

System Purpose

If you don't know where you are going, don't be surprised to end up somewhere else

Stuart Burge

All systems seek to achieve a purpose. Whether human made or natural, all systems strive to do something. When creating a new system or modifying an existing one, it is done in order that the resultant system does something “useful”. The reason useful is in quotation marks is that “usefulness” of a system depends upon the viewpoint of the observer. The purpose of a system is a property of the whole and not in any of the components. Notice here that there is a close link between emergence and purpose. At this point it is useful to talk about two types of system; designed systems and evolved systems.

Designed systems have a defined start and finish to its life. They are human developed systems that have come about by a deliberate conscious act; we put effort into ensuring that the actual emergent behaviour matches the purpose. Designed systems tend to be product-based systems that include, pens, houses, aircraft, etc. It is also possible to include some service-based systems in the designed category and is where the next great revolution in system design will take place.

Evolved systems may have specific start and certainly have no end date. They include businesses, institutions, and legislative systems. A classic example of an evolved system is country's tax system. They may even have had a “designed” start, but have been modified in a piecemeal fashion over many years. Evolved systems are potentially immortal but many do die. The use of the term evolved is quite fitting, as their persistence is often a matter of the survival of the fittest. Quite often with evolved systems the actual emergent behaviour doesn't match the stated purpose. And, indeed, one of the reasons evolved systems continue to evolve is because their actual behaviour doesn't match the desired and are therefore constantly subject to change. The fact that this change is often “not thought through”, root causes not found, solutions not explored and implementations rushed can only, as you will see later, cause more problems.

It is also possible for a system to have more than one purpose, particularly evolved systems. One only needs to consider a financial bank to realise that what once was an institution that had a sole purpose (to store money securely) has evolved into complex system that carries out multiple purposes.

When we consider the purpose of a system, logic and the laws of the universe dictate that it requires the achievement of lower level purposes. Each of these lower level purposes in turn logically requires the achievement even lower level purposes, and so on. This is shown diagrammatically in figure 1.

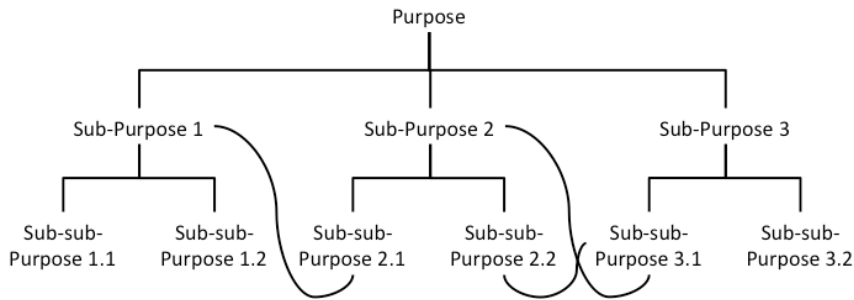


Figure 1: The System Purpose logically requires the achievement of lower level purposes For example, consider the humble toaster! Its purpose is quite simply:

- To toast¹ bread-based items

Logically, to toast a slice of bread it is necessary to:

- Load bread-based item
- Generate heat
- Apply heat to the bread-based item
- Monitor toasting
- Control toasting
- Remove heat
- Unload toast

This is a list of lower level purposes that are necessary to achieve the higher level one. If I now move into the object world we are familiar with, Table 1 shows a range of solutions to the lower-level purposes.

¹Toasting is the browning of the surface of a bread-based item by exposing it to radiant heat. The browning is due to the Maillard reaction. Louis-Camille Maillard first described a chemical reaction between amino acids and reducing sugars. This reaction changes the flavour and colour.




| | | | |
|----------------------------|---|--|---|
| Lower Level Purpose |  |  |  |
| Load bread | Stick bread slice on end of toasting fork | Put the bread into the slots | Put bread on conveyor |
| Generate Heat | Open coal fire | Electric elements | Electric elements |
| Apply heat to bread | Use toasting fork to bring bread close to open fire | Lower bread next to elements using lever mechanism | Conveyor takes bread past the electric elements |
| Monitor toasting | Look at the bread from time to time | Look at the bread from time to time | Look at the output |
| Control toasting | Move bread to get even toasting | Adjust Timer | Adjust speed of conveyor |
| Remove heat | Use toasting fork to take bread away from the open fire | Lift bread from elements using lever mechanism | Toast falls on to catch tray |
| Unload toast | Take toast off of the fork | Take toast from slots | Take toast from catch tray |

Table 1: A range of solutions to the lower level purposes

The first point I would like to make about Table 1 is that all the toasting solutions just present different ways of carrying out the lower-level purposes. In fact the lower purposes will never change! In 500 years, if we still like toast, in order to toast a slice of bread we will still have carry out the purposes in the left-hand column. This is simply because they are a logical consequence of the higher-level purpose.

The second point I would like to make concerns “what is the system”. Clearly the toasting fork will not carry out, on its own, the higher-level purpose – “To toast bread-based items” – the coal fire and the human are also essential. There is a link between what is the system of interest and its purpose (and sub-purposes). Indeed, in order to define what is my system of interest I will need to find out its purpose and perhaps also lower-level purposes. It is also, perhaps, interesting to note that similar comments can be made for the remaining two “toasters”. Neither carries out the sub-purpose of “monitor toasting”, that task is still carried by the human².

² At this point when I use this example I often get people stating that they don’t do this with their toaster. I actually believe they do but can learn what setting to use. My toaster (the one in the middle) has a simple clockwork timer, which if it is the first round of toast (i.e. the toaster is cold) and it is wholemeal bread

Returning to Figure 1, it also shows that the relationships between the various purposes are rarely a simple hierarchy and often are complex. It is important in Systems Thinking to be aware of, and pay attention to these relationships.

Interestingly, people who use, or are part of a system are often totally unaware of its purpose. Moreover, when pressed these different people will often have different, and even sometimes conflicting, views as to the exact nature of the purpose. This inability to inherently understand purpose is innate in all humans. We are object-oriented creatures since we live in a world of objects. We use items on a day-by-day basis almost totally unaware of their purpose. On one level we must understand the purpose since we readily select the correct object for the job-in-hand. Yet when questioned what the purpose of an object is – we struggle to give an answer. For example what is the purpose of a pen? This is such an everyday artefact that what it does is rarely questioned. What a pen does is enable its user to make marks on paper, but why do we want to make marks on paper? The answer here is two fold:

- to communicate an individual's thoughts to other humans
- to record an individual's thoughts

Fundamentally the purpose of a pen is:

to turn thoughts into marks on paper

Describing a pen in this way may appear a little perverse and indeed unnecessary. Nevertheless, it does result in a more profound understanding of a pen. Indeed, there is hierarchy of purpose here as shown in figure 2.

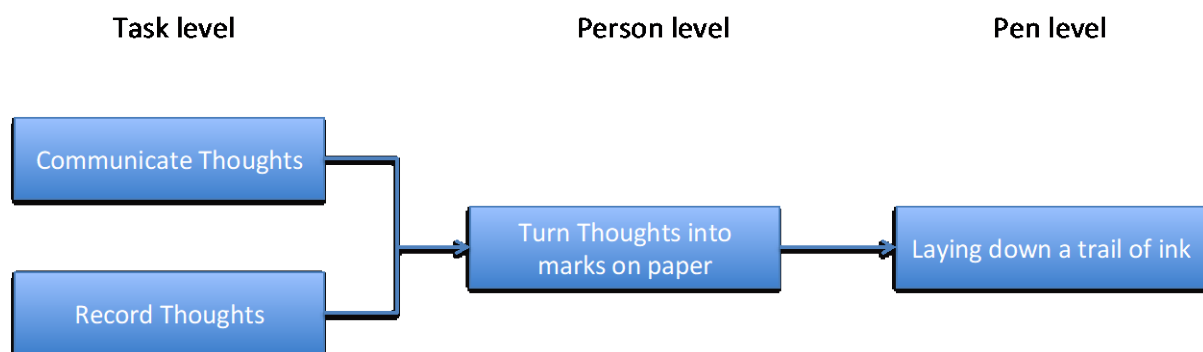


Figure 2: Hierarchy of Purpose for a pen

Figure 2 presents a picture that has several profound ramifications.

medium sliced, I have learnt to turn the timer to 2 minutes. For the next round I have learnt to look at the bread/toast after 90 seconds to stop it from burning.

- Firstly, whatever level you sit at there is always higher-level purpose. Even in figure 8 you can ask the question “why do you want to communicate your thoughts?” and arrive at a number of reasons (purposes) for doing so.
- The purpose is invariant. While the solution may change the purpose will not; particularly the higher level purposes
- At each level there is always choice in how the purpose can be accomplished. In figure 8, if we consider the person level, we can “turn thoughts in to marks on paper” by:
 - Using a pen
 - Typewriter
 - Computer, software, and printer

As already stated, humans are OBJECT ORIENTED. All of us are brought up from an early age to talk and think about things and not what they do! In fact it is extremely important that we are able to correctly classify things. To illustrate this consider Table 2 which shows four commonly found wild mushrooms two of which are edible and two of which are poisonous. All of us would correctly classify the four objects as mushrooms or fungi because we recognise the class of objects called mushrooms. Most of us also know that some mushrooms are poisonous and faced with choosing which are and which not would probably prefer not to, but pushed would go for the two red mushrooms as the lethal ones. This is because we know nature usually likes to hide if it's edible but display bright colours if it isn't. In this case as you have probably guessed, one of the drab mushrooms is in fact poisonous, as is one of the bright red mushroom edible. Interestingly, this knowledge is often tacit rather than explicit.

Our ability to recognise and correctly classify things is innate, it's important to our survival that our brains are wired to do this remarkably quickly. What brought this home to me was watching my young daughter grow up. I can remember her coming with me to deliver a training course and realising even at the tender age of 4 years she could correctly classify an unseen table – sad as I am I remember taking her into the room where the training was being delivered (no one else was there) and patting a table – one she had never seen before as she had never been in the room before – and asking “what is this sweetpea?” Her face was one of incredulity, “why Dad it's a table”. She hadn't even been to school yet but she could correctly classify an unseen object. It seems so banal, because we can all do this, but simultaneously, I now realise, it's amazing. Our brain as a pattern recognition system is truly remarkable – but it often stops us from systems thinking.



Agaricus Macroporous



Fly Agaric

Agaricus Pilatianus



Beefsteak Fungus

Table 2: Which would you eat? (source www.wildfood.com)

Systems Thinking, however, demands determination and consideration of the purpose – it is PURPOSE ORIENTED. Our brains are wired not to think this way explicitly – we have to force ourselves to do it.

Understanding purpose is important, understanding the purpose of the system you are investigating is important. We do need, however, to make sure we are not being glib when considering purpose. I often ask people what is the purpose of a TV and frequently get the answer “to entertain” – actually its not the purpose of a TV is “to receive and turn a broadcast signal in to sound and light”. It’s back to figure 2 and we have to be clear what level we are working or looking at. Indeed, recognising that there will always be multiple levels is a key aspect of Systems Thinking.

Determining the purpose of a system is not easy because individuals are used to referring to the object but thinking about the purpose of a system allows a profound understanding of a situation permitting objectivity while increasing the potential for innovation. For example, if a team of engineers were challenged to design a new pen, they would indeed design a new pen. But if asked to design a new system for turning thoughts into marks on paper, the outcome may be different because the problem has been couched in a subtly different way that allows for many different solutions apart from the pen and hence the potential for innovation. Understanding a system’s purpose is therefore useful in helping to identify candidate solutions choices. We will, however, have to decide upon the best solution to a purpose and that often is dictated by the System’s Context.