LESSON 1: Introduction to Systems Thinking

What is Systems Thinking?

Systems thinking is both a ***collection of tools and methods*** (for example causal loop diagrams and decision matrices) and ***it is also a mindset, a way of seeing the world and issues as systematic wholes.*** Many issues and problems facing the world today, such as the global climate crisis, are caused by a web of interconnected circular relationships and in order to understand and solve these problems we need systems thinking. This is in contrast to seeing the world as a series of linear, causal relationships (x causes y).

Systems thinking is:
• ***Solving complex, dynamic, ill-defined problems***
• ***Designing systems as well as components***
• ***Communicating with the wider community***
• ***Working with people from other disciplines and cultures***
• ***Meeting social, ethical, and environmental responsibilities while addressing challenges*** from engineering and science.
• ***Managing projects and operating within business and political environments***

B. **Characteristics of systems thinking:**
• ***Thinking of the big picture***
• ***Balancing short-term and long-term perspectives***
• ***Recognising the dynamic, complex and interdependent nature of systems***
• ***Taking into account measurable and non-measurable factors***
• ***Recognising that we are all part of the systems*** in which we function and that we each influence those systems and are in turn influenced by them.

According to The Systems Thinker, **problems** that are ideal for a systems thinking intervention **have the following characteristics:**
• The ***issue is important***
• The ***problem is chronic***, not a one-time event
• The ***problem is familiar*** and has a known history
• ***People have unsuccessfully tried to solve the problem before***

Key Concepts of System Thinking

1. **Context and belief systems. *People do not have a consistent view of a system.*** 'Soft' systems approaches can be used to understand these different perspectives, enabling solutions to be developed that meet a diverse range of stakeholders needs and wishes.
2. **Parts, wholes and layers**. ***All systems are similar.*** For example they have an environment, sub-systems and interactions. Understanding of basic systems theory helps ensure that solutions are viable and that systems (including social systems) can meet their performance and effectiveness requirements.
3. **Connections and loops**. ***Understanding how different systems interact*** is one of the most powerful tools to solve some of the most intractable situations faced by government. System dynamics has been used to describe complex situations and evaluate alternative policy and technical solutions.

4. **Processes**. and ***how change happened.*** The systems approach is core to realizing complex systems. It has been used to get humans on the moon, win the Battle of Britain and transform major corporations.

LESSON 2: Understanding Feedback Loops

What is a feedback loop?

A **feedback loop** is a ***process where the output of a system is fed back into the input, resulting in a cycle of cause and effect***. In other words, the output of a system influences its input, which in turn affects the output, and so on.

Typically, a **feedback loop consists of four stages.**
• First, we ***create*** input.
• Second, we ***capture and save*** that input.
• Third, we ***analyze*** it.
• Fourth, we use what we learned from analyzing to ***make decisions***.
• It's ***like a continuous process that helps the system improve and become more effective***.

There are also **two types of feedback loops based on how the input is utilized:**

Positive feedback loop. is a ***self-reinforcing cycle in which the system's output amplifies the input, leading to further growth or escalation.***
Positive feedback loops are ***often seen when a small change or disturbance triggers a* chain reaction.** Whether you're a creative professional or a business strategist, your organizations can use feedback loops in many ways for better performance.
An example of a useful positive feedback loop ***is social media's "echo chamber" effect.*** When people are exposed to information confirming their beliefs, they tend to share it with others with similar views, leading to a cycle of confirmation bias and amplifying extreme or polarizing views

Negative feedback loop is a ***type of feedback loop where the output of a system works to decrease or counteract any changes in the input.*** In other words, the system seeks to maintain a state of equilibrium or stability.
There are **several example**s of negative feedback ***loops in nature and human biology, like blood sugar regulation and maintaining temperatures***.
But since ***businesses operate more on positive feedback loops***, we'll spare you the jargon and science rambles and get real-world examples of how you can use positive feedback loops to maximize review and approval productivity in your business.

Feedback Loop Examples

1. **The creative loop**
The creative loop ***involves collecting feedback on creative content, analyzing it, implementing changes, and restarting it until everyone is satisfied with the final***

product. This feedback loop can be internal or external, and it continually helps creatives improve their work based on stakeholder feedback. For **example**, a *graphic designer creates a logo for a client. The designer presents the initial design to the client and collects feedback on what they like and dislike*. The designer analyzes the feedback, makes changes, and presents a revised design. The *loop continues until the client is satisfied with the final logo design.*

2. **Customer feedback loop**

A customer feedback loop ***involves collecting customer feedback about their experiences with a product or service.*** The *feedback is analyzed, and changes are made to improve the product or service to meet customer needs better*. The loop restarts as the updated product or service are re-released, and feedback is collected again. This can be implemented both on a macro and micro level for businesses. **Like** a restaurant collects customer feedback on its dining experience, it uses it to change the menu, decor, and service. The restaurant then *collects feedback to ensure the changes have improved the customer experience.*

3. **The development loop**

The development loop ***involves developers creating code or software, testing it, and receiving user feedback.*** The *feedback is then used to make changes to the code or software, and the updated version is tested again.* This loop continues until the code or software is stable and meets user needs. *When a software development team creates a new app, they test it and collect feedback from beta users. The team then analyzes the feedback, makes changes to the app, and releases an updated version for further testing. The loop continues until the app is stable and meets user needs.*

4. **Employee feedback loop**

An employee feedback loop i***nvolves managers collecting feedback from employees on their experiences working for the company.*** The *feedback is analyzed, and changes are made to improve the employee experience.* The loop restarts as the changes are implemented, and feedback is collected again. Typically, a company collects employee feedback on job satisfaction, working conditions, and growth opportunities. Then uses this feedback to change policies, benefits, and work environment. The company then collects feedback again to ensure that the changes have improved the employee experience and it continues. *Such loops are often never-ending since employee needs and workflows change with changing times and modern technologies* (e.g., the remote working boom from 2020.)

5. **Project management loop**

The project management loop ***involves managers collecting stakeholder feedback on a project's progress.*** *Using creative project management software makes the workflow 10x better for digital creators*. In other industries, like construction, a construction project manager collects feedback from stakeholders on the progress of a building project. Then uses this feedback to change the timeline, budget, and resources. The manager then *collects feedback to ensure the changes have improved the project's outcomes.*

6. **Pricing loop**

The pricing loop ***involves companies collecting customer, competitor, and other stakeholders' feedback on their pricing strategy.*** The *feedback is analyzed, and pricing changes are made to meet customer needs better and stay competitive in the market.* The loop restarts as the pricing strategy are adjusted, and feedback is collected again. For **example**, a retail company collects customer feedback on its pricing strategy. The company *uses this feedback to adjust its prices and monitor the market to stay competitive.* The company *then collects feedback to ensure the changes have improved customer satisfaction*

and sales.

7. **User engagement loop**

A user engagement loop ***is a feedback loop that helps businesses to understand how engaged their users are with their product or service.*** It i*nvolves analyzing how users interact with a product and then using that information to make changes that will increase engagement.* This can include tracking how often users log in, how long they spend on the product, and what features they use the most. Once this data has been collected, it is analyzed to identify patterns and trends. A successful **example** is how *Meta analyzes user behavior to improve engagement on Facebook and Instagram. They track what posts users interact with most, what times of day users are most active, and what types of content are most likely to be shared.* They then u*se this information to make changes to the platform, such as adjusting the algorithm that determines which posts users see first in their feed.*

8. **User experience (UX) loop**

The UX feedback loop ***is similar to the user-engagement loop. However, it focuses more on understanding how users feel about a product or service.*** The first stage of the user experience feedback loop is to collect feedback from users. This can be done through surveys, user testing, or social media monitoring for user feedback. Once this feedback has been collected, it is analyzed to identify common themes and issues. For **example**, *if users consistently report that a certain feature is confusing or difficult to use, the business can investigate why and make changes to improve the feature.* One real-world **example** of a user experience feedback loop *is how Apple collects user feedback through its customer support channels. When users contact Apple with a problem, the company collects information on what went wrong and how it can be fixed*. This information is then used to improve future products and services, with Apple often releasing updates that address common user complaints.

LESSON 3: Causal Loops

Construction of Basic Loops

Causal loop diagrams can be thought of as sentences that are constructed by identifying the key variables in a system (the “nouns”) and indicating the causal relationships between them via links (the “verbs”). By linking together several loops, you can create a concise story about a particular problem or issue. **A causal loop diagram consists of four basic elements:** the **variables**, the **links between** them, the **signs on the links** (which show how the variables are interconnected), and the **sign of the loop** (which shows what type of behavior the system will produce).

4 Elements of Causal Loop diagram:

1. Create Variable Names

These are the main parts of the system that can change over time, like nouns in a sentence. For instance, in a company setting, variables could include things like "TQM Activities" or "Demand for Training."

2. Draw the Links

These are the connections between the variables, similar to verbs. They show how one

variable affects another. A link can be labeled "s" (same direction) or "o" (opposite direction) to show if one variable increases or decreases as the other does.

3. Label the Loop

This tells us if the loop is reinforcing (growth keeps going in the same direction) or balancing (growth is limited to reach a stable point). To identify, count the “o’s”: even means reinforcing, and odd means balancing.

4. Talk Through the Loop

Once the diagram is complete, you can walk through it to tell the "story" of how the variables interact. This step helps clarify how changes in one part of the system affect the others and the overall behavior.

Storytelling

By using causal loop diagrams to create stories about complex issues, we can make our understanding of the interrelationships within a system’s structure more explicit. The resulting diagrams also provide a visual representation that can be used to communicate that understanding with others. With practice, we can become more adept at telling systems stories that help us recognize the multiple, interdependent effects of our actions.

LESSON 4: System Boundaries

Defining system boundaries

System boundaries can be defined based on a variety of parameters.

For the simplicity of the argument, we focus on one parameter out of several, yet prefer not to discuss in depth the interaction of different parameters. Many people would define such interactions as complexity within systems thinking, but the examination of system complexity is premised on a coherent understanding of what is in and out of the system being examined. This is an inherent precondition for analysis, which is often discussed or taken as an assumption that is often not clearly defined.

Independent of the given parameter, we propose that both the state and the variance can be clear delimiters in defining boundaries between systems.

When looking at a larger system, it can have an overall average value as well as an overall variance regarding a system parameter. If we would now divide the larger system into two smaller parts, it might be that the two systems have a different average value regarding this parameter. However, two smaller systems could also be different regarding their variance, where one smaller system has an overall large heterogeneity, and the other one a small heterogeneity.

A **good example** of this could be two neighborhoods within one city. One could be very heterogeneous in terms of green infrastructure, having many smaller parks, trees, and green rooftops. The other one could be highly homogenous, being widely dominated by houses without any green infrastructure. Clearly, both systems vary both in terms of the average value, as well as the variance. Thus, where boundaries are drawn to define those neighborhoods in that city will dictate the analysis and conclusions about its variance and values.

Another example would be two smaller systems, one again being highly heterogeneous, and the other consisting of one half that is a park, and another half that are large apartment houses. Many would opt to divide the second smaller system into two subsystems. This example illustrates how different parameters allow for a different division of systems according to the habitat recognition. However, the park could be functionally related directly to the apartments, constituting its own unit in an urban planning context. This illustrates how system boundaries depend on the parameters we observe, but also the reasons why we want to measure them and what we want to know and value about the system.

More importantly, **system boundaries** can also differ regarding the average value of a parameter but can show different patterns when looking at the variance. This difference is often associated with the grain size of parameters. Grain size can be defined as the resolution at which a parameter is observed. A parameter can be for instance very homogenous at a large scale, yet very heterogenous at a small scale. The question of grain size is often associated with nestedness, yet grain size and nestedness are only indirectly connected, but not always necessarily linked.

The problem with System Boundaries

While boundaries of some isolated systems as well as simple theoretical models can be rather clearly defined, much attention of the recent literature has actually focussed on the effects that systemic interactions create across distances, which have historically been considered separate (see for example 'teleconnections' in atmospheric research). It is now evident that inland watersheds are linked to oceanographic processes through freshwater and nutrient inputs, although these have historically and disciplinarily been examined separately. Furthermore, the nestedness of systems is another challenge - the idea that smaller systems are contained within, and are the constituent components of, larger systems such as organs within the larger integrated functionality of the human body. Some organs can be removed or replaced, but only in relation to the overall functions they provide and how they fit or match the context of the overall body (i.e, blood type or immune response). Government jurisdictions give other clear examples, where countries may contain several provinces as part of a federal system, which in turn can contain smaller administrative units, creating a multi-level administrative whole.

LESSON 5: System Dynamics

What is System Dynamics?

The purpose of System Dynamics is to help people understand complex and dynamic systems and help them make better decisions. The field provides a philosophy and tools to model and analyze dynamic systems. Equally important, the field provides techniques and tools to investigate current decision making and to help decision makers learn.

System Dynamics is a computer-based mathematical modeling approach for strategy development and better decision making in complex systems. This approach uses

computer-aided simulation methodology based on feedback systems theory which complements the other Systems Thinking approaches. Also, it provides tools and methods to analyse dynamic systems.It can help solving problems arising in complex socio-economic systems (economic, social, managerial, political, public health or etc.) and as well as physical and/or natural systems where humans interact with them (physiological, environmental, ecological, or etc.).

Like Systems Thinking, System Dynamics has also a holistic and causality driven approach to describe and understand the relations between components or variables within a system which influences it internally or externally. But unlike Systems Thinking, System Dynamics quantifies relations between variables to develop a view of behavior of the system over time through computer simulations.

System Dynamics Approach

As the complexity of our world increases, we need holistic approaches to tackle the problems we encounter in this complex and developing world. Missing the holistic view could lead us to struggle with the symptoms of a larger problem arising from the structure of the system. Hence, the System Dynamics approach provides us tools and methods to understand the complex systems.

Variables, accumulation, and time delays

Feedback loops are basically chains of cause-and-effect relations that form a loop where its output routes back to the chain as an input. Hence, these systems feed back into itself. All systems contain feedback loops since all dynamics of systems arise from interactions of feedback loops. Therefore, identifying the feedback loops is crucial in system dynamics methodology.

Feedback loops

Feedback loops are basically chains of cause-and-effect relations that form a loop where its output routes back to the chain as an input. Hence, these systems feed back into itself. All systems contain feedback loops since all dynamics of systems arise from interactions of feedback loops. Therefore, identifying the feedback loops is crucial in system dynamics methodology.

System structure

Components of the system build feedback loops and the relations between these feedback loops create structures which form the behavior and events of a system. Every system has an underlying structure which determines the behavior of the system. Hence, to understand the system, it is necessary to discover the underlying structure through mapping it.

Modeling and simulation

After mapping the system structure, computers are used to develop a model of the system via quantifying the relations between system components. The model is simulated on computer software to observe the output of the system.

Policy design and strategy development

Observing the behavior of the system with computer simulation allows us to analyze the system and the underlying structure. Hence, it helps us to understand the system better.

Having a better understanding of the system provides us the opportunity of designing policies to solve problems in complex systems.

LESSON 6: System Thinking in Business

What is system thinking in business?

What Is System Thinking? – What Is System Thinking in Business

System thinking is a way of looking at how a system works, its perspectives, and how to improve its behavior.

It involves looking at the various elements within a system and how they're interconnected and related.
System thinking is a holistic approach to problem-solving in business.
It involves considering a system and all its interrelated parts rather than focusing on each component separately.
It involves looking at and considering the underlying causes and root issues of a problem instead of focusing on the immediate symptoms.

Elements of System Thinking in Business – What Is System Thinking in Business

System thinking is a problem-solving approach that sees the organization as a system made up of interconnected parts.

Holistic Perspective

A holistic perspective is an essential element of system thinking.
It involves looking at the organization as a whole rather than just focusing on individual parts.
In other words, it is the element that considers the interconnectedness of different components and looks at how they impact each other.

Feedback Loops

Feedback loops are essential components of system thinking.
This is because they help companies understand how different business parts influence one another.

Feedback loops occur when the output of one part of the system affects another part and then feeds back into the first part of the system.
There are two types of feedback loops: positive and negative.
Positive feedback loops occur when the output of one part of the system leads to an increase in the output of another part of the system.

Ultimately, this can create a self-reinforcing cycle that can benefit or harm the business, depending on the circumstances.

In business, a dynamic system is important because it helps companies understand an organization's complex and constantly changing nature.
When it comes to dynamic system thinking, you will need to analyze the dynamic relationships and feedback loops within a system.
This will help you identify how changes in one part of the system can affect others over time.

For instance, let's say your company introduces a new product.
Dynamic system thinking would encourage you to consider how this product might affect the rest of the organization.
For example, it might affect supply chain logistics, customer service demands, or employee workloads.
However, when you analyze the dynamic relationships within that system, you can anticipate the potential risk of introducing the new product.
And to take steps to mitigate those risks.

Complexity System Thinking – What Is System Thinking in Business
Complexity system thinking is another system thinking that can be useful in business.
It focuses on understanding how complex systems emerge and evolve.
To explain complex system thinking, let's use the example of a traffic system.
So, a traffic system is complex because it involves many interacting parts – cars, roads, traffic lights, pedestrians, etc.
Each part's behavior influences the system's behavior as a whole.
Complex systems thinking is important in business because it helps us understand the complexity of modern organizations.

Conclusion on What Is System Thinking in Business
System thinking is critical for businesses to thrive in today's dynamic and complex business environment.
It requires a holistic approach that considers the interrelationships and interdependencies of various system components.