

## Informality

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The notion of formal structure underlies the construction and operation of all our information systems. Data, programs and information models are all structured. As communication and information systems begin to merge, we are beginning to move away from traditional notions of formality. "Informal" information like voice and scribble is being captured and shared across communication channels. Distributed ownership of document creation and minimal standards of formalisation have fuelled the growth in the World Wide Web. This discussion document tries to set out a simple model of informality, as a first step in understanding how information and communication systems relate to organisational structure. In particular, a definition of informality will be offered for information, for processes, and finally for artefacts. The last is perhaps the most important, because it will bring us to the point where we can pose the question – how can we design systems that support informal information and informal processes?

## **1.0 Introduction**

The notion of formal structure underlies the construction and operation of all our information systems. Data, programs and information models are structured. There are even formal methods available to structure how we structure.

It is clear that the search for appropriate ways of formalising the way information is represented and manipulated has delivered more reliable and maintainable systems. It is also clear that in practice there is a limit to which this process of formalisation can be taken. Computer systems exist as models of processes in the real world. While it is possible to constantly push the way computer systems are structured, the real world is not so amenable.

Language, for example, constantly evolves ahead of our capacity to formally record it. Human organisations also are fluid and constantly evolving. As soon as aspects of an organisation are captured in a formal model, the model begins to decay in accuracy (Hogarth, 1986). This is because, while the model remains fixed, the processes it models continue to change. As time progresses, the formal model becomes less and less a true representation of the system it tries to model. Thus the lifetime of an information system is bounded by the rate of change of the system it models.

Rapidly changing human systems are therefore seemingly those least amenable to the application of information technology. Slowly changing ones, in contrast, allow time to capture a model, then implement and apply it. A relatively designed human system is also more likely to accommodate formalisation, since the presence of an obvious structure reduces the time it takes to create a model. Compare the difficulty in constructing an information system to manage processes in a government bureaucracy, to one that tries to manage trader behaviour on the floor of a stock market.

In contrast to information system, communication systems have provided relatively unstructured mechanisms for the exchange of information. For example, beyond modelling simple things like telephone number, and the way a call is made and terminated, there are no structures imposed on what is done during a telephone call. Thus there are no restrictions on what tasks are accomplished in a telephone conversation. There is even no restriction to the need for conversation. The system is sufficiently unconstrained that one can allow fax machines and computers to use the voice channel for entirely different purposes.

One can in this way, think of communication and information systems thus being quite complimentary. An information system exists to support relatively stable processes when they are important and efficiency gains can be delivered through automation. A communication system exists to support information exchange for all the other processes in an organisation that are not appropriate for formalisation into an information system. These might be too dynamic, too short-lived, or too infrequent to be appropriate for formalisation.

Thus communication systems, because they are informal, are relatively general purpose. They act as the glue that allows and organisation to connect together its formal processes, and work around formal processes as they start to become less appropriate over time. One would thus expect an organisation that had a good communication systems and worked around formal processes when they were inappropriate to be one that was flexible and responsive to change. Equally, a

bureaucratic organisation, with over reliance on formal process, will tend to become increasingly inappropriate in the way it interacts with the world, as its formal processes decay over time.

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These new systems are clearly much less formal than traditional information systems, partly because they are communication based. Hybrid in nature, systems like the Web and information-mediated communication devices are changing our understanding of the role that formality plays in the exchange and manipulation of information. It is not yet clear in what ways they will evolve, but one of the key ideas that will help us understand is the notion of informality. The remainder of this discussion document will try and set out a simple model of informality, as a first step in understanding how information and communication systems relate to organisational structure. In particular, a definition of informality will be offered for information, for processes, and finally for artefacts. The last is perhaps the most important, because it will bring us to the point where we can pose the question - how can we design systems that support informal information and informal processes?

## **2.0 Informal information - Getting formal about informality**

What does it mean for a system to be informal? We know that a formal system has certain properties arising out of having an *imposed structure*. Informality should therefore imply that a system is in some way unstructured.

One could thus say that informal information was simply unstructured information. This however, does not leave us with much. If information contains no structure then it is as good as random. In other words, it is not actually information at all, but random data.

The essence of any piece of information must thus be that it contains some structure. That seems unavoidable. What is possible, however, is that to an observer, that structure is in some way hidden. In other words, without access to some knowledge about its structure, data for all practical purposes *is as good as* random. This leads to a first intuitive definition of informal information:

***Definition 1: Information appears to be informal when we are unable to interpret its structure.***

This is useful, as it separates the notion of data and model, and brings in the notion that informality is something to do with one's relationship to information, and awareness of its underlying structure. Let's stick with this for a while.

Clearly formality is not a binary attribute of information. Models can vary in their level of complexity, and the scope of the real-world processes they model. The degree of structure we perceive in data depends entirely upon the models we bring to the interpretation. Consequently, it makes sense to think of informality also as an attribute that varies according to some measures of model complexity and completeness. For

example, a map designed according to a detailed set of symbols for navigation seems more formal than one that is drawn by hand. This leads to the next definition:

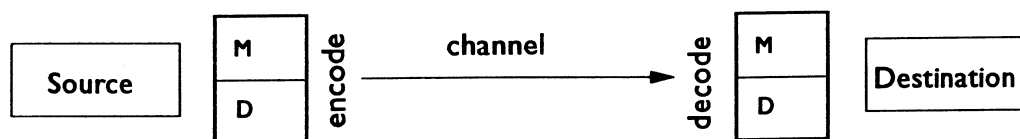
**Definition 2:** *The degree to which data appears to be structured indicates its degree of formality.*

There are many schools in the field of knowledge representation devoted to understanding how people draw inferences from minimally structured data. Qualitative physical representations (Coiera, 1992), causal models and fuzzy systems all attempt to find ways of creating minimally formal models that are still powerful enough to allow inferences to be drawn from data. So, a qualitative model of an engine is less formal than one based on a set of ordinary differential equations.

### 3.0 Informal Systems and Interactions

We have up until now loosely talked about information and communication systems as being somehow different. In particular, it has been implied that communication systems are somehow informal and that information systems are formal. They are in actual fact just different views on the same underlying communication structure, first elaborated by Shannon's Information Theory.

Shannon's model starts with a source and a destination, communicating across a channel. These communicating entities can be humans, communication devices, or computer programs. When information is exchanged, it is structured according to some code by the sender. Its meaning is extracted by the receiver, who also has access to the code. So, when data is exchanged, its interpretation is dependent on the sharing of a model between sender and receiver (Fig. 1).



*Figure 1: Information and communication systems share a common underlying model where data (D) is exchanged and interpreted according to a formal model (M).*

We can contrast information systems with communication systems by noting that the degree of formalisation between the two is traditionally significantly different. Normally, a communication system only models data to ensure that what was sent is the same as what was received. An information system goes further by modelling some of the semantic structure of data.

Thus, with a communication system, the models needed to interpret the meaning of the data have to be *external* to the system. For example, the models used to interpret the meaning of speech in a telephone conversation are contained in the heads of the people engaged in the discussion. With an information system, the models used to interpret the meaning of data are partly *internal* to the system. Thus for example, a program is able to respond to the values of data because it has some internal model that allows the data to be interpreted. Note however that we are not saying that the information

system has a complete model. As was noted at the very beginning, information models capture only some aspects of the real world. This led to a system definition of informality:

***Definition 3: An informal information system is one that cannot interpret data because the model that permits interpretation is external to it.***

Of course, once again formality is measured across a continuum, rather than being a binary attribute. A system may contain some models, but others may possess a richer set:

***Definition 4: For two systems containing identical data, the system possessing models allowing the greatest set of inferences to be drawn from the data is said to be more formal.***

This set of definitions suggests that formality is dependent entirely on one's frame of reference. If a machine does not possess a model to interpret data, then that data is informal with respect to it.

This actually accords well with many common uses of the word informal. One can have an informal meeting with a colleague, for example. As far as one person is concerned, the meeting is unstructured, with no fixed agenda, and appears informal. This does not prevent the second person actually coming with a quite fixed, but unshared agenda. They can steer what is an apparently informal meeting along a very structured path without the first person ever being aware. The second party has thus been involved in a formal meeting. This now leads to a very interesting definition:

***Definition 5: During an interaction between two systems, information appears relatively informal to one system if a model for interpreting the information is not shared with it by the second system.***

Thus, with any man-machine system, our notion of the formality of the interaction depends upon the position of the models that will allow interpretation of data. If the machine and human share some models, then the interaction seems formal. If only the human possesses the models, then the interaction seems informal. This is why we intuitively feel that writing a note on paper or having a telephone conversation is a more informal process than entering data into a spreadsheet. With the phone call or the note taking, we do not share a model of the meaning of what we are doing with the telephone or the notepad. When using a spreadsheet, there has to be some degree of model sharing between the user and the models embedded in the spreadsheet.

#### **4.0 Informal Artefacts**

We are now at the point where we can try and extend the idea of informality to the instruments we use to help us manage our information and communication interactions. These artefacts might be as simple as a notepad or telephone, or as complex as a computer mediated communication device. In many circumstances informality is clearly a powerful attribute of information and interactions. If we are to build systems and artefacts to support this informality, we need to understand how informality affects design.

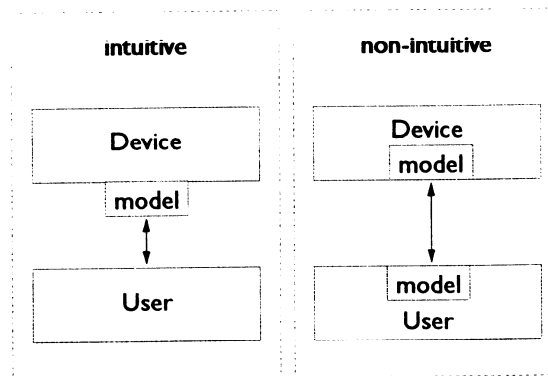
To operate a device, we need to possess a model of its operation in our head. When discussing the design of objects, Donald Norman makes a distinction between this

knowledge existing in the head or in the world (Norman, 1988). Norman's distinction refers to where we keep the model that allows us to interact with a device.

Objects which carry clues about how they should be operated are examples of knowledge existing in the world. This knowledge does not need to be retained by humans, but can be extracted from the object during the interaction with it. Thus with a well designed door, it is obvious whether a door should be pulled or pushed from its structure.

For Norman, the less we need to know before we come to an object, the more 'intuitive' we perceive its operation to be. With intuitive systems, we infer the model of operation from the external design of the system. The reason a trash can icon works on a computer desktop is because we can infer how to delete a file from the visual analogy, without having to learn a system specific set of commands. The trash can offers us a model we can use without bringing knowledge specific to the operation of the computer.

Thus intuitive systems make their models externally available. Non-intuitive systems do not reveal the model that is required to operate them. It must be brought in advance of meeting the object (Fig. 2).



*Fig 2 : Artefacts which carry an externally visible operating model with them appear more intuitive to use than those that demand that we bring knowledge specific to the interaction with use. The degree of effort involved in deciphering the model corresponds to our sense of ease of understanding the device's operation.*

This resonates with some of the above discussion about informal processes, i.e. a phone call is informal because the data is interpreted in the head, while a formal interaction requires us to have interaction specific model e.g. a model of how spreadsheets work.

The immediate inference one might draw from this is that intuitive systems are informal, and non-intuitive systems are formal. This is however not the case, since in the intuitive situation, the user still needs to have a model to operate the device. It is just that the model doesn't have to be brought a priori, but can be communicated at the beginning of the interaction.

If we recall the Shannon model, this means is that the human and the device don't possess common models *before* they meet. The model has to be transmitted at the beginning of the communication. So, as long as there is enough common ground between the two to allow models to be shared, then the interaction can continue. This

is why the trash can icon works, for example. It assumes that there is a shared understanding of “trash” between the user and the device (or more precisely - the device’s designer). The user can then use this to infer the operating model for document deletion. (Parenthetically, the amount of thinking one has to do to construct this operating model also contributes to the ease of understanding a device’s operation.)

Consequently, device informality is not about ease of use, ease of understanding, or intuitiveness of use.

What then do we expect of an informal artefact? Lets, for argument sake, compare two simple devices - a door knob and a pen and pad. Which is more informal? I will argue that the doorknob is most formal, and the pad least formal. This is because the way we use the doorknob (in all respectable social circles at least) is constrained to a simple operating model. It is operated, in one of a number of ways specific to different design variations, to do a standard function. The use of a pen and pad is much less constrained. There are many possible uses of these artefacts on many different tasks. We can make the same comparison between the pen and pad and a spreadsheet, and come to the same conclusions. The essence of artefact informality seems to be that several different models of use can be applied to the same artefact. We can expand definition 4 to now say:

***Definition 6: For two artefacts, the one permitting the smallest set of operational models is said to be more formal.***

***Corollary 1: Informal methods impose minimal constraint on the ways in which they can be used.***

***Corollary 2: Informal methods are more general in purpose than formal methods, having a wider range of tasks on which they can be applied.***

One lesson from AI is that general reasoning methods can be applied to many task, but are not particularly great at any one task. In contrast, specific methods are powerful, but have narrow application. Typically the general methods are knowledge poor i.e. they do not require much knowledge to be applied, whereas the specific methods rely on a lot of domain specific knowledge to work. A similar relationship between generality and power seems to hold for informal artefacts. While we can use paper and pen for a wide variety of tasks, there is a limit to the power of the method. If I want to manage small calculations, then I can use pen and paper, but if I want to do complex calculations, then a spreadsheet is more powerful.

This begins to explain the role of informal artefacts - they are multipurpose tools, which can handle many different tasks of low complexity. They are useful when:

- a task is simple
- the resources needed to use a more complex tool are unavailable e.g. I’d rather use a spreadsheet, but given the time constraints, a back of the envelope calculation will have to do
- a task is new, and no better tools yet exist. This is common in a dynamic environment, or when an individual has a wide variety of different and rapidly varying tasks
- a task is so infrequent that there is no call to formalise it

- more specialised tools are unavailable (at least to the limit of the informal artefact to handle the task)

Thus informal artefacts "fill in the gaps" for people as they go about doing their tasks. Interestingly, a "multipurpose" Swiss-army knife is probably not an informal artefact in this world view. It's a collection of relatively formal things, but because there are enough of them collected together, the collection starts to have a generality of application. So, if a Swiss army knife is like a computer with a set of applications, a pen and pad is like a...?

### **References**

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