Systems Thinking 2023

The Guide

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Introduction

> ***"…it is becoming more and more evident that the major problems of our time – energy, the environment, climate change, food security, financial security – cannot be understood in isolation. They are systemic problems, which means they are all interconnected and interdependent." (Capra and Luisi, 2014)***

The point of departure for this guide is a recognition that the topic of systems thinking is vast and that we needed a way to provide *sensemaking* of the *landscape* of the subject. In doing so, we recognise that Systems Thinking itself, should be understood not just as a set of the parts we identify, but that these parts themselves are 'interconnected and interdependent.' In doing so, we will make use of analogy and theory from the natural world (as did Capra and Luisi – quoted above) and a range of other academic disciplines. Our challenge is focused however: *what does this mean for the leaders of major projects?*

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Definition – what is Systems Thinking?

A **system** is anything we can identify in the natural, physical or social world, that performs a function, is comprised of parts and which relies on those part for its functioning. In the natural world, we consider systems of weather, climate or combinations of entities that exist within a particular ecosystem. In the social world, we consider systems as being *socially constructed* – that is they are products of humans and human interactions. Families, organisations and major programmes, are all good examples of social systems. Abstracting further, we can consider philosophical systems of values and beliefs, or legal systems of rules and precedents.

Systems thinking is a set of approaches for discussing, understanding and tackling complex issues. It comprises many elements and schools of thought. We have found the definition provided by Arnold and Wade (2015) of Systems Thinking to be instructive:

> *"Systems Thinking is as set of synergistic analytical skills used to improve the capability of identifying and understanding systems, predicting their behaviours, and devising modifications to them in order to produce desired effects. These skills [themselves] work together as a system."*

Typically, the approaches of Systems Thinking comprise elements of:

1. ***Reduction*** – breaking complex wholes down into the constituent parts for the purpose of understanding.
2. ***Integration*** – seeking understanding of how those parts interact in performing the function of the system.
3. ***Holism*** – viewing the functioning of the whole of the system, not the parts.

Reduction is the classic approach to managing projects, as defined by the use of various breakdown structures (WBS / PBS / OBS). Take a large task, determine the **boundaries** (what is in, what is out) of the **system of interest**, and break it down into a set of tasks or work packages.

For project management this works to a point. However, where work becomes more complex the leadership task is not well described in terms of reduction. Instead of the role being to hand out and monitor work packages, the role becomes to bring them together. We say that the task is not to ask the question: *how do you eat an elephant (or vegetarian equivalent)*? Answer: one slice at a time. The question becomes: *how do you build a working elephant from all of these slices*?

However, as we have seen in a number of highly problematic major projects (London's Crossrail is a classic case), this integration must not simply focus on the bottom up joining of those parts. Instead, achieving good outcomes requires both bottom up and top down, keeping the overall function of the system in mind.

For that reason, we advocate what is known as *Holism.* As Jackson notes:

> *"Holism considers systems to be more than the sum of their parts. It is of course interested in the parts and particularly the networks of relationships between the parts, but primarily how they give rise to and sustain in existence the new entity that is the whole…"* (Jackson, 2003: p.4).

This process of reduction and integration is evident in the topic of organisational design. The application of a model (for instance Galbraith's Star) provides a lens, a view on how to look at organisations. By using the model, you are able to identify five elements of the organisation. By considering their interactions and interdependencies, you are able to identify the tensions (both creative and destructive) in the system. Holism requires that we consider throughout this process how an entity (in this case your organisation) is built and is sustained.

Framing, perspective, sensemaking, analogy and metaphor

A key challenge for leaders today, is that the systems they work in are likely to be complex (more of what this means later) and not easily reduced. Indeed, in order to understand complex systems, we have a simple principle: you need to be able to take multiple **perspectives** on that system (Morgan, 2006; Winter and Szczepanek, 2009). In practice, this often means that your reduction of the system needs inputs from many diverse people who will see elements that you would not be able to, if attempting the analysis alone.

In considering complex challenges we talk about 'the **framing** of problems.' Frames are our mental models or 'persistent knowledge structures' (or schema, theories-in-use or cognitive maps) representing knowledge elements and the structures between the elements (Walsh, 1995). Frames direct our attention to what is important, and what is not (Creed et al, 2002). For instance, when economists look at the performance of projects (e.g. Flvbjerg et al, 2020; Love et al, 2015) they frame the performance in financial terms, typically how much budget versus final cost. They do not consider the inner workings of the project, but use economic theory to speculate about what might be happening. An organizational theorist, would frame the problem differently, preferring to look at the behaviour of different agents in the system and how these behaviours interact, for instance.

In developing your Systems Thinking, it is necessary to become aware of how you naturally frame problems. For instance, an engineer will typically frame a problem as a set of mechanical parts and interfaces, and want to build 'an optimal solution.' A social scientist may be interested in the web of stakeholders and their interactions, and the stories that are told of the problem.

The following example invites that consideration of perspective and framing of a simple task.

Two academics are walking from their offices to the Club Room at the Park End Street site in Oxford.

Q. ***How might people from different subject areas (each has a typical perspective) frame this activity?***

Operations Management: the route they took was clearly sub-optimal. Had they gone across the quad and up the stairs, they would have avoided the outdoor atrium and this would have been more efficient.

Organisational theory: why are they going for coffee? What are the social interactions that led to the decision to go for coffee? What are the implications for those not invited for coffee? What is being discussed?

Finance: what are those people doing out of their offices? Don't they have productive work to do?!

How would you frame this activity?

Often our framing comes as a result of our professional background. This is worth taking a minute to consider, and what impact that has on how we see the world. During our session, we will be focusing mainly on social systems. Instructive in our consideration of framing is the work of Gareth Morgan. His Images of Organizations (Morgan, 2006) identifies eight typical framings of organisations:

1. Organisations as machines
2. Organisations as organisms
3. Organisations as brains
4. Organisations as flux and transformation
5. Organisations as cultures
6. Organisations as political systems
7. Organisations as psychic prisons
8. Organisations as instruments of domination.

Whilst the titles can initially appear abstract, a deeper reflection is instructive.

Sensemaking (e.g. Weick, 1995, 2009; Holt & Cornelissen, 2014) is an important part of the purpose of Systems Thinking.

"Sensemaking involves the ongoing retrospective development of plausible images that rationalize what people are doing." (Weick et al, 2009, p.131)

And

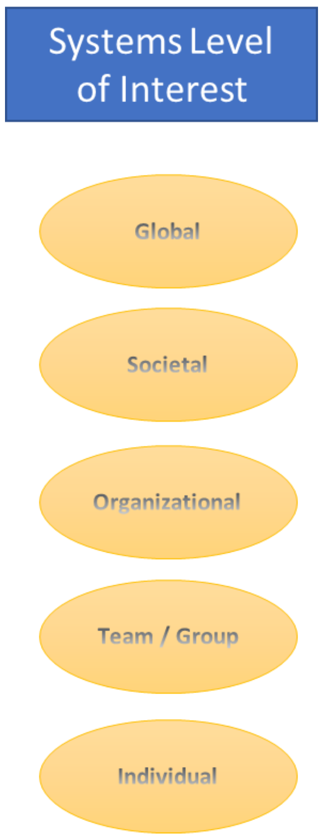
> *"Sensemaking is a way station on the road to a consensually constructed, coordinated system of action."* (Taylor and Van Every, 2000, p. 275).

The starting point in a process of sensemaking is many things happening, what Weick calls 'the flux' of a situation. How we interact with that system, determines then what we notice or see happening, and how we then describe it, and just as importantly, what we do not see or do not describe. The next part is about 'what we do with system given what we know'. That is how we **organise** to respond to it, and how we **communicate** about it.

Central to this process, is how we view systems in general. A self-critical understanding of this is crucial as a first step and the use of **analogy** or **metaphor** can be most helpful, but also limiting. For instance, some view their place in an organisation as being nothing more than 'a cog in a machine' (see the list of 'Images of Organizations'). In their view, they are simply carrying out a function in a mechanistic organisation. Others would see themselves existing in a political system, with politics played out, positions taken, agenda enacted and winners and losers for every exchange. Both of these are useful in terms of sensemaking but are also individually limited as they are, at best, partial views of the systems in which they work. This reinforces the need to seek multiple perspectives on systems to enable understanding.

Purpose

Figure 1: Systems levels



When you look at the literature on Systems Thinking, one of the notable features is the diversity of contexts and levels of those contexts in which the approaches are applied. The range of levels of application are equally broad. Figure 1 shows a typical set of descriptions of levels that we see in the literature. For instance, work on healthcare systems has taken place at team levels (how to improve the process of patient admissions or administration) through to a global level (the near elimination of Polio globally is a good example).

The benefits of applying Systems Thinking are numerous. However, in work with the leaders of organisations, we are frequently asked to look at highly complex issues, and provide one slide with three bullet points for the solution to those issues. This request is based on the limited time, attention and frequently interest, of the most senior leaders of organisations. We trust that because you are investing your time and energies in doing this programme, that you are prepared to give the time, attention and interest to complex issues. The purposes is not necessarily to solve these issues, but to find a means to discuss them, obtaining an improved understanding of those issues. In doing so, you will be in a far better place to then tackle those issues. By this we mean to propose or carry out interventions which can be tailored to have beneficial effects on that system. We see these three as not being a linear process, but interplaying. They are shown in Fig. 2.

We shall be exploring these benefits through our approach that links the principles, to practice and then to your particular context. Our three pedagogical levels are shown in Fig. 3 along with how these will be approached in the session.

Figure 2: Benefits

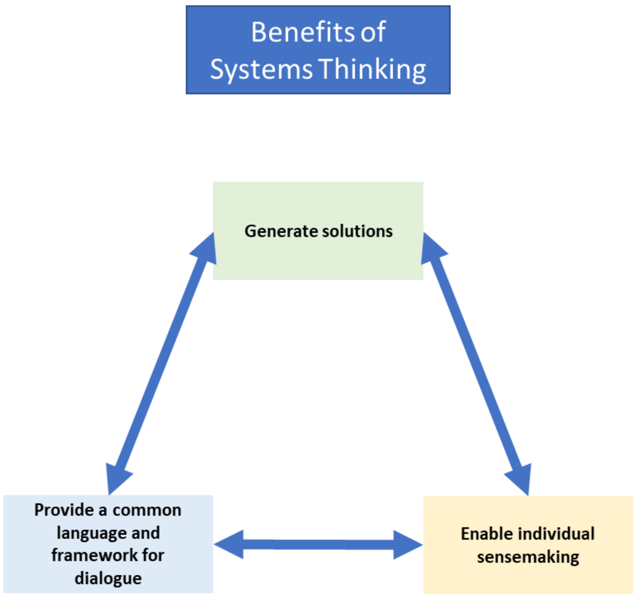
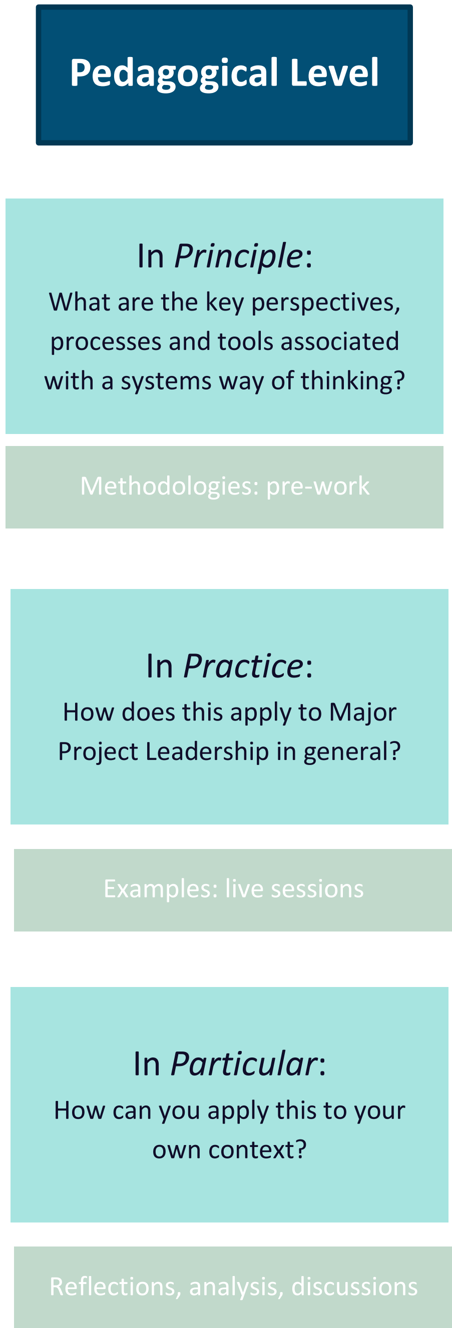


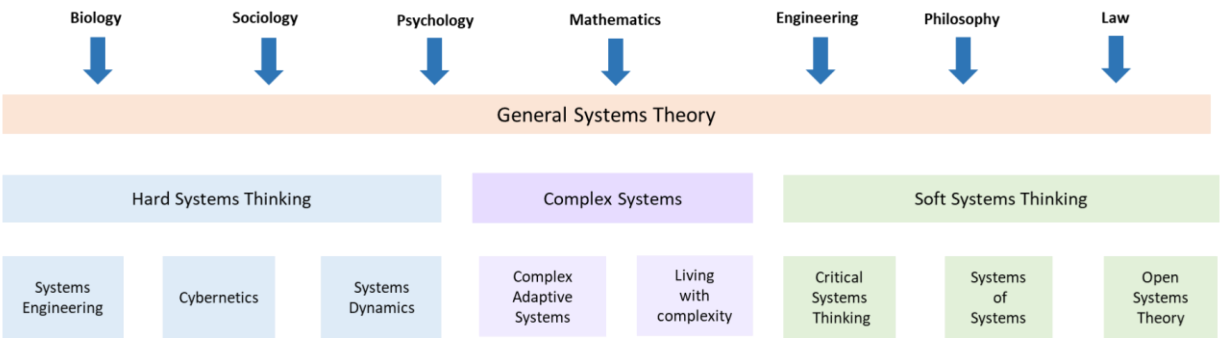
Figure 3: Pedagogy



Our Landscape of Systems Thinking

Our systematic literature resulted in a landscape of the subject area as shown in Fig. 4.

Figure 4: Landscape



At the top of the figure, the influences of seven key subject areas are shown. Such a list will inevitably be incomplete, with enduring and well-developed areas of scholarship including literature and theology, also having their own theories and systems of logic. However, these are the major contributions. The **Scientific Method,** as applied in Biology was a crucial part of early Systems Thinking development, with studies of organic systems providing many insights into the behaviours of systems, and just as importantly, providing the means to describe them. Similarly, from the 1940s, engineering provided further concepts, including developing systems of **control** and the role of **feedback** in systems.

As mathematical modelling capabilities developed with increases in both computational power and theoretical advances, the impact of mathematics was felt keenly in the 1990s. Most notably, it was shown that complex systems possessed regions of relative **order**, **chaos** and **boundary regions** between the two. It was also clear that apparently random behaviours, usually had some form of high-level pattern that were being followed. These formed part of an influential body of work that today we know as **Complexity Theory** (e.g. McKelvey, 1999 for early commentary on Complexity Theory in Organisation Science).

These areas fed a growing body of work known as General Systems Theory. Within this, it is helpful to distinguish between **hard systems** thinking, **soft systems** thinking and how these can be combined to think about complex systems. The work we will be covering is based around these eight elements at the bottom of the figure. We are not claiming this to be absolutely comprehensive, preferring a pragmatic consideration of the main elements and our belief on the major influences in Systems Thinking as of today, and their applicability to our context of major programmes. This is our way of making sense of a complex field.

Finally, we would not want you to get the idea that all of the inputs to General Systems Theory are independent. There are many examples of cross-over of ideas. For instance, the notion of applying a control system to social systems (applying the ideas of feedback and control from engineering to social science – included in the topic of *Cybernetics*) have had considerable impacts on thinking, both positively and negatively. Again, these need to be explored further.

Typical Characteristics of Systems

We already identified some characteristics of systems, including boundaries.

> *"It is widely accepted that systems are characterised by **feedback loops**, **self-organisation**, and **hierarchies**. Feedback loops are closed chains of causal connections that can be either sources of (in)stability, (dis)continuity or resistance to change. Self-organisation describes the ability of systems for self-structuring to learn, diversify and become more complex over time. However, self-organisation also tends to create resilience towards radical changes as systems tend to keep coherence in their functions. Systems often involve hierarchies too with arrangements between systems, subsystems and their components."* Savaget et al, 2019.

For the purposes of our initial discussion – these three characteristics are also worth understanding. We will explore them further later.

Feedback loops

The most basic systems of control have some kind of feedback loop. At its simplest, imagine you are listening to some music. It's good music. You want it louder. So, you turn it up. At the end of that track, you turn it down again. Both of these actions – turning it up and down – are examples of feedback loops. Initially, the system performance expressed by the volume of the music was too quiet. So you turned it up. You made a change to the system. Likewise at the end. You were part of the control loop providing feedback to the power being used in your headphones or speakers. We will investigate the impacts both quantitative and qualitative throughout this module.

Self-organisation

The explanation given above works less well with social systems. Whilst mainstream, studies of organisations regularly assume that the organisation is the direct result of the choices of leadership, these systems comprise people, and as such will have an ability to learn and re-organise as time progresses. Understanding that this self-organising capability is both an asset and a challenge for the leaders of major programmes is key insight from the application of Systems Thinking.

Hierarchies

A key requirement for understanding systems, is to recognise that we can consider them at many levels. This was already demonstrated in Fig. 2. In the context of a major project, Fig. 5 shows three levels within a hierarchy of systems that exist within any such undertaking.

There is nothing special about three levels, and it is part of the challenge of any analysis to define at which level(s) the analysis is being conducted, as well as what are the boundaries of the systems at that level.

Level	Description	Characteristics	Typical MPM Tasks
Level 1	Major programme: *System of Systems*	N = 1; high uniqueness; Low volume, high variety work	*Overall Systems Leadership* Deconstruction, integration and holism of systems; Systems governance and ownership
Level 2	Component programmes and projects: *Individual Systems*	N = few; some uniqueness; Medium volume, medium variety work	*Individual Systems Leadership* Strategic design of component systems; Managing interdependencies and boundaries between components
Level 3	Operational tasks and work packages: *Sub-Systems*	N = many; predominantly high volume, low variety work	*Operational control* Control and coordination of tasks; Ensuring workflow and continuous improvement

The characteristics include the nature of the process that we would typically see at each level. At level 1, we say that the configuration is likely to be unique (n=1). This contrasts with level 2, where the processes are typically more akin to a batch process in manufacturing. In such a process, resources are temporarily configured for the purpose of the project, and have the flexibility to do so. At level 3, the tasks become more highly repetitive, consistent with a production line approach in manufacturing.

Whilst the levels are useful to provide a means of deconstruction for our consideration, these are also **nested** – that is the systems do not exist independently, but inside other systems. Further, a key property of a system at any level, is whether it is considered to be **open** or **closed**. Both of these have bodies of work associated with them, so for our consideration we consider:

- An open system has exchanges with the environment in which it exists. These exchanges could be information, influence, people, products, or any other entity.
- A closed system operates without any interaction with its external environment.

Lastly, to the above list we would add the characteristic of **dynamism** i.e. that systems for the purpose of our consideration have emergent properties.

Dynamism

Figure 5 shows the sources of this dynamism in the context for major project operations. Whilst there are many sources of dynamics or emergent complexity (Geraldi et al., 2011), we have classified some of the typical scenarios in two dimensions. The first concerns the nature of the dynamism, whether it was deliberate or the result of some materialized uncertainty. The second dimension concerns the source of the change – does it come from within (endogenous) or outside the programme (exogenous).

Figure 5: Sources of change in the context of major projects

	Planned for	*Materialised uncertainty*
Exogenous change	IV: Change in organisational strategy	III. Environmental uncertainties
Endogenous change	I: Project lifecycle	II: Technological or people changes

The four main sources of change are:

I. The project life cycle: as a project progresses from concept through to execution, handover and closeout, there will be a natural shift in the activities carried out. It would be usual to expect the initial stages to be characterized by 'idea generation' whilst execution is focused on exploitation of those ideas. This is to be expected, hence it can be planned for.

II. Materialized uncertainties during the project: at the outset of for instance, in engineering design, there will be uncertainties around what product configuration options can be considered because of a lack of information. As the design progresses and more information is gathered, these former uncertainties result in changes to what was originally intended in either product or process.

III. Environmental uncertainties: for any major programme there will be fundamental external uncertainties, for instance in terms of material or labour prices or the political environment in which they are operating. As these materialize, there will be ongoing changes required to respond.

IV. Changes in strategy: for an organization running major programmes, this is a perpetual challenge, particularly when they take place over a prolonged period. The decision by the organization to change its strategy is planned, but exogenous to the programme organization.

These four of characteristics of feedback, self-organisation, hierarchies and dynamism are typical, and this is the start of our consideration. It is a list you will doubtless want to supplement, as the discussion progresses.

And finally…

A small prize will be awarded to the first person on the discussion forum who correctly identifies the species of trees pictured on the front page of this document in the quad at Saïd Business School, Park End Street site. The picture was taken in May of 2019.

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