CHAPTER 1

Understanding Things: The Manager's Guide to Systems Practice

Introducing some basic (but powerful) ideas

Begin at the Beginning – What is a System?

We encounter the word 'system' often in our daily lives. It crops up in many different contexts – some technical, some social and some philosophical. This text is for people who are intrigued by the concept of 'Systems' and want to clarify and develop understanding of its usefulness. In this text, we will explore use of the word 'System' and related terms such as 'Systems Thinking' and attempt to resolve some of the confusion surrounding these terms. As the chapters progress, we will introduce further aspects of Systems practice, and elaborate upon its usefulness in dealing with the challenges of life in the 21st century.

We will deal with the origin of the word system and its meaning later in the text as we do not need that now, but what we do need is to understand what it means in a practical sense. In everyday conversation we use the term loosely which helps to confuse understanding. In everyday speech we often refer to a 'system' when we mean a computer system. Many people, when told that one is involved in systems, assume that we mean that we are computer engineers. In other instances, people may use the term generally and speak of a system when referring to a government department. Such generalization is often the case when we complain about the unfairness of something: we blame the system. In recent times we hear newscasters and government spokespersons reporting a failure as being systemic, which seems to mean that no individual is to blame as the failure was a failure of the whole enterprise.

The way that we use the term system in everyday speech is imprecise and relies upon the listener interpreting what the speaker means. If there is plenty of agreement between the speaker and listener it suggests that the conversation is going well and that the speaker and listener inhabit the same area of interest (at least they assume that they do) but there is no guarantee that the system to which the speaker refers is the same one that the listener had in mind. The imprecise way that we use the word can be misleading, often resulting in the participants ending up with completely different understandings of the situation and worse, if we think of such a situation in terms of practitioner and client, what appears to be the right answer but is actually inappropriate to their particular problem.

A useful starting point in the practice of Systems thinking is to consider carefully what we mean when we refer to a system and define what system it is we are talking about. For example, if we were to discuss a transport system we need to decide what transport system it is we are considering. Is it freight? Is it a public transport system or is it a personal transport system that we mean (i.e. motor cars)? Do we include bicycles and other types of personal vehicle, and so on? Even when it seems we are referring to a computer system, do we mean just the hardware and software or are we including the people who are using it too? So let us agree some rules:

i. Always give the system a name.
ii. Agree that the name of the system to which the client is referring means the same thing to you!

Like many ideas in Systems, implementing such a simple idea is easier said than done but we have other ideas that can help us and the client to clarify what system it is we are interested in.

Some Simple Tools

Boundary and Environment

Most would agree that in any given circumstances it is wise to take into account as much of the situation as is possible before taking action. We need to see the situation in its entirety – that is to say to take in the whole, what we call adopting a holistic perspective. Many of us assume that we do this instinctively but often our horizons are limited by lack of experience of a new situation or awareness that things are changing from the familiar to something more challenging. When confronted with a new or a complex situation it is difficult to know where to start. The complexity of the situation itself can be overwhelming and it is not unusual at this stage that we can retreat to the safety of familiar techniques or rely on an individual within the situation to tell us what they think the problem is.

It is self evident that in any situation of interest we need to make decisions about what to include and what to leave out. Clearly a situation must have a beginning and an end point, and there must be some form of boundary around the system. If we do not do this then the alternative is that we will have to take the whole planet into account, which of course we cannot do; or conversely we slice up the problem into small pieces, but with this comes the danger that we might ignore important areas. One useful Systems idea is a simple yet powerful practical tool to help with this difficulty. The idea behind the 'tool' is the notion of boundary and environment.

What are these ideas and why are they useful? Many may be tempted to ask if they are just a fancy way of packaging up common sense. Well there is nothing common about common sense and the ideas which at first seem simple often have hidden depths which are realized as a user becomes more adept at using them. Despite the fact that, when confronted with a problem, most of us will consider the 'system' and make a mental note about what it seems to comprise, most do not represent it explicitly. We do not provide a clear enough description for the listener to understand and provide critical appraisal of what is being said. Using the idea of boundary we can begin, with those involved, to enrich understanding about the system – the situation of interest. But how do we set about deciding what is part of the system of interest and what is not? The first thing to remember is to beware a quick assessment. A hasty judgement can inhibit thinking, so take care. When you first draw your boundary remember that as you begin to understand what it contains, so will the boundary alter to reflect your richer understanding of the system of interest.

Let us consider an example. Imagine 'A Manufacturing System' is our area of interest. Where should we draw the boundary? We can start by thinking of things to exclude, including service industries and local government and obvious things like the entertainment industry and libraries. But what should we include? Well are we thinking of all aspects of manufacturing or specific areas such as those using metal? Do we wish to include all manufacturing or just those institutions within a given country? We need to decide what constitutes manufacturing. But, I hear you say, we would know the industry we were called upon to examine. This might be true but equally the practitioner might be asked to look into a changing manufacturing environment in which the company concerned needs to react.

Initially, our boundary and environment might look like Figure 1.1 below:

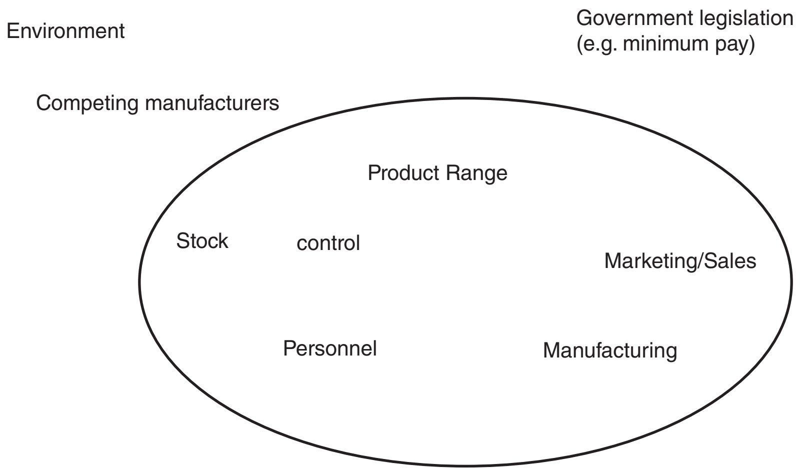

Figure 1.1: Drawing a boundary

This diagram enables us to begin discussions with the members of the enterprise. As more is learned about the situation the boundary might add more sub-systems such as Production Control, Research and Development, Drawing Office and in its environment 'Parent Company' (which may control the policy that determines the market within which the enterprise can trade), Suppliers, Skills Availability and Sources of Capital. We may find as we begin to gain greater insight that one or more systems in our environment might be better placed within the boundary of the system itself or vice versa. For example, the parent company might have a Board member on the Board of the subsidiary, in which case a sub-system relating to that role should be within the boundary. It might be that the R&D department is part of the parent company and should be in the environment (it might be a separate cost centre that is contracted by various parts of the holding company's portfolio).

Following discussions with all concerned, the final diagram might now look like Figure 1.2:

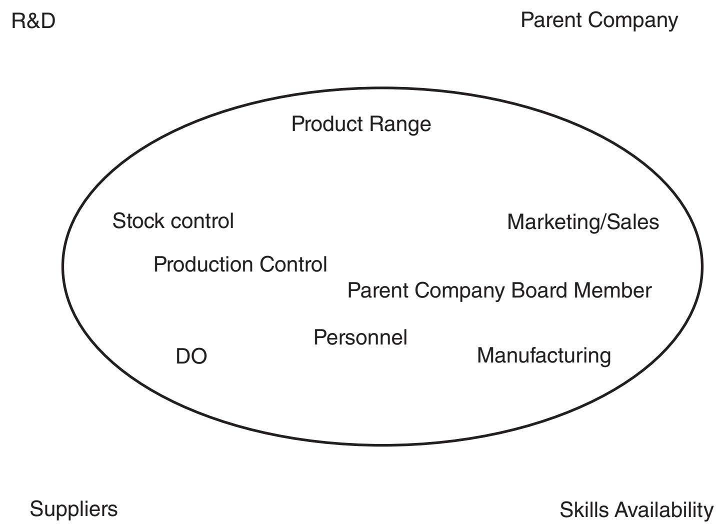

Figure 1.2: Boundary and environment

Using what appears to be a simple diagram we can begin to gain an appreciation of the system itself and what is in its environment. The process of developing the diagram will play its part in enriching the understanding of those involved. The simple idea of drawing a boundary around the system of interest demands clarification about what the system is (it requires a name) and what component elements make it up. Once an agreement about the system has been reached the next stage is to decide what is in its environment and what is not. In this way we are beginning to be more precise in our description of the system of interest and its surroundings. The development of the diagram is a part of a process of learning for all those involved, the outcome of which is an agreed representation of the situation of interest and the context in which it exists.

We now move on to another apparently simple idea, that of a 'black box'.

Black Box Diagrams

Another simple analytical tool that helps us make sense of complex issues is called a Black Box diagram. This thinking tool is borrowed from engineering where it is used to represent situations where the inner working of the product is less important than is the relationship between each of the sub-systems that make it up (see Figure 1.3).

Black Box diagrams provide a useful means of representing a complex situation using the notion of 'input → process → output' which is common to many systems diagrams (see Figure 1.4):

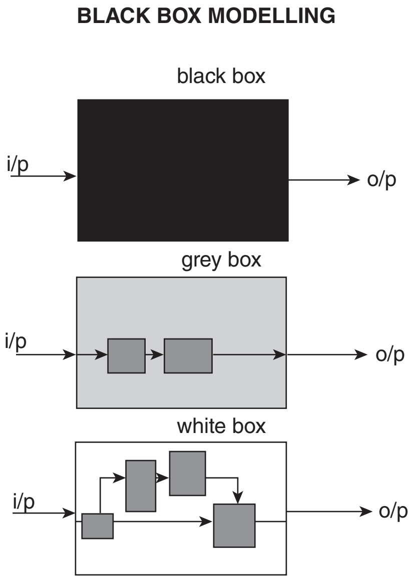

Figure 1.3: Black Box modelling

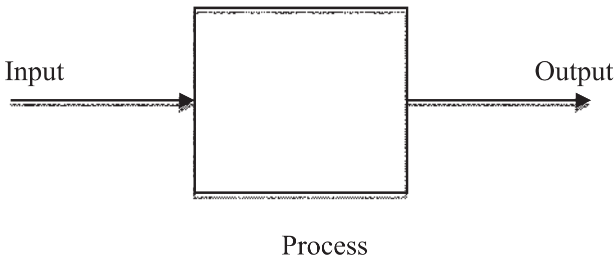

Figure 1.4: Input–Process–Output diagram

The strength of a Black Box diagram is that there is no need to understand all the detailed processing that is undertaken inside the system as a whole, it is enough to recognize that 'something' happens and that this 'something' has particular inputs and outputs which can be identified. A further advantage of a Black Box diagram is that by obeying a few simple 'rules' the process can lead to a comprehensive learning exercise.

The first stage is to represent the whole system (i.e. the situation under investigation), as a single 'input → process → output' diagram. The system is named and the inputs to this system are listed and drawn and shown to be feeding into the system – let's call it stock control. The outputs of this system are then identified and shown flowing out of the system as illustrated in Figure 1.5 below:

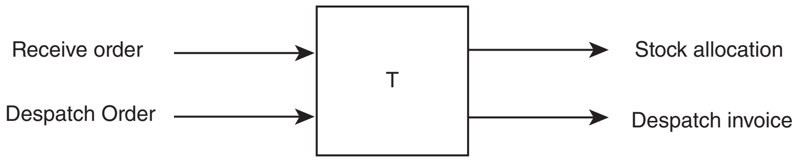

Figure 1.5: Simple first level Black Box diagram

The given system is then 'broken down' into smaller wholes, or sub-systems, and the process of identifying the different inputs and outputs for each sub-system is undertaken until a list of all relevant sub-systems has been developed. The completed diagram may look as shown in Figure 1.6:

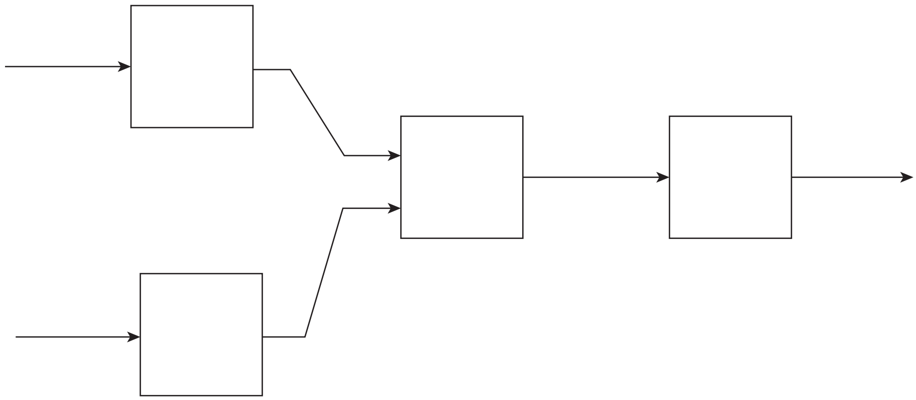

Figure 1.6: Outline of developed Black Box system

As is the case with most systems diagramming the idea is quickly learned but there are pitfalls as it is possible to get it wrong if the conventions of deductive logic are not followed. This and an example of a more complex Black Box diagram, are given in the next chapter. Why not try to represent a system of interest to you – say your central heating system. If you do you will learn that you can produce quite a complex diagram without the need to become a heating engineer.

Another diagramming method we have found to be useful is the influence diagram. These diagrams allow us to represent a situation in terms of the relationships and outcome of various interactions.

Influence Diagrams

Our experience of life shows us that the way we react or the way that things interact with each other will produce some kind of effect. So we can represent our system of interest as a series of relationships or influences. For example, we can say that, by and large, the number of calories we consume will influence our weight. This is not true for everyone but generally speaking it is true. Using this simple idea we can build up quite complex models of any given situation. Let us take a simple representation showing the relationship between consuming chocolate and weight gain, shown in Figure 1.7:

Craving for chocolate	⟶	influences the	⟶	Acquisition of chocolate
Acquisition of chocolate	⟶	influences the	⟶	Quantity of chocolate eaten
Quantity of chocolate eaten	⟶	influences the	⟶	Weight gained
Weight gained	⟶	influences the	⟶	Craving for chocolate
Craving for chocolate	⟶	influences the	⟶	Acquisition of chocolate

Figure 1.7: Example of possible influences of chocolate upon weight

The diagram is an oversimplification of course as it is not true that everyone who consumes chocolate gains weight. The value of influence diagrams lies in their simplicity and in their power to represent the relationships between complex issues. These diagrams can be extended and translated into a computer program using building blocks as part of what is called System Dynamics (SD). System dynamic programs allow us to represent a situation using the notion of feedback to discover what might happen if we alter inputs, what effect certain influences might have upon the system. SD is a useful aid for assisting us to make decisions. We will return to feedback and influence diagrams in the next chapter and deal with System Dynamics in Chapter 3. Meanwhile why not try to represent a situation familiar to you as a set of influences?

Feedback – Positive and Negative

It is obvious that the way we influence things can be in a positive or a negative way. Influence is not a neutral thing. In Systems we do have a way of representing these kinds of influences but at first they seem counterintuitive. Positive feedback can be a bad thing and negative a good thing. Too much positive feedback or lack of negative feedback will cause the system to collapse. Think about what happens when an electrical device gets near a microphone: there is an unpleasant howl isn't there? The characteristics of a system, which has only positive feedback, will be that it is driven in

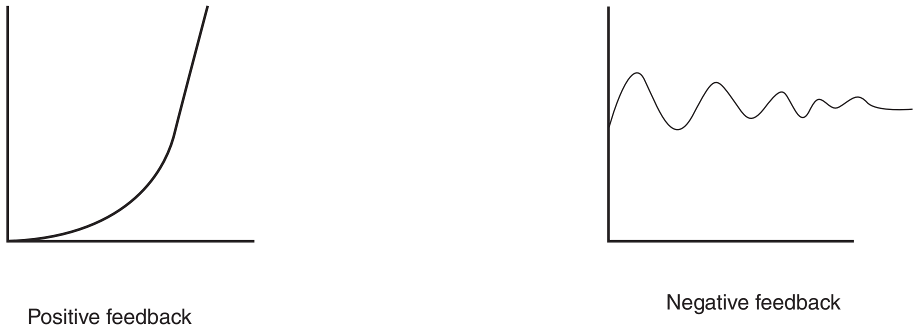

Figure 1.8: Positive and negative feedback

the same direction until it collapses. The characteristic of a fire provides a good example of positive feedback. We light a fire and it burns until all the fuel has been consumed. We can delay it going out by replenishing the fuel, but it will eventually run out of fuel and go out. Negative feedback on the other hand seeks equilibrium and stability. The control it exerts seeks to find equilibrium and stability. For systems to survive there must be a sufficient amount of negative feedback to maintain stability (see Figure 1.8).

Systems Maps

You will have seen this style of diagram elsewhere and called them by another name but we use them in a slightly different way to that which you may have experienced. For example, you would be correct in thinking that they resemble a Venn diagram but because we use them in a particular way and for a particular purpose we call them systems maps.

So what is particular about the way we create and use these diagrams? Well we use them in two ways. First and most importantly, we use them as a means of helping us to think about a situation of interest (which we will call our notional system). When thinking about what makes up our system of interest, we need to consider boundary and environment (see page 4). Once we have decided what it is we go on to consider what components (call them sub-systems for now) make up our notional system. The second reason we use the maps is as a simple means of communicating our ideas to other interested individuals. Do not underestimate the educational value that the process of creating a systems map provides. Remember that the map is the means for you to present your thoughts to others. You should take time to develop the map and consider it as complete only when you have exhausted every aspect of the area of interest. Remember that there is no right or wrong answer to your map because it is your view of the situation (we sometimes call this our *Weltanschauung* but we will come back to that later in the text).

What is the difference between a systems map and the notion of boundary and environment that we discussed earlier? Well the notion of boundary and environment is a means of deciding what is relevant to your area of interest, what is outside in the environment and what is of no interest at all. The systems map on the other hand is a diagram of all the elements that make up your notional system. Let us take one of the components from the boundary example above: marketing. For this example of a map we will be considering 'what is marketing?' (the proposition). Remember that this activity is part of an exercise in learning so you are not expected to be an expert in marketing but the map provides you with an opportunity to explore your thinking before you discuss your ideas with colleagues. The systems map might look like Figure 1.9:

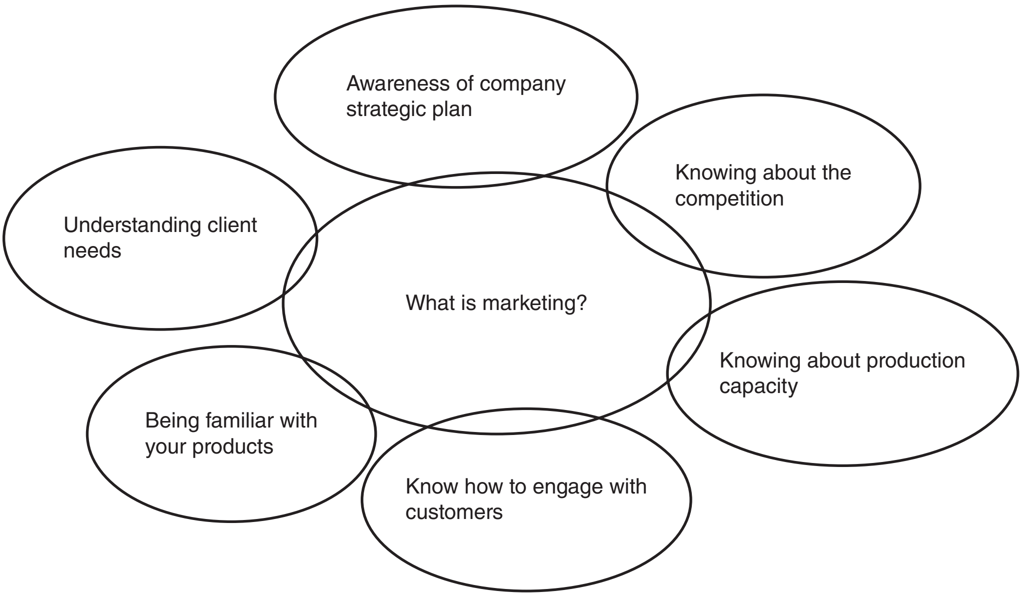

Figure 1.9: Example of a systems map

This of course is by no means THE map of marketing but it is (in this case) my map. All of the sub-systems overlap the central element, which we now call the proposition, because, in the opinion of the drawer, these make up Marketing. Needless to say you would require clarification and confirmation of each of the sub-systems but more of this in later chapters. For the moment just practise producing a systems map of your own which represents something you are interested in, such as a hobby or a holiday.

Rich Pictures

If you happen to be familiar with Soft Systems Methodology (SSM) you will recognize this as one of the early stages in SSM mode 1 (SSM is discussed in detail in the next section). The idea of a Rich Picture is to represent a situation of interest in the form of a cartoon-like diagram. We all know how a good cartoonist can capture a whole event or series of events in one picture. This is a general idea behind RPs. Like all systems of interest you and your clients will have to decide where your boundary lies but as you have learnt already the boundary gradually unfolds as you learn more about the situation. The key to a successful picture is not so much your skills as a cartoonist but your ability to capture a rich representation of the situation but without putting a rigid structure around the elements contained within your picture. The RP should be an unstructured account of the situation of interest. What do we mean by unstructured? Well we do not mean a random set of images but a representation which is the result of the interaction between the structure and the processes within the situation and the issues that arise from them. What we do not want is a pictorial representation of a list – that is to say we do not want a formal account of each part of the situation as one might create a list. For example, in the case of a manufacturing enterprise we do not want to see all of the production activities in one corner, marketing in another, stores in another and so on. What we are looking for is the emergence of issues and resultant activities which, together, portray the situation as a whole. You can try this by drawing a picture from a short piece reported in a newspaper. You can ask a friend to look at your picture and see if it tallies with what was written down. There are few examples of Rich Pictures publicly available but most are contained within the numerous studies undertaken by postgraduate and Open University students over the last 30 years. The picture in Figure 1.10 is taken from an SPMC workshop in 2009 and depicts the summer heatwave of 2003 which had a profound impact upon the United Kingdom with complex effects being experienced both immediately and into the future. The most widely reported result was the large number of excess deaths directly attributable to the weather, but the effects upon businesses, individuals, the emergency services, hospitals, the justice system, insurance services, utility companies, tourism and transport services to name but a few, whilst not as widely or comprehensively reported, were wide ranging.

Although the Rich Picture in Figure 1.10 provides the observer with a full account of the situation it is possible to produce a picture (see Figure 1.11) which is as rich but perhaps not as 'pretty':

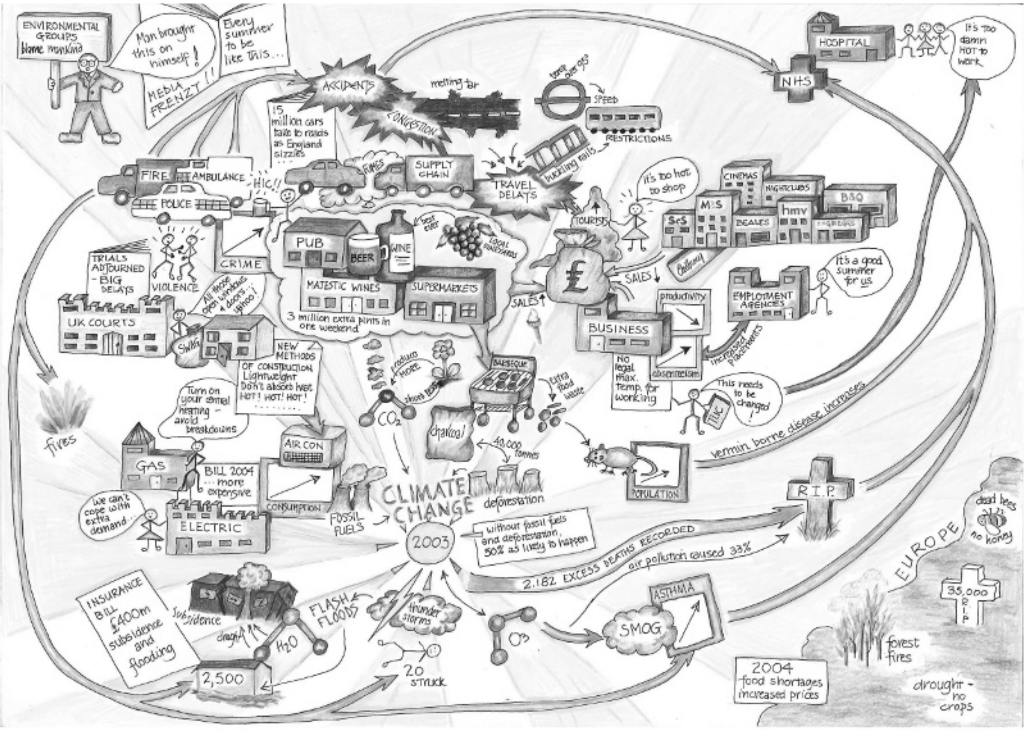

Figure 1.10: Example of a Rich Picture: perception of the heatwave of 2003 (Courtesy of L. Day)

Activity or Conceptual Models

For those familiar with Soft Systems Methodology mode 1 you will be familiar with the Conceptual Modelling stage. Here we refer to it as an 'activity model'. An activity model is a model of a series of activities which show how a given system functions. It is a diagram where activities of a named system are identified and expressed using the verbs of the English language as their main component. The form of the diagram is built around the logical dependencies of the activities involved with arrows linking them. The activities themselves are placed within cloud-shaped boundaries as a means of emphasizing that they represent the working of a given notion system (an example of an activity model can be seen in Figure 1.12). The activities that have been named are not necessarily real-world activities – they are the activities that need to take place if the notional system is to function. In SSM, the conceptual model has traditionally been described as being purely a description of an ideal type that is developed from a detailed and carefully composed description (a Root Definition) of some notional system. However, practice has shown that we do not need to adhere strictly to the Root Definition-Conceptual Model conversion, but instead may produce an activity model

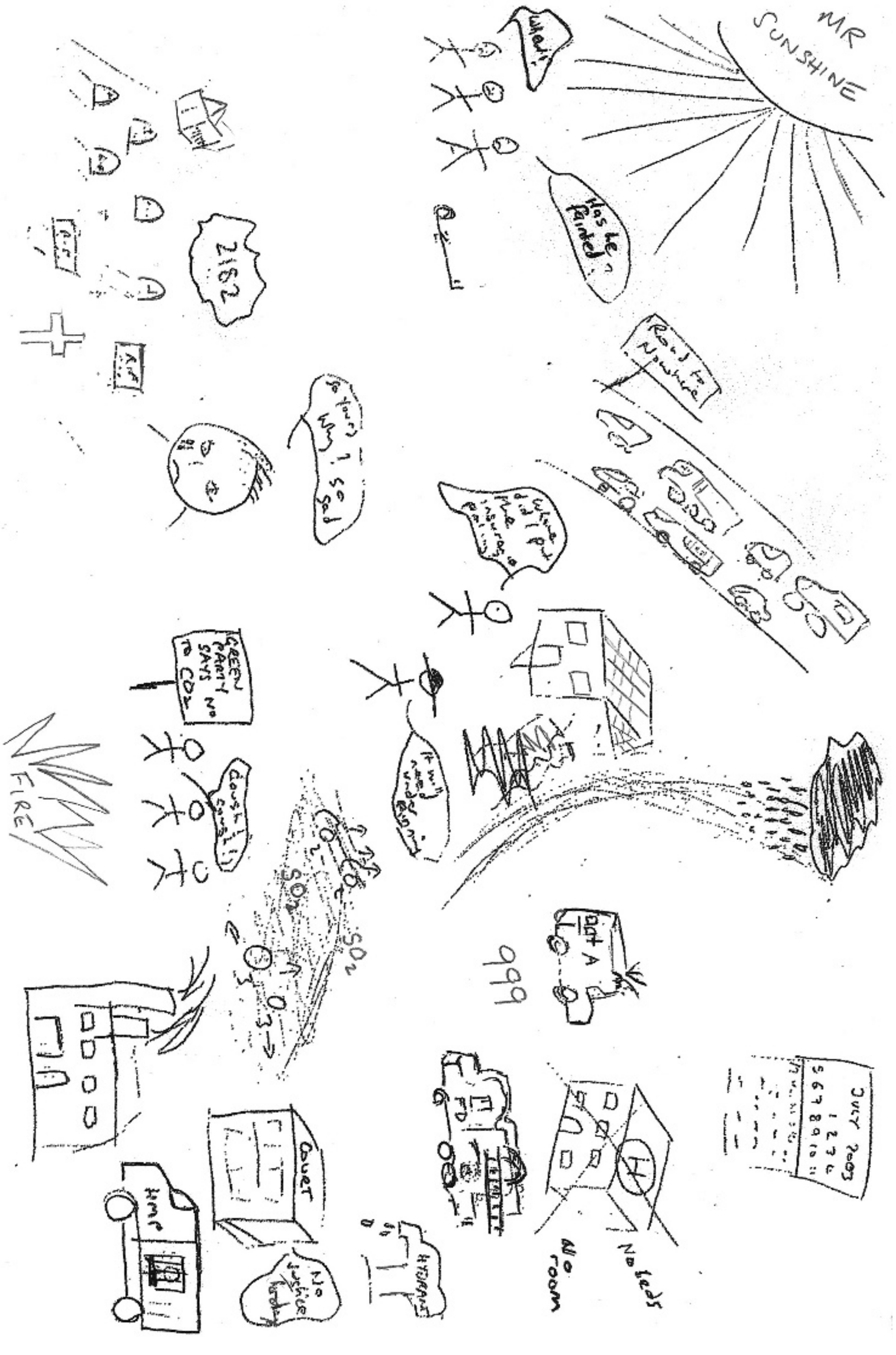

Figure 1.11: Rich Picture of the same situation but less artistic!

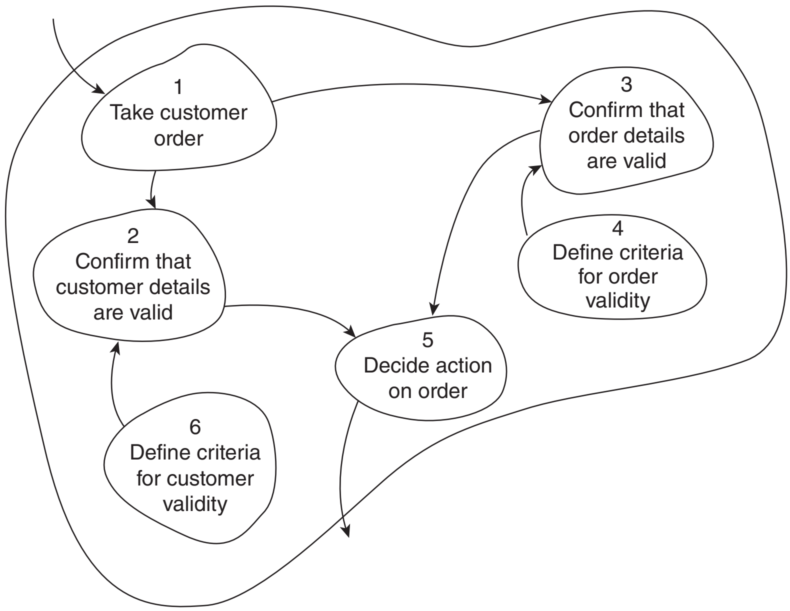

Figure 1.12: Example of an activity model of an Order Validation System (see Stowell and West, 1994, p. 87)

directly from some appreciation of the activities of any named system (for example, one identified in a Black Box diagram or a systems map).

The activities themselves describe purposeful activity, each activity is doing something and as such each description of an activity begins with a verb. The relationship between each activity is a logical one rather than an incremental one. If the activities are numbered then it should be taken as an address rather than a representation of the order of execution of a set of actions. Care should be taken to ensure that the activities in the model are all at the same level of resolution; as a rule of thumb an activity model should not have more than 7 ± 2 activities. If not, it may be necessary to conduct further modelling in order to decompose activities. An example of an activity model is given in the next chapter.

In order to develop an activity model the system of interest must be carefully named (e.g. expressed in terms of the transformation to be effected together with its associated perspective). Then the next step is to begin to assemble verbs which relate to the activities that must be undertaken in order to achieve the stated transformation. Once these activities have been identified they are arranged by identifying their logical dependencies using arrows to link the activities. A system boundary needs to be added and it is worthwhile to try to identify the input and output of the system (and subsystems). Finally, since we are interested in viewing the named activities as a collected whole, or system, we need to be concerned with the continuity of the system which can be brought about by monitoring and controlling it. For this reason it is usual to include the monitor and control activities within the overall system boundary. But we will return to activity models in more detail in the next chapter.

Summary

The above examples show different ways of both representing and gaining understanding of a situation of interest. We need to remind ourselves that a diagram is a representation of the way that we, or if used correctly, those involved, see the situation. It is not the situation itself but an interpretation of it. These diagrams are useful thinking tools in their own right but, as you will learn later in this text, in Chapters 2 and 6, when used as part of a method or methodology they take on a greater significance. When they are considered within a particular intellectual framework the way in which they are used becomes more demanding.

Each of the Systems methods and methodologies described later in this text all share the same aim and that is to produce a model of some kind as a way of learning and of gaining an appreciation about the situation of interest. But it is important to remember that these are models and as such a representation of a thing or situation at a given moment in time and which is the view of those who create the model.