldom explicit about their philosophical positions but these have far-reaching effects. For example, the classical methods of systems analysis and design recognise only the existence of signs (messages and records) in their formal structures and have little interest in their implication beyond these signs. The introduction of semiotics to computing systems work has raised a range of useful questions and some answers from philosophical and organisational perspectives, which are now regarded as highly relevant to information systems development (c.f. Andersen 1997, Calway 1995, Gonzalez 1997, Souza 1993, Liu *et al.* 1998, 1999).

Our approach is radically different from most information systems methods in adopting a social-subjectivist stance and an agent-in-action ontology. This philosophical position states that, for all practical purposes, nothing exists without a perceiving agent nor without the agent engaging in actions. That is to say, each thing depends for its existence upon the existence of its antecedents. Words and expressions we use are names for invariant patterns in the flux of actions and events which the agents experience. The classical distinction between entity, attribute and relationship disappears to be replaced by the concepts of agents, affordances (the actions or attributes of agents) and norms (for the socially defined patterns of behaviour) related to their antecedents to indicate the ontological dependency.

Figure 3 shows a semantic model, also called ontology chart because the affordances are linked by lines if there is an ontological dependency. This chart shows how projects

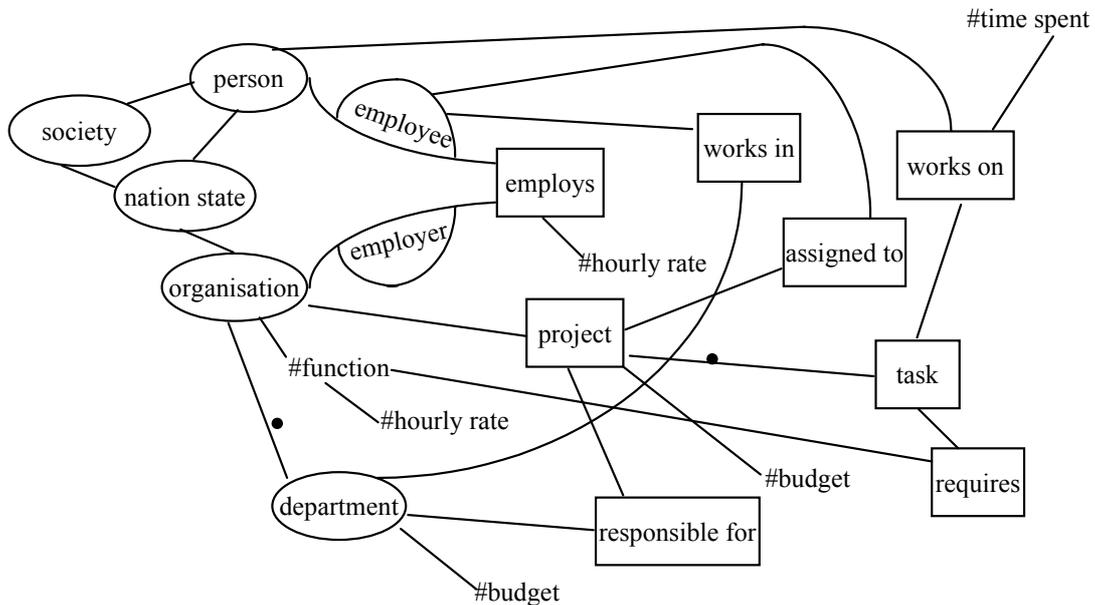
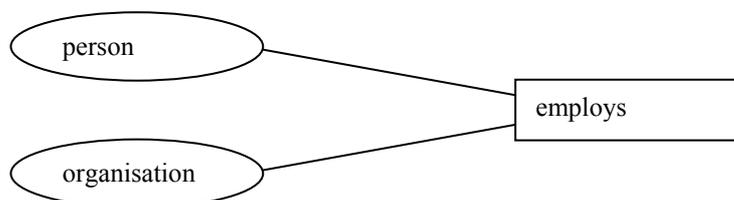


Figure 3. A semantic model for project management.

are organised in a company, which is typical in many large organisations. Agents (in ellipses) have affordances (in rectangular boxes). Affordances may have determiners (in plain text preceded by a hash sign), which quantify the affordances or describe their attributes. The ontological dependencies are denoted by lines, with antecedents shown to the left and dependants to the right. This semantic model mainly represents that a project can be sponsored by any department, which is a part of the company (a line alone with a dot denotes a whole-part relationship). A project is composed of tasks, which can be undertaken by employees. Departments and projects have separate budgets.

The agent-in-action ontology has important implications for requirements engineering. In particular, it requires the relevant agent to be specified in every component of the requirements definition. The benefits of this constraint are: (a) we know the originators responsible for production of requirements are the users of information; (b) we can handle differential meanings for the same term; (c) we know exactly whom to consult over details of design; (d) we can organise norms (system functionality) according to the various agents involved. These will help us in requirements engineering. Clearly a philosophical position is not a side issue but of fundamental practical relevance (Liu *et al.* 1999).

Our philosophical arguments lead directly to the observation that an agent in a situation where it experiences certain invariants (or affordances) becomes a modified agent, such as this part shown in Figure 3:



This part states that an organisation and a person jointly acquire an ability of employment. Both the *organisation* and *person* are the antecedents of the invariant *employs*, which means that employment is only possible when both the organisation and the person exist. An agent involved in a relationship has responsibilities and entitlement, and therefore may have a role name. For example, a person employed by the organisation has a role name “employer” and therefore can undertake a task in a project.

A semantic model provides a conceptual design for an information system. It represents the patterns of behaviour of an organisation, or the possible actions that an organisation can perform. However, there are other norms, as specified as business rules and regulations. These rules determine the conditions for the events and actions. Therefore, during the process of information modelling, norms have to be identified by studying the organisation’s behaviour and rules. Behavioural norms can be specified using deontic operators, such as “obliged”, “permitted” and “prohibited” as in the following generic form (Liu and Dix 1997).

whenever <condition>
if <state>
then <agent>
is <deontic operator>
to do <action>.

In the example of project management, the norms below describe the company policies about the powers and responsibilities of a project manager in the case of a project exceeding its budget.

whenever a project exceeds its budget
then the project
is obliged
to inform the heads of sponsoring departments.
whenever a project exceeds its budget
if a sponsoring department is to cover the excess and no objection from others
then the project
is permitted
to start a new task.
whenever a project exceeds its budget
if no consent from sponsoring department
then the project manager
is prohibited
to start a new task.

This format enables one to capture all the necessary elements of norm specification. They can be translated into a lower-level language, for example, LEGOL (Liu 2000, Stamper 1980) that can be executed in a computer system.

3.3. Information System Architecture

A semantic model defines the patterns of behaviour or the possible actions that a system can perform. Moreover, there are business rules and regulations that control the dynamic

aspects of the events and actions, and they determine when certain events happen or actions are taken. These norms should be captured during semantic modelling and norm analysis, and they will be linked with affordances in the system. In further detailed design and implementation, each affordance can be treated as an entity or an object (in relational or object technology), while the norms captured can be used as specifications for constraints and operational procedures that can be programmed in a computer system. Figure 4 shows conceptually how an affordance is linked with norms. Using this approach, a design of a computer information system is composed of two parts: the semantic model, which defines the patterns of behaviour, and the norms, which specify the conditions and constraints of the behaviour.

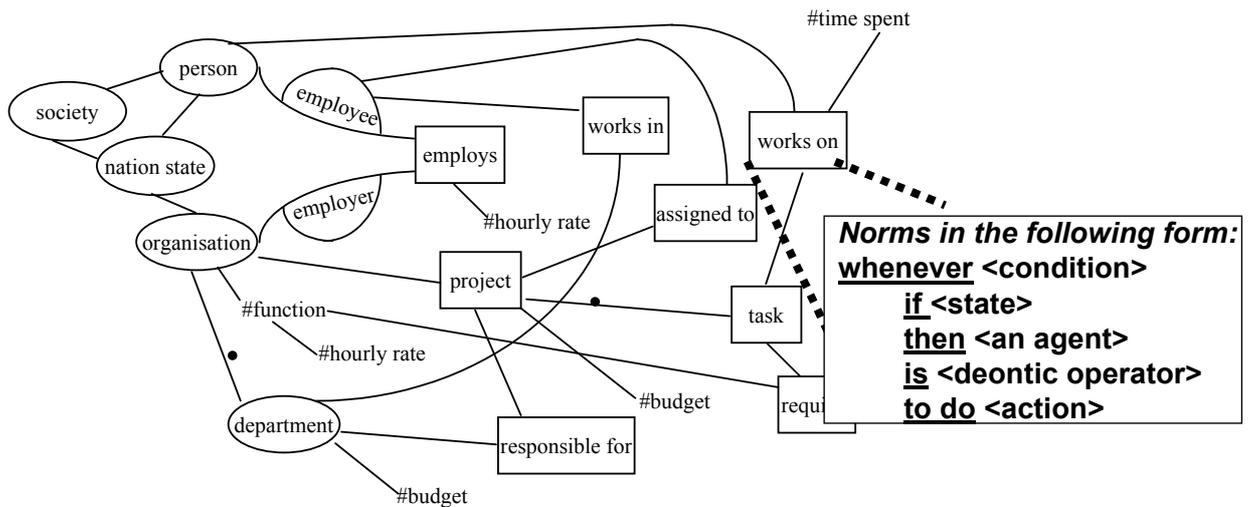


Figure 4. Norms as constraints are coupled with affordances.

This architecture allows a clear separation of data from business knowledge, i.e. norms (Stamper *et al.* 1991). The norms are centrally stored and managed, therefore it is much easier to check and maintain the consistency and integrity than if they are scattered in the system, as in a traditional system architecture. The norms can be also inserted and updated in the central repository. Business knowledge can be maintained using standard operations as “query”, “insertion” and “update”, as one would operate on the data in a database. In this way, the maintainability of the system is much better than traditional systems (Liu *et al.* 1994).

4. Conclusions

Our intention has been to introduce an approach to theorising about organisation based on the closely linked concepts of norms and signs. The method is particularly well suited to the study of organisational change. We have chosen it because of our interest in the roles that IT plays in enabling and disabling organisations trying to adapt themselves in a world of flux. This approach provides an effective way to information system design. Methods developed from this theory, such as semantic modelling and norm analysis, can be used for analysing organisations and modelling organisational behaviour. The resulting conceptual model of an information system has not only a sound philosophical basis, but also retains semantic richness. The architecture of information systems in this approach offers advantages over other traditional ones especially in system’s consistency, integrity and

maintainability. However, more research effort is required to make this approach more structured and perhaps more "formalised"; and therefore it can be easier to use in the development of information systems

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