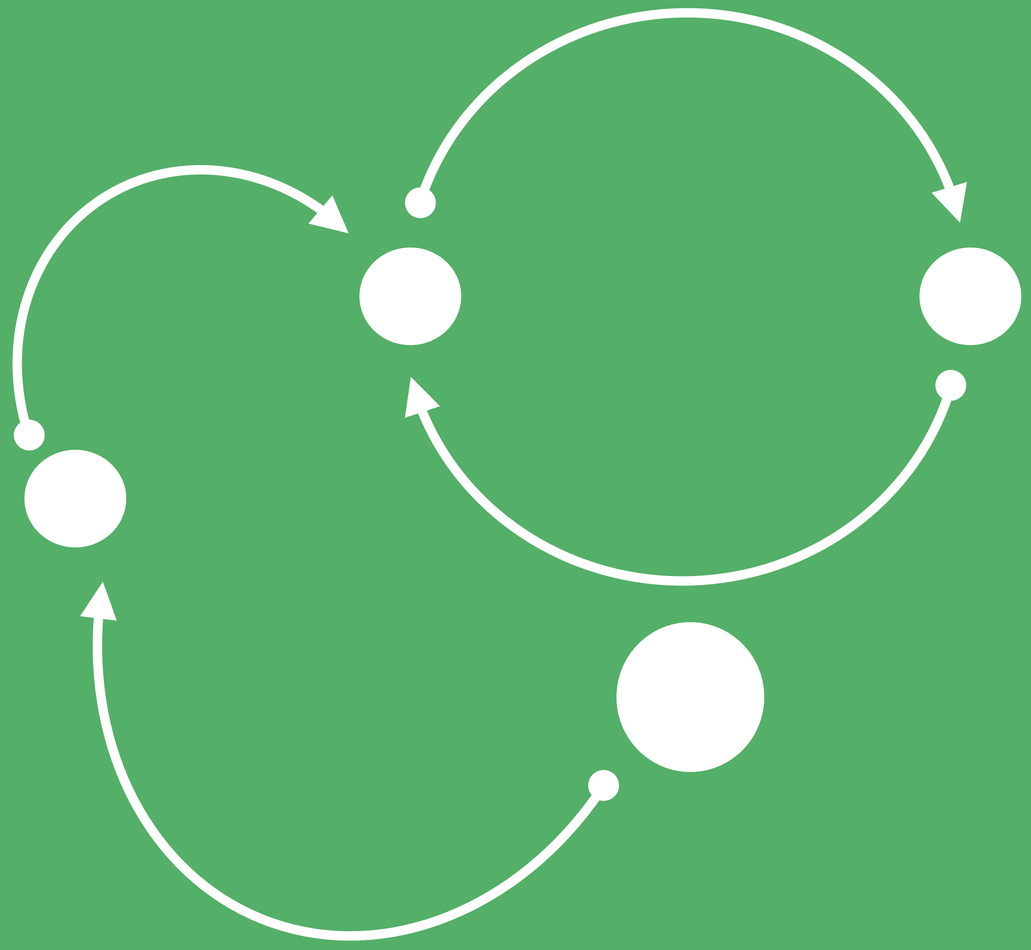
System Mapping



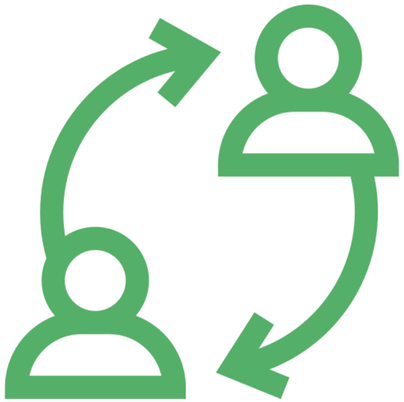
Overview

This guide will walk you through the tools needed to start to build your own systems maps. Although useful for anyone wishing to teach or learn systems mapping it is primarily designed for those facilitating systems change initiatives or running a systems innovation lab.

The guide starts with a high-level overview of the value and relevance of mapping for those interested in changing systems. The body of the content is a composite of four main dimensions to mapping systems outlined on the following page.

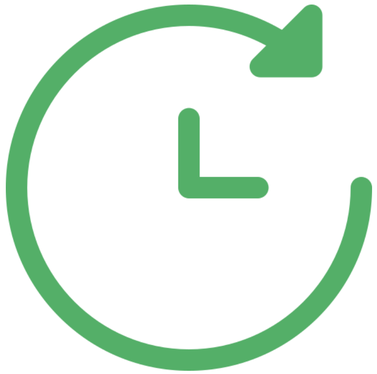
Mapping

We start with the basic language for mapping systems



Actor Maps

For mapping out the actors, their values, models and incentives



Causal Diagrams

Now we add causal relationships to look at the feedback loops

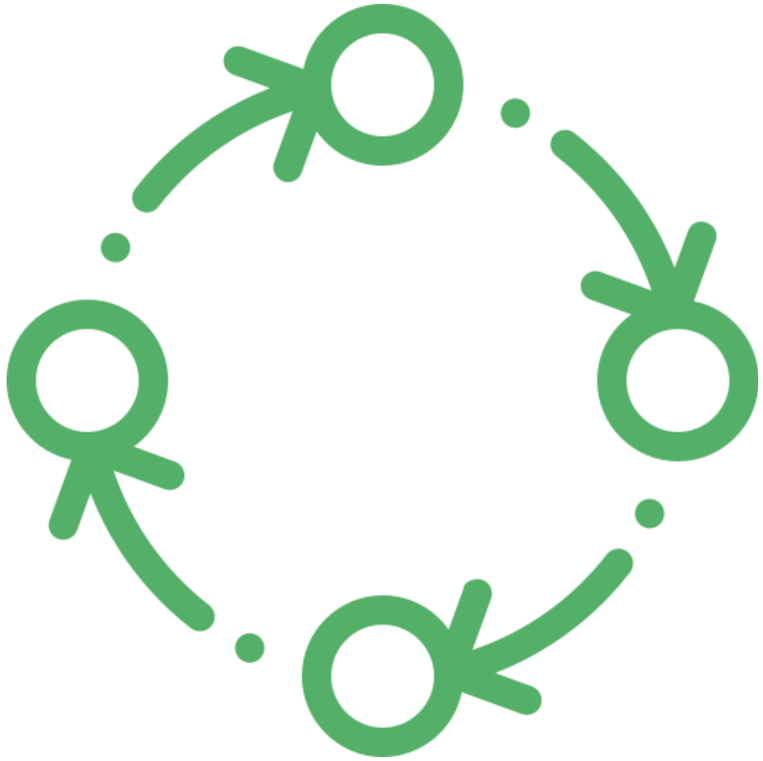
Multi-Level Maps

For mapping out the many levels of a system, from micro to macro

Understanding Systems

One of the central propositions of systems change is that we should not change a system without first gaining a deep understanding of its overall structure and workings. As the influential systems thinker, Donella Meadows wrote: "Before you disturb the system in any way, watch how it behaves. If it’s a piece of music or a whitewater rapid or a fluctuation in a commodity price, study its beat. If it’s a social system, watch it work. Learn its history.”

There are many ways in which we can fail in our systems change endeavors, one of them is to not properly understand the system we wish to change. A narrow analytical and partial vision of the system we wish to change will lead, at best, to partial results. If we want to achieve something more than this then we will need a more holistic vision of the system. It is only from a more comprehensive view of what we are dealing with that we can hope to achieve qualitatively better outcomes.



Recognition of Complexity

To be successful in our endeavors to change systems we firstly need a deep appreciation for the complexity of the systems we live in. The reality we have to face as systems innovators is that we are just tiny blips within vast complex networks that shape the world around us. These systems that we are trying to change are often so large and complex that we have almost no opportunity to actually "change" them. The idea that we can come in and define the desired outcome and impose it on the system is not realistic; we see it fail time and time again.

This often followed path to failure is a product of a lack of recognition of the complexity of the systems we are dealing with. Thus one aspect to mapping systems is for us to gain a deeper appreciation for the complexity and from this an acceptance that we ourselves can’t change the system but must instead work with its potential for change. Being responsible in our change endeavor means firstly understanding the overall structure, and complexity of the system before attempting to influence it.

The Art of System Mapping

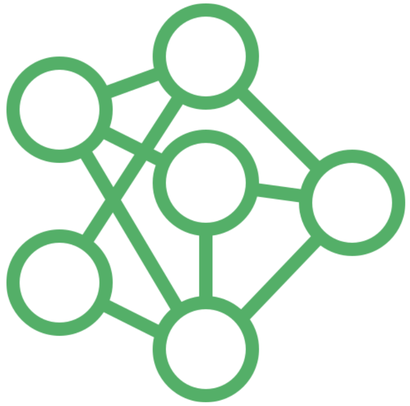
Systems analysis is a science and an art. It involves aspects of formal modeling, but just as importantly it involves the skills of a good investigative journalist or an ethnographer. We need to follow things wherever they lead, drawing upon any and all relevant information like a good investigative journalist. Likewise, we want to get out of our own perspective of the system and into that of others, like a good ethnographer.

Systems do not fit into the nice need organizational and conceptual boxes that we create, getting to the source of truth about how a system really works often leads us across boundaries. Thus the aim is to defy traditional disciplines and boundaries and expand thought horizons. As Donella Meadows wrote: "Defy the disciplines. In spite of what you majored in, or what the textbooks say, or what you think you're an expert at, follow a system wherever it leads. It will be sure to lead across traditional disciplinary lines."

Why Systems Mapping

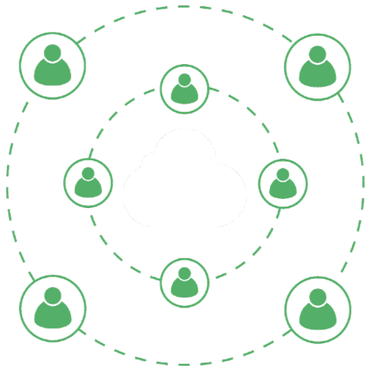
Holistic View

Maps help us to view the system as a whole



Analysis of Structure

By mapping linkages maps help to reveal the underlying structure



Shared Perspective

By creating a shared visual diagram maps help to build shared understanding

Course of Action

Shared understanding reveals points of intervention and consensus on action

Wholistic Approach

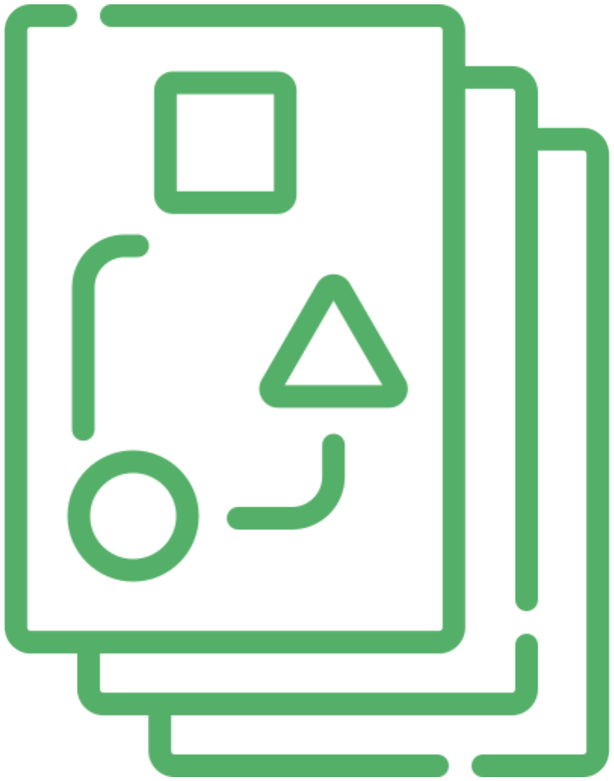
System mapping is a holistic approach that becomes particularly relevant when systems become complex. The reason our initiatives often fail is that we take a partial approach, based upon a partial understanding of the system. We often start with a pain point and rush to find the solution to that, in the process, we quickly narrow our vision to only those factors directly impacting the issue. When issues become complex there is no simple solution; outcomes are emergent phenomena of the way the system is organized as a whole and we need to look at and map out the whole system.

Too often our endeavors fail because we try to reduce the whole system to one dimension so as to simplify things. To avoid common pitfalls, of linear ways of thinking the aim should be to expand our vision rather than to reduce it. We need to grasp the multi-dimensional nature of complex organizations and map this out as best we can. If we want to be successful in our systems change efforts we need to be aware of all the different dimensions to the system we are dealing with.

Sustainable Outcomes

When we rush to find direct causes for an issue and reduce our vision, we may get quick fixes but often the result is unsustainable solutions. The issue reveals itself when the whole system changes and we find that our perceived solution is no longer relevant in this new context and we have to start again. A holistic vision prevents us from becoming too narrowly focused on any one part of the system or any one solution. By doing this we may not get quick solutions but what we do get is a view of the whole that should stay relevant as we can stay updating our map.

Mapping the whole will help us to void getting stuck, because we will always be able to go back to the overall map to see why our given interventions are not working. The map will provide an infrastructure out of which we can start to develop our solutions. This is a sustainable approach where we can be continuously developing and building upon our model; crafting and refining the map so as to develop our systemic problem statement.



Understanding Structure

System mapping is about trying to gain an understanding of how the system is, how it works, but not on a superficial level. We are trying to see the underlying structure rather than just the observable outcomes. By mapping the connections and linkages we start to build up a view of the system's structure. This helps us to start to understand how system structure creates the observable outcomes.

As Donella Meadows notes, starting with the behavior of the system directs one’s thoughts to dynamic, not static, analysis—not only to “What’s wrong?” but also to “How did we get there?” “What other behavior modes are possible?” By looking at linkages and structure we can start to see the system in a new way, not as things and what is wrong with those things but instead in terms of dynamics, flows, and blockages.

A Share Vision

Maps not only help us to gain an overall vision of the structure of the system, but also by creating them collectively we can start to come to some shared understanding; some objective reference point. The map becomes useful when individuals who experience the system day-to-day can see themselves and their challenges represented by the model; people start to see their actions in a new light and how they affect the whole. Once the causal linkages can be seen, they can be understood and discussed openly.

This shared view of the system is a solid foundation for forming collaborations. If we want coordinated action we need some shared understanding of what the system is and how it is operating and this is what systems mapping can provide us. Of course, if we want shared consensus about the state of the system then the mapping has to be a collective action, created by those different parties involved.

Co-creation

When one looks at most systems, be that in education, finance, energy systems or politics, one will observe that there is limited understanding or consensus about the overall system. The inevitable outcome of this is incoherence and lack of capacity to take coordinated efforts for the benefit of the end-user. If we want coordinated action we need some shared understanding of what the system is and how it is operating and this is what systems mapping can give us.

Just as importantly mapping is visual; it helps to get our thinking "out there", making it tactile and interactive in different ways. Mapping should not be seen as simply a means to an endpoint but a process for scaffolding debates as we build. The process of building the map is a shared one where we reveal each other's assumptions and start a conversation. The process of mapping helps to; surface assumptions; provide the context for us to ask questions; identify different perspectives; to see which voices and opinions are being heard or not and to start to build consensus across boarders, divides and boundaries.

Pathways Forward

Although much of the value of mapping is in the collective process of its creation as a method for building shared understanding, the ultimate aim of a systems map is to start to reveal places where we can try to influence the system towards a more desirable direction. Once we start to see the events of the day as parts of trends, and those trends as symptoms of underlying system structure, we will be able to consider new ways to intervene and new courses of action.

Once a model of the current state is agreed upon, it is time to go to work deciding upon how to influence the system to a more desirable state. The map is not only a way of making sense of complex systems it is also a way to identify points of potentially high impact. The systems map holds the leverage points upon which a group can collectively act. With a map, we can start to explore the underlying forces in the system, start to identify what is working and what not; where to make interventions; where to invest our resources; how to create new, more productive stories and develop a systemic problem statement.

Getting Started with

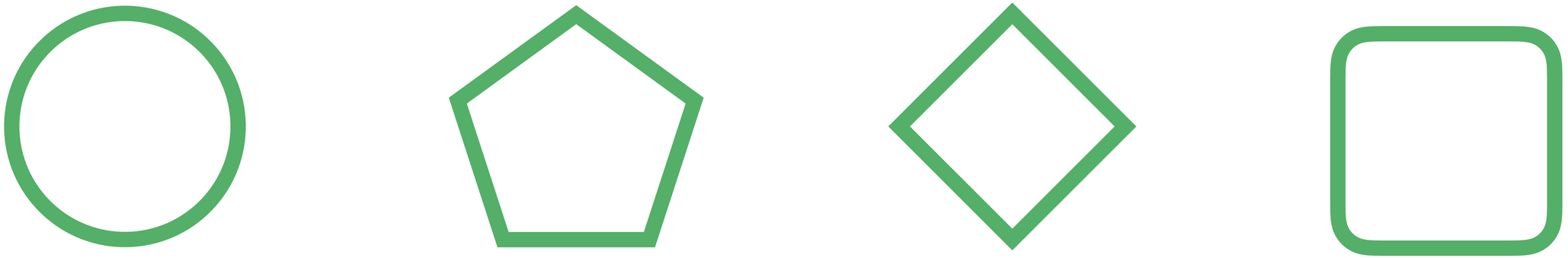
System Maps

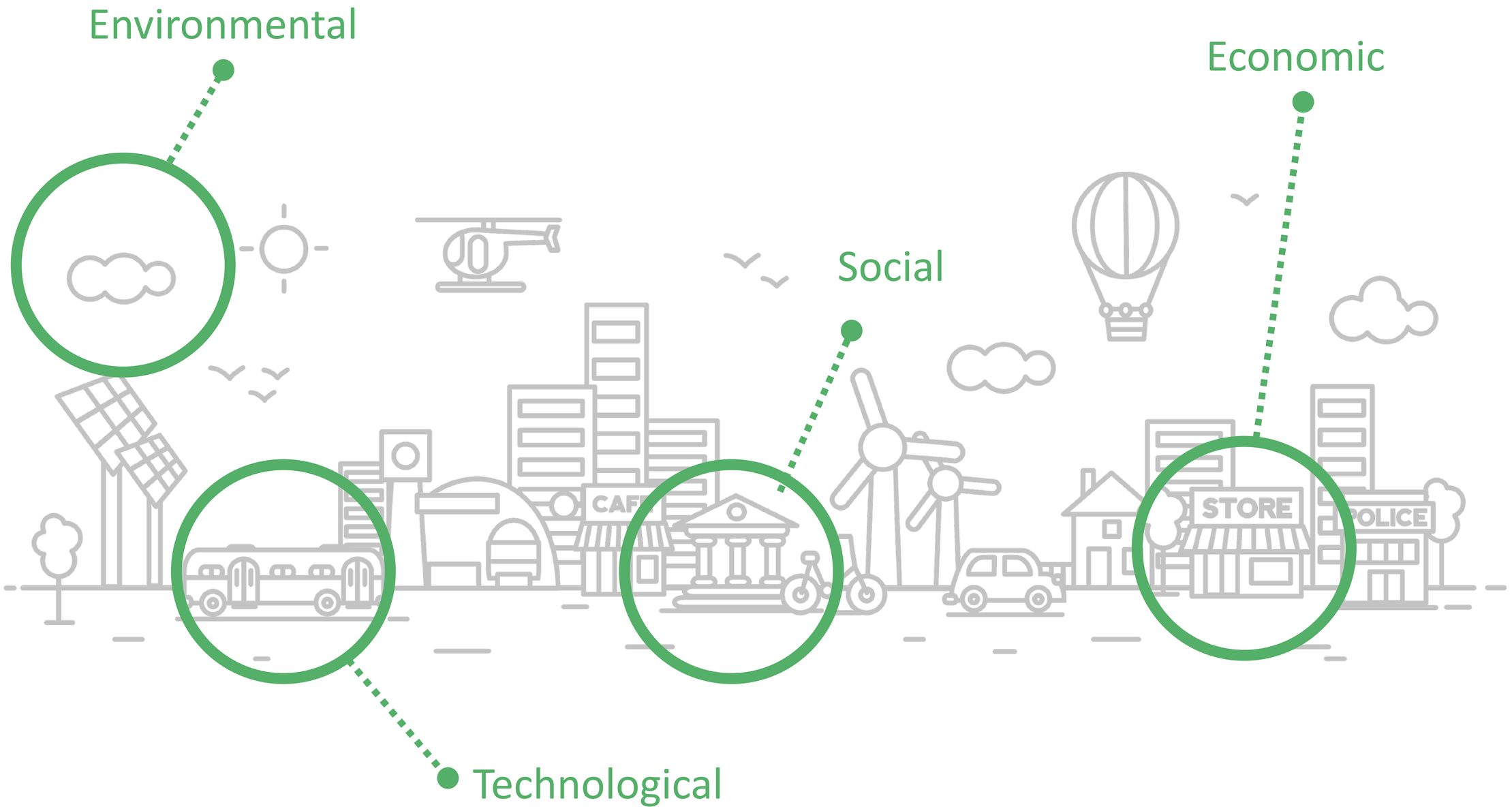
Starting at the Beginning

Let’s start at the beginning. The aim at this early stage is to get a visual overview of the system we are dealing with; the different component types and generally how they are interrelated. Before we start adding causal relations or different dimensions to the map we want to simply get it all out in front of us so that we are sure we are not missing anything. Once we have this overview we can start to refine it and add in detail later in the process.

System Dimensions

Change in complex systems does not happen from one centralized locus but instead is the product of many concurrent and parallel processes taking place at multiple different levels in multiple different domains at the same time. For this reason, the first thing is for us to go expansive in our thinking so as to make sure that we are adding in all the different dimensions to the system we want to map; this is the divergent stage of the process so let's try and capture all relevant dimensions. For example, at first glance, we might think that education is just about teachers and schools, however, if we were to dig into it we would see that it is as much about external factors such as food, family finance and employment, politics, media and entertainment, etc. Our map should start by trying to capture those different domains and factor them in.




Environmental
Economic
Social
Technological
CAFE
STORE
POLICE

Define Nodes

The basics of a systems map is very simple, just nodes and links between them.
We can then start by defining the different kinds of nodes in the system.

Social

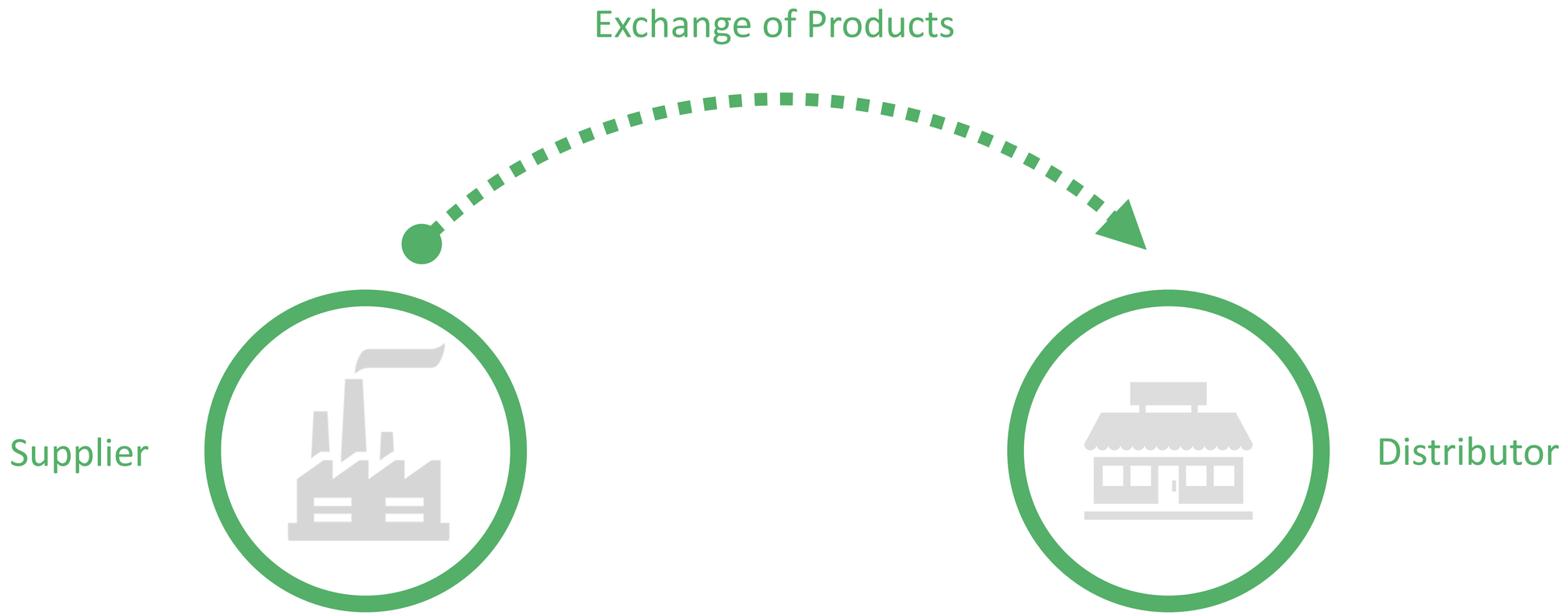
Economic

Technological

Environmental

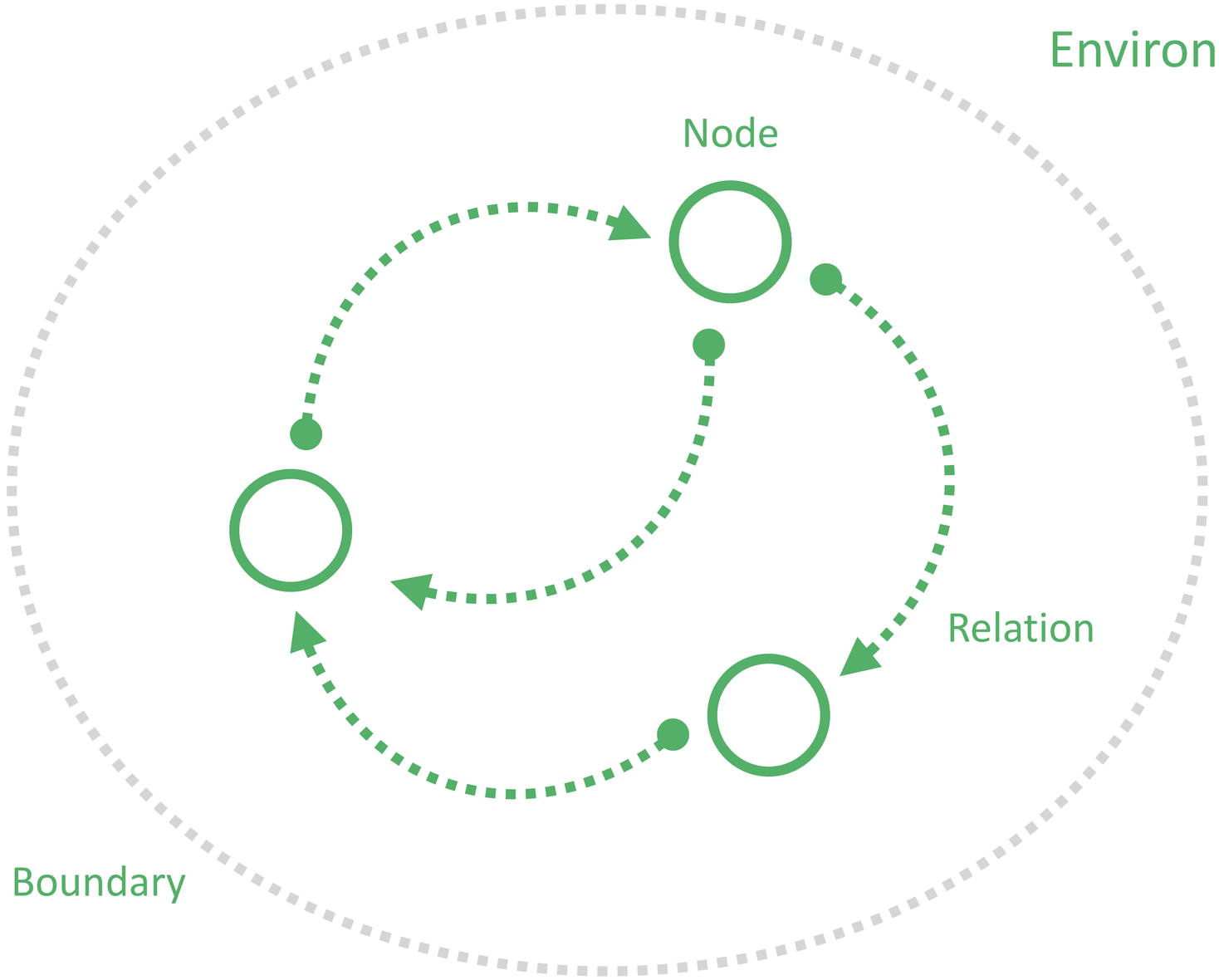
Linkages

A link simply denotes that two things are connected in some way. This may be the exchange of information between two organizations, the flow of goods from a manufacturer two distributor, or money from citizens to government via taxes.



System Map

A system map is then the network a nodes and links with a boundary



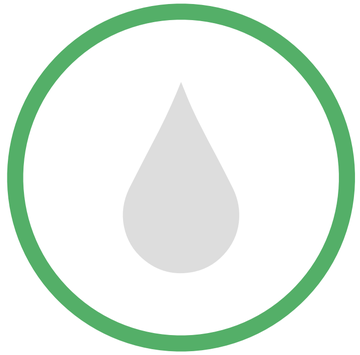
Environmental Factors

Environmental Factors

All the systems we are interested in are at the end of the day dependent upon material and energy flows, sometimes this is explicit e.g. mapping a food system, sometimes it is in the background, e.g. mapping a commercial system. Either way environmental factors should be added into the map when and where relevant. Some of the primary categories to consider when including environmental elements include:

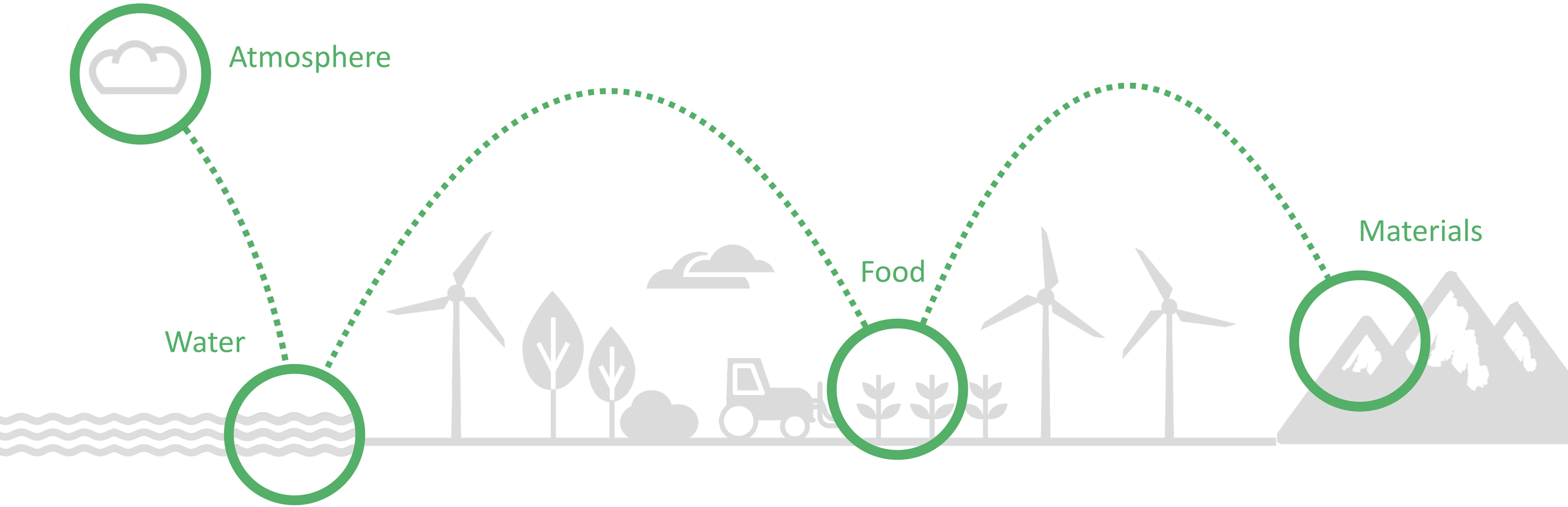
Food

Materials

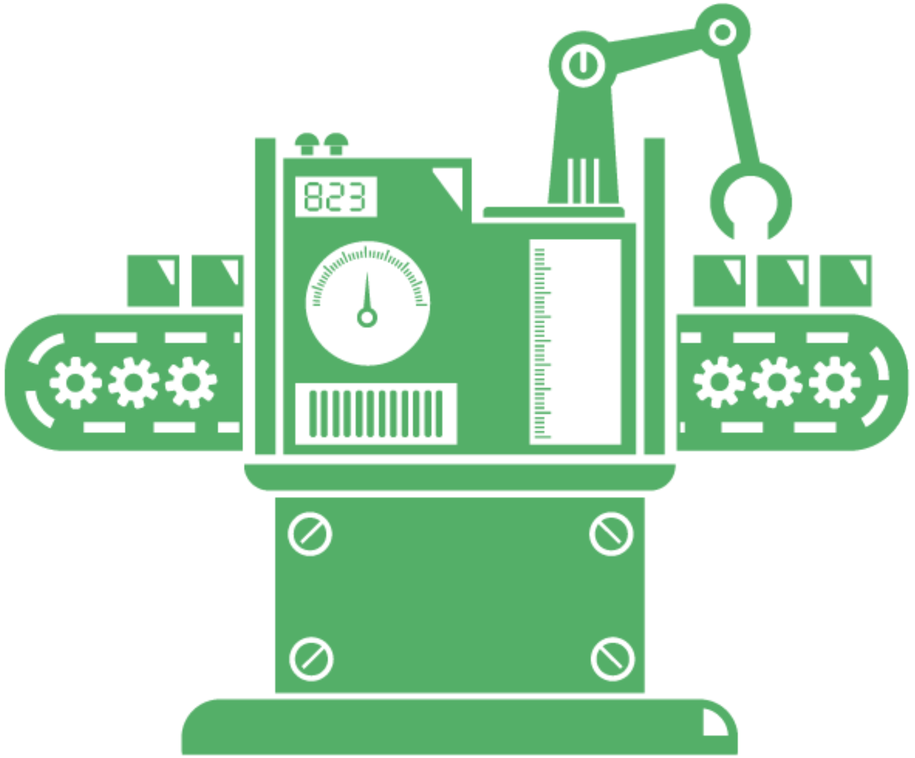


Water

Atmosphere


Atmosphere
Water
Food
Materials

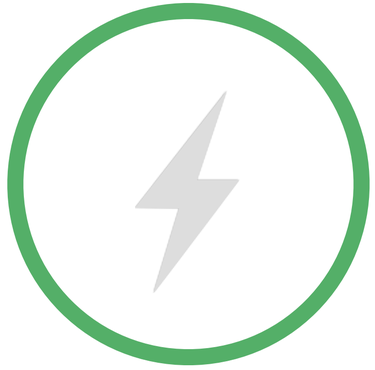
Technological Factors



Technological Factors

All the systems we are interested in are also dependent upon a huge infrastructure of technology. Whether we are dealing with education, media, finance or commerce, they all require vast networks of telecommunications, energy supply, transport and physical infrastructure to enable them.

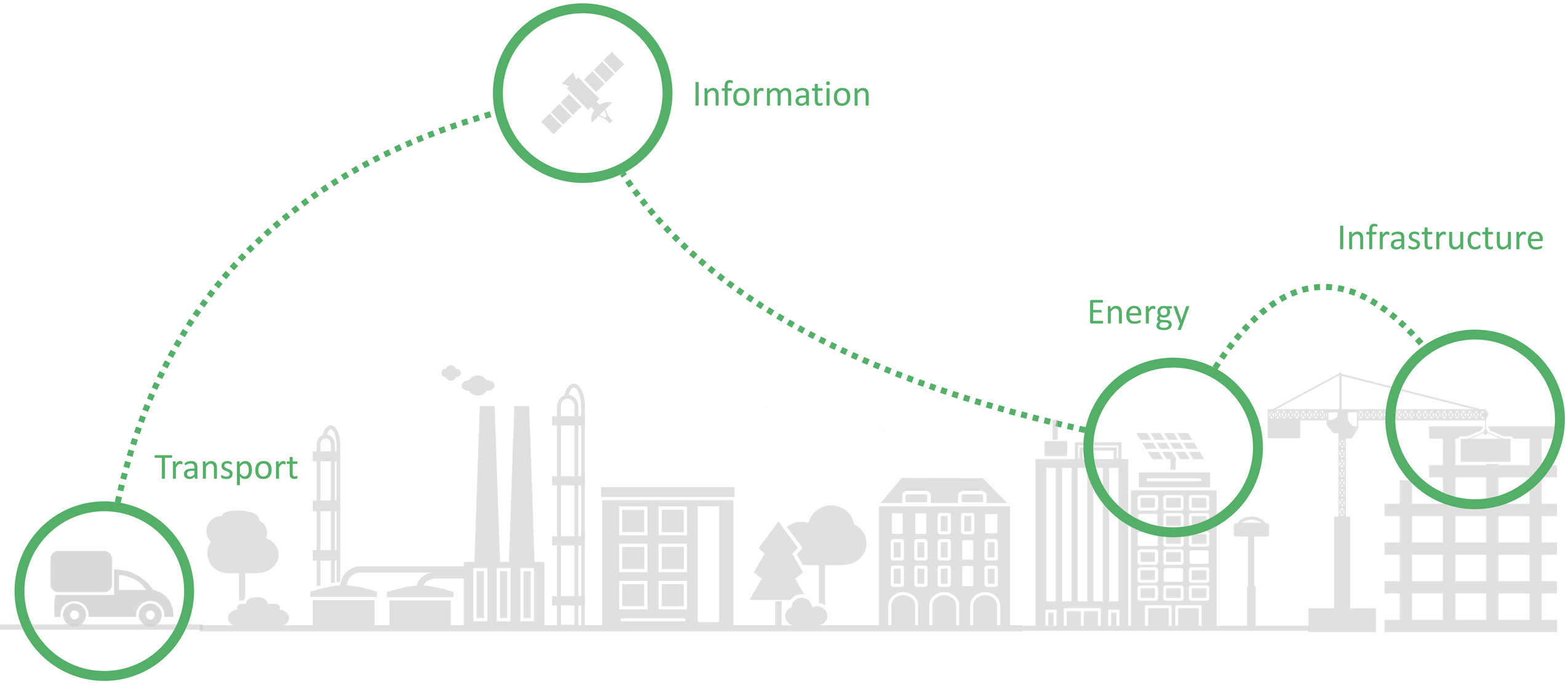
Information



Energy

Transport

Infrastructure


Information
Infrastructure
Energy
Transport

Economic Factors

Economic Factors

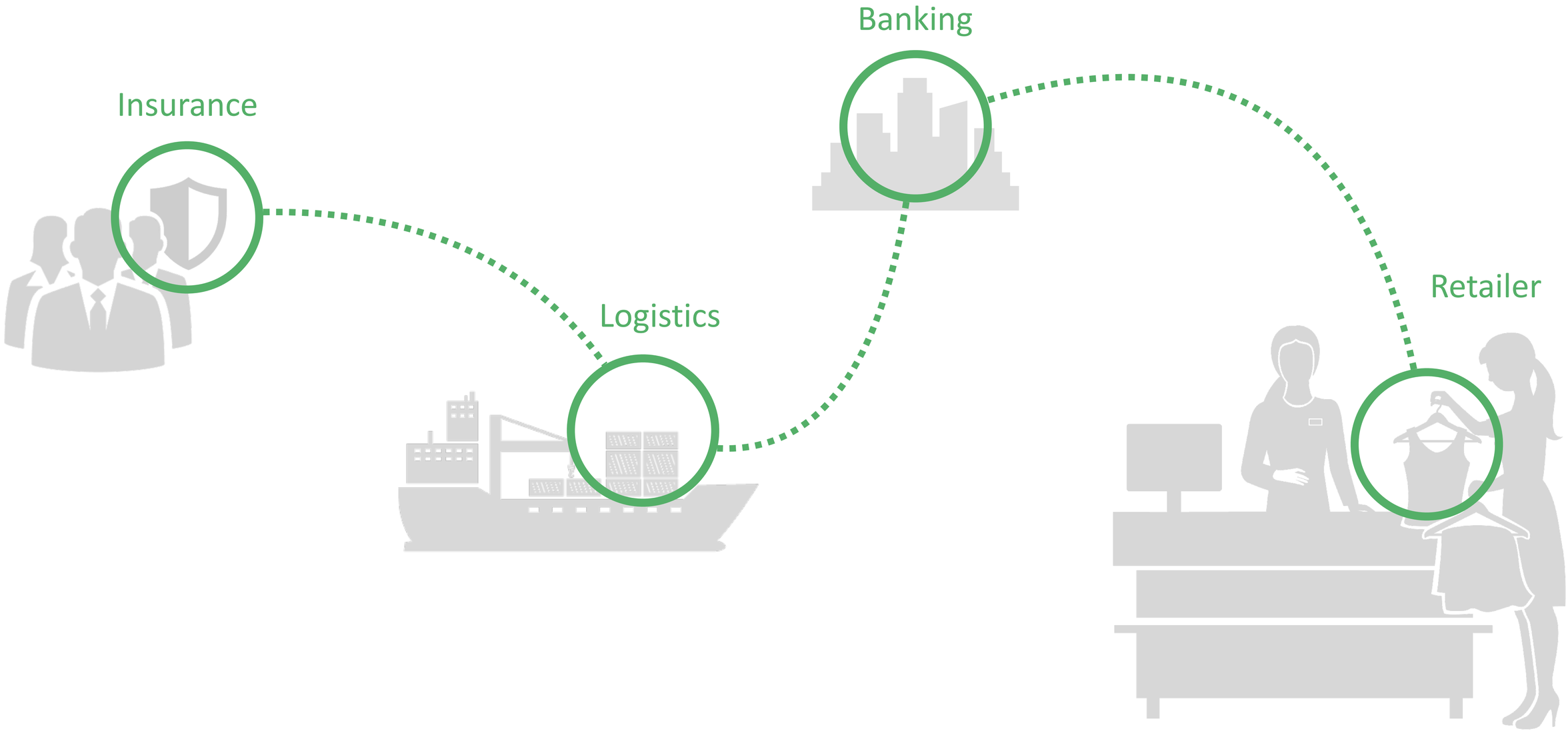
To run a hospital, provide water to a city, run a concert or even a local church all involve economics. The influences and considerations of economics and finance are everywhere and its many different dimensional must be factored in.

Insurance

Finance

Retail

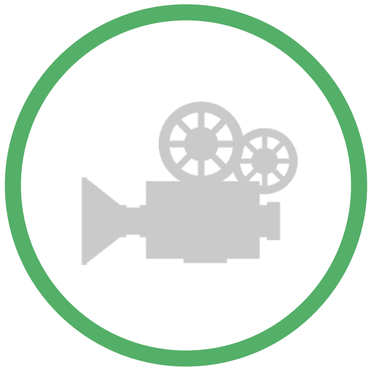
Logistics


Insurance
Logistics
Banking
Retailer

Social Factors

Social Factors

Lastly socio-political factors need to be included. These may include: regulation and governance, media and entertainment, education and science, healthcare, etc.

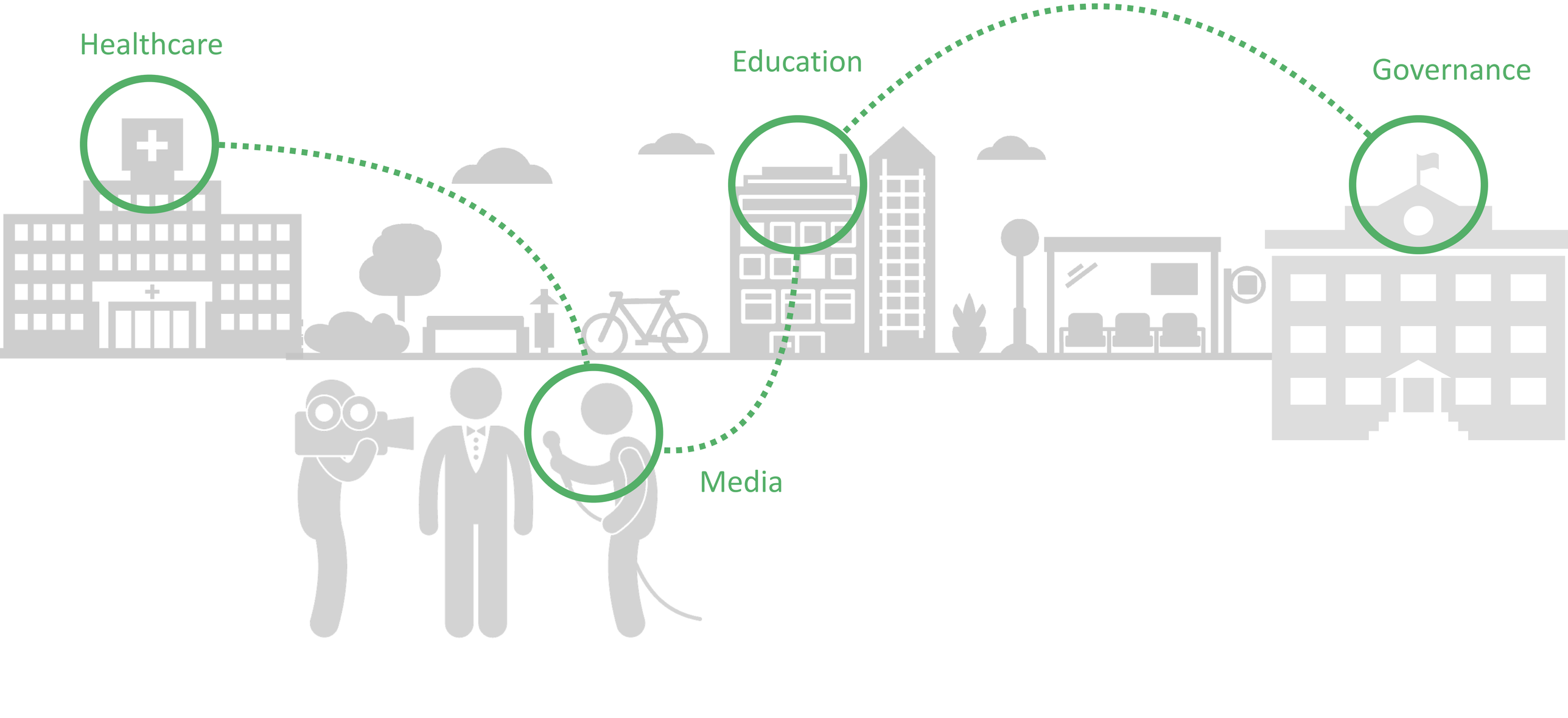


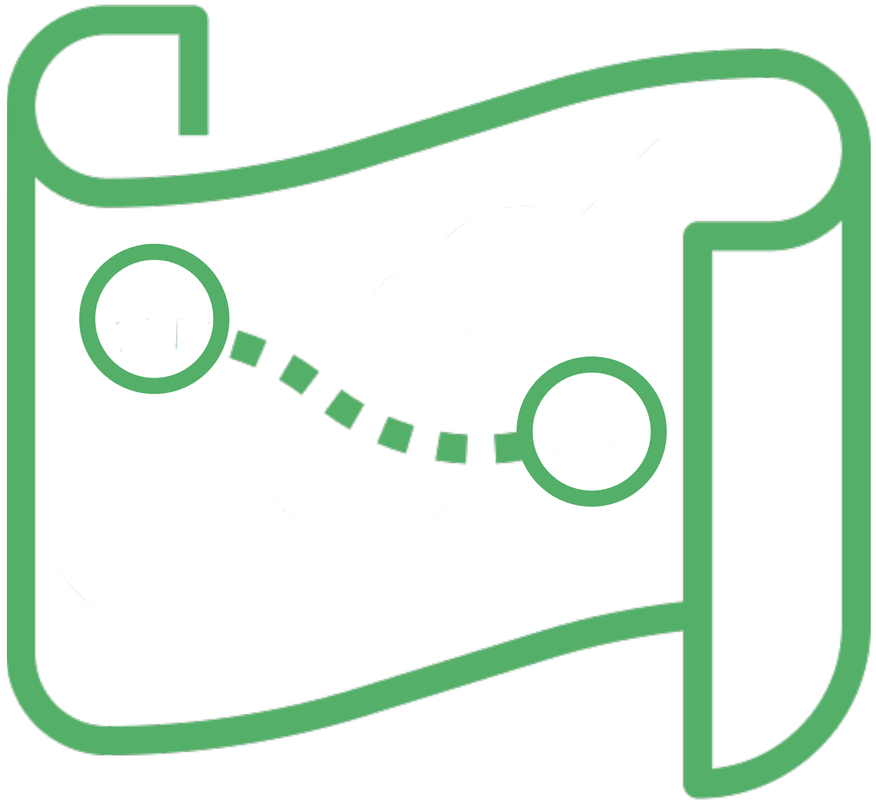
Media

Education

Governance

Healthcare


Healthcare
Education
Governance
Media

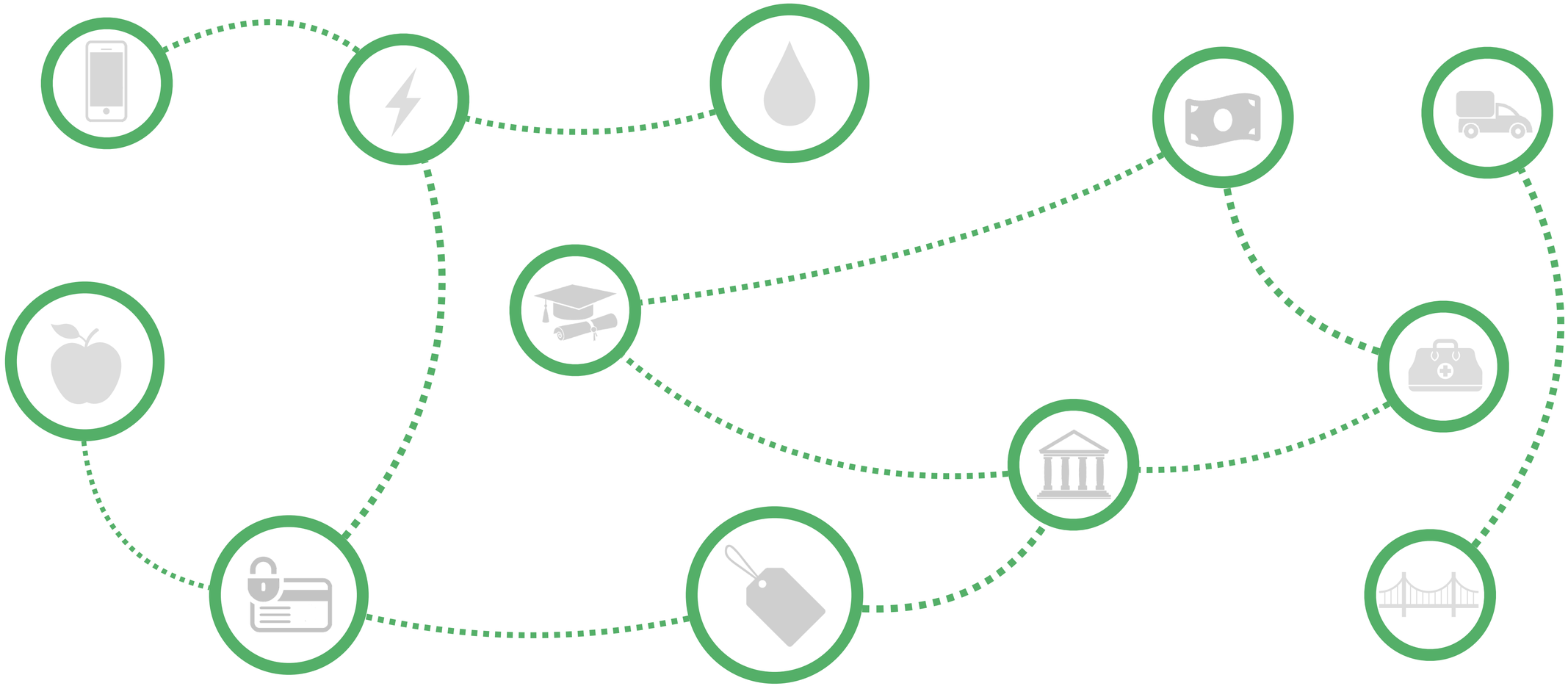


Giga-Mapping

Giga-mapping?

Giga-mapping is a way of getting everything out there in front of us. Giga-mapping is extensive mapping across multiple layers and scales. It is aimed at investigating relevant far-reaching connections between seemingly separated categories.

Giga Mapping - Map Everything



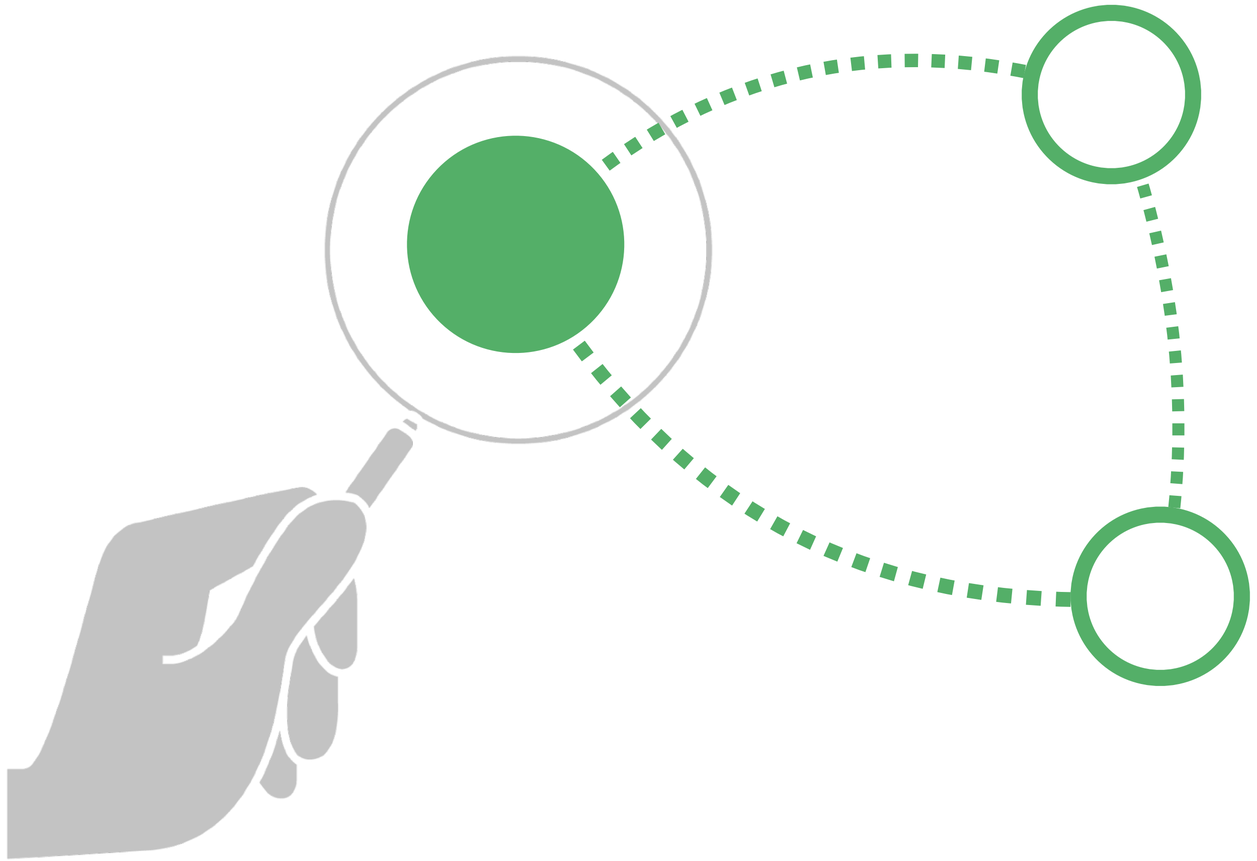
Food Systems Map

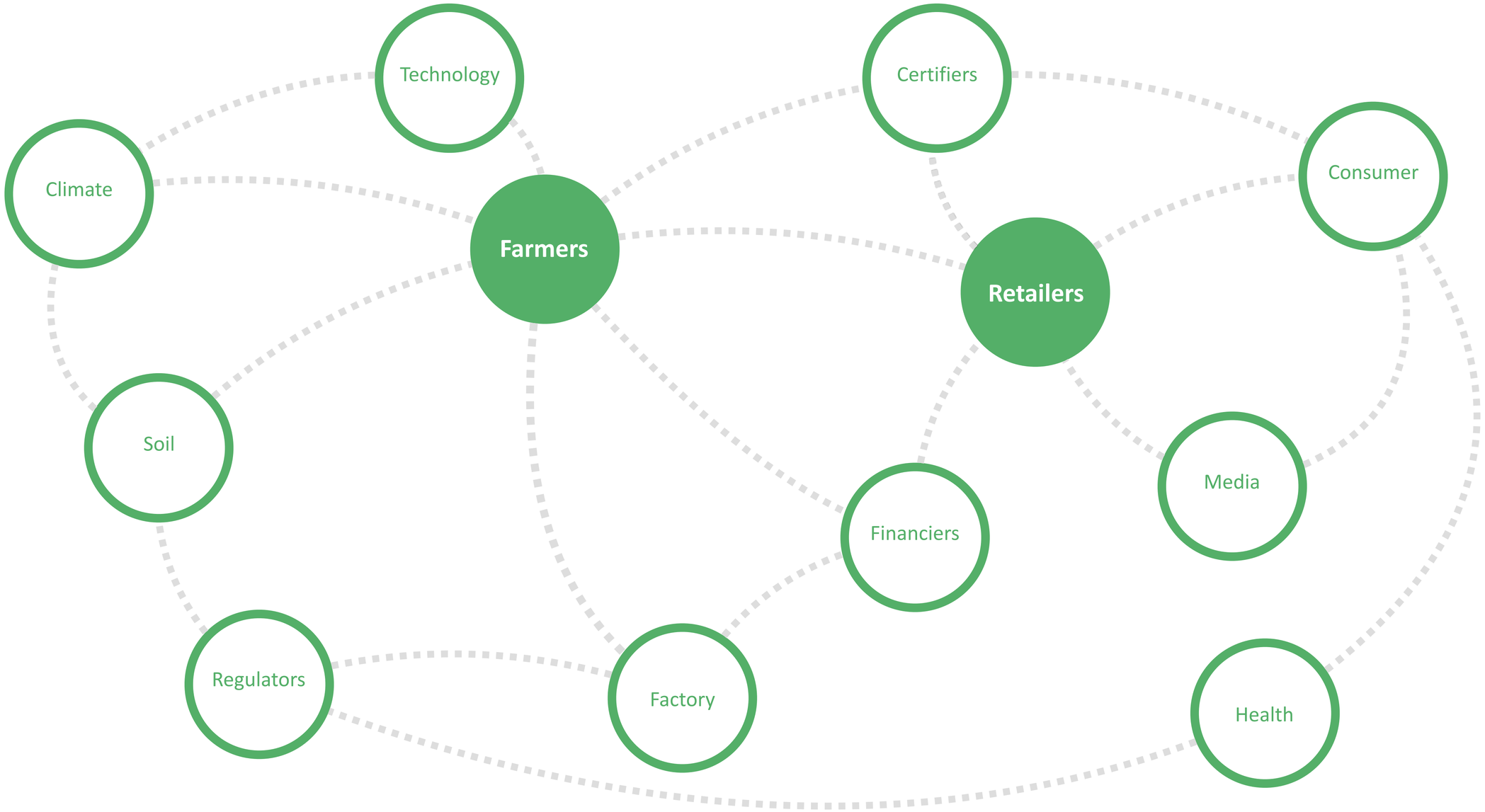
Now lets take a look at what the map of a food system might look like, putting in the relevant social, economic, environmental and technological factors.

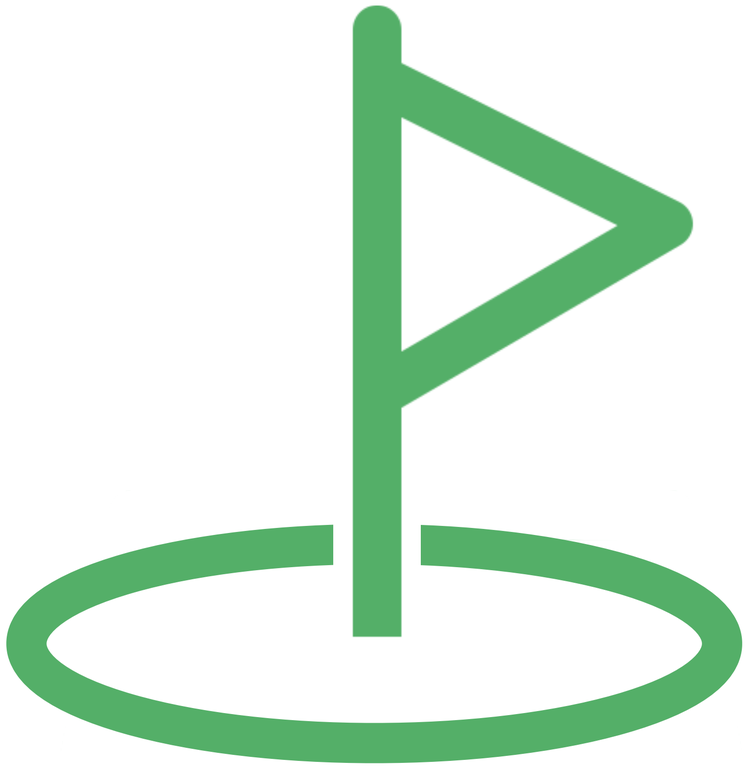

Certifiers
Technology
Consumer
Climate
Farms
Retailers
Soil
Media
Financiers
Regulators
Processors
Health

Insights

With only this basic map we can already start to gain insight into the system, such as identify key important elements based upon their level of connectivity e.g. the Farmers and Retailers




Technology
Certifiers
Climate
Consumer
Farmers
Retailers
Soil
Media
Financiers
Regulators
Factory
Health



Conclusion

That’s it Folks

That’s all you need to get you started, you can now create your own basic system map. Define the elements - try to include everything of relevance - create the connections and map the system. Congratulations you've got the basics.

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Actor Mapping

A Field Guide

Overview

Actor maps are a type of system map designed to reveal the network of people and organizations within a given system and how they are interrelated. The aim is to gain a deeper understanding of the stakeholder’s values, models, incentives and the power dynamics in the system. This is done by creating maps consisting of the various individuals and organizations that have a role in the system we wish to change.

With actor mapping, we are asking who are the individuals or organizations that have an influence in determining the pattern and outcomes of the system and who are influenced by it. These "stakeholders" have a stake in the outcomes to the organization and thus an interest in shaping events according to their stake. To be responsible in our systems change initiatives, we must be first aware of these actors, their perspectives and interests.

Why Actor Maps?

Involvement

Start to recognize who will be affected by a change process and thus who needs to be involved

Communications

To understand the mental models and values of actors so that we can better speak their language

Opportunities

Find opportunities for alliances, collaboration and recognize potential points of conflict

Explore Perspectives

Build up a better understanding of the system by looking at it from the different perspectives of the actors

Identify Gaps

Identify where gaps to the flow of information or resources are as potential intervention points

Adoption

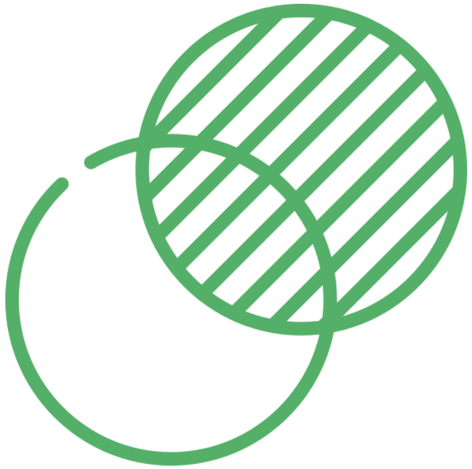
Understand how an adoption process may take place; who would be likely to resist or promote change

Involvement

If we map out any complex organization, we will see that for almost every element on the map there will be a stakeholder; a person or group of people that have an interest in that aspect of the system. For example, if we are considering a food system we may have nodes representing the farmers, regulators, consumers, machinery manufactures, the water system, environment, etc. each one of these elements on the map will have an associated stakeholder that has an interest in the system being a certain way and the capacity to affect some aspects of its outcomes.

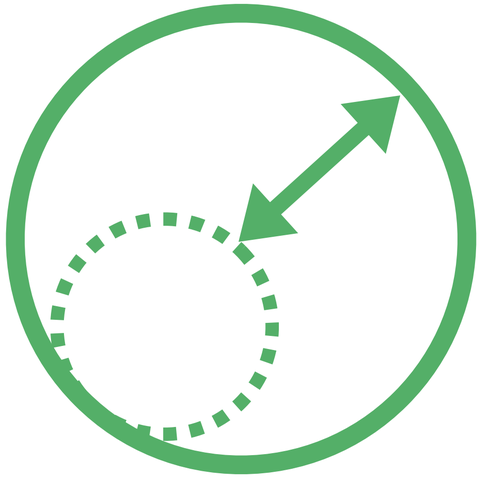
At the end of the day, stakeholders are the ones who control the state of the system and we need to understand them so that we can work with them and not against them - remember stakeholders can become "stick holders" if we get things wrong. As such, if we want to change a system we need to get both a comprehensive and detailed understanding of these stakeholders, their interests and potential actions and this is the aim of actor mapping.

Key Considerations



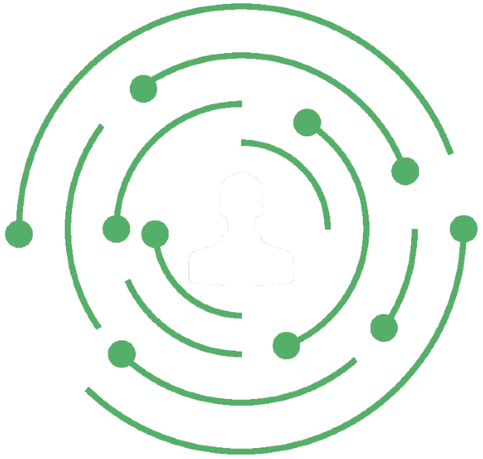
Multi-Dimensional

People are multidimensional, they have values, a view of the world, incentives, power, etc. and we have to factor in these different aspects.



Multi-Scale

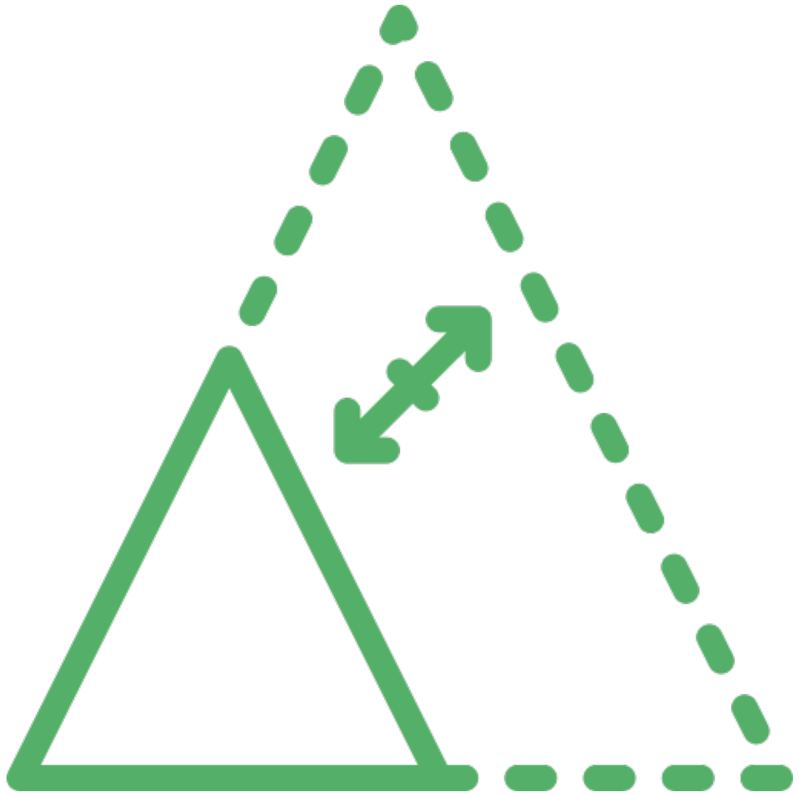
To understand potential externalities, we need to consider actor groups on different levels, from the individual to organizational but also whole ecosystems.



Multi-Perspective

To build up a more comprehensive picture of the whole we need to try and view the system from the many different dimensions of the actors within it.

Multi-Scale



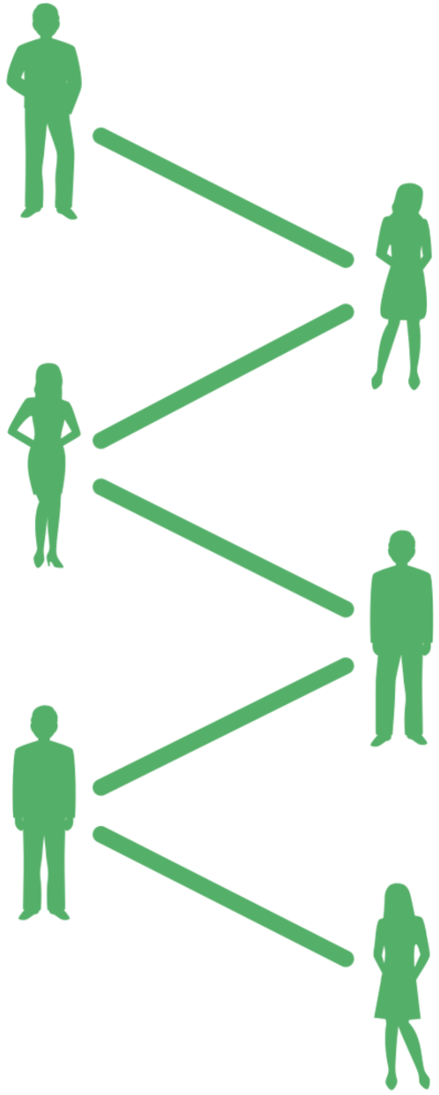
One reason systems change is complex is because typically many parties are involved with each having their own interests, goals, and strategies. Large scale change will involve many alterations across the system with many actors being affected in many different ways. In this process of considering who will be affected by our interventions and how they will be affected, we need to think across different levels and scales.

The aim should be to consider actor groups on different levels to better understand potential externalities. Taking a holistic approach means considering not just the immediate individuals and organizations that will be affected but to step back to think of whole communities and ecosystems. This implies considering not just the immediate effects of an action but also the ramifications across different systems - to factor in the externalities, both positive and negative, so that they do not become our stumbling blocks but can provide us with added opportunities.

Multi-Perspective

Complex systems involve a vast array of actors with many different perspectives, simply having one global view of the system is not sufficed. We need to build up our view of the whole from the specific vantage points of the different individuals within it. Think of the global financial system, it affects almost every person on this planet, but in very different ways. Each of us experiences this system from our own historical, social, economic and geographical context with our own set of interests shaping our perspective.

Reality is about context, everything happens in the context of space and time and involves people interacting with the system based upon their own uniques set of conditions. Gaining a grasp of a system through an abstract model is valuable but this model does not exist in reality. Our model and understanding of a system have to be enriched and brought to life through seeing it from the perspective of the lived experiences of the people who form part of it and use it daily. From this, we can start to understand better why the system is the way it is; why the individuals perpetuate the system patterns and the opportunities for changing those patterns.



Multi-Dimensional

We all have values, a view of the world, we form part of social structures with incentives and based upon that we make decisions and take actions that affect outcomes. However, we are not simply rational agents trying to maximize against a mono-dimensional conception of value, as humans, we value different things and make trade-offs between them in our decisions.

We have values, a way of looking at the world and an identity, we form part of social structures of incentives and power, and thus, in reality, the choices we make and the way things play out are a product of these many different dimensions to ourselves. As such for a solution to be viable it has to create value for all along different dimensions. Looking at a system we wish to change in terms of the different kinds of value to the different actors is an important consideration. If we don’t understand and factor in those different dimensions then we are unlikely to create a solution that is sustainable and viable in the long run.

Identity

We want to first identify the relevant parties

Analyst

Analyze the actors and relations

Prioritize

Prioritize the actors in relation to our change initiative

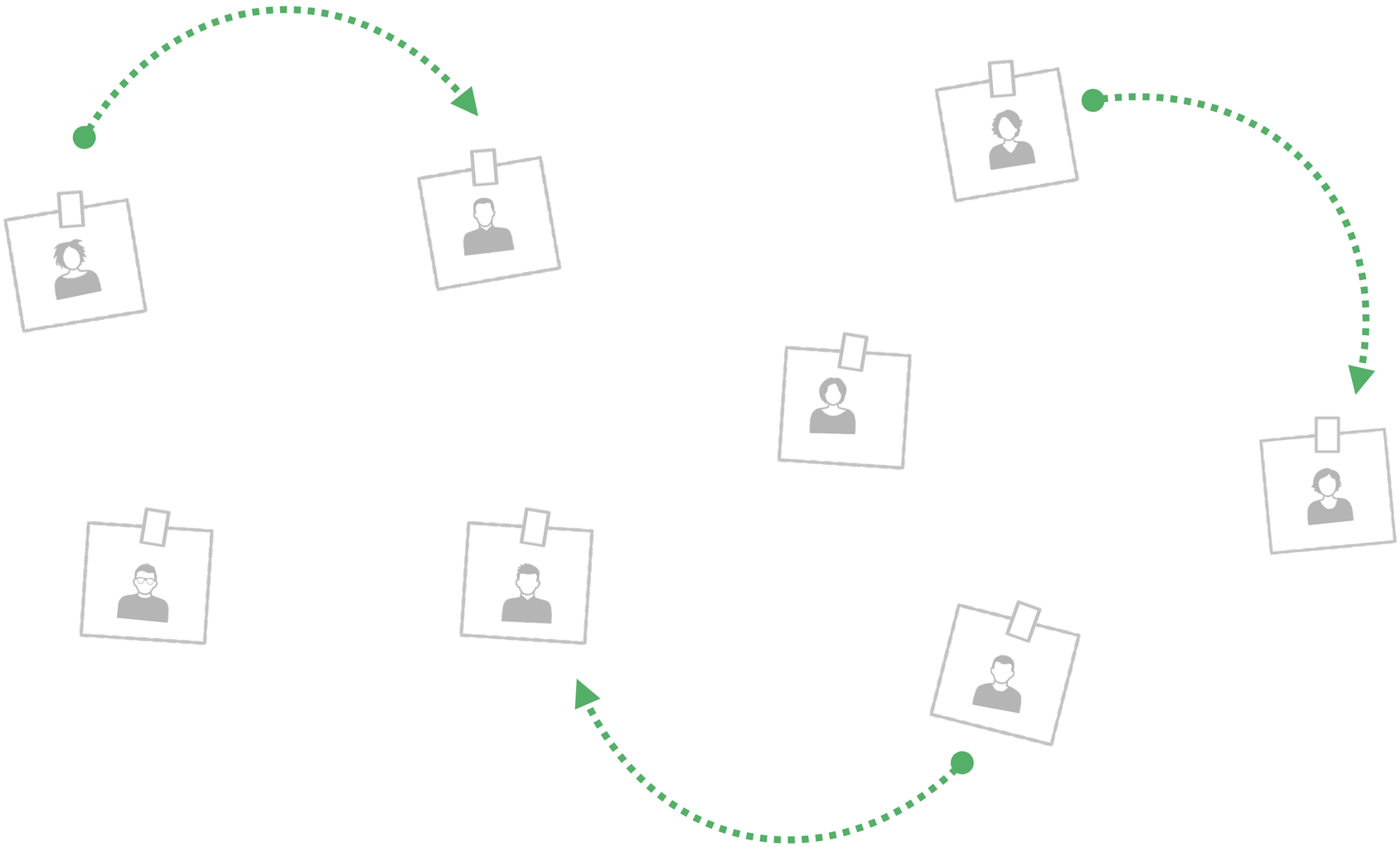
Actors

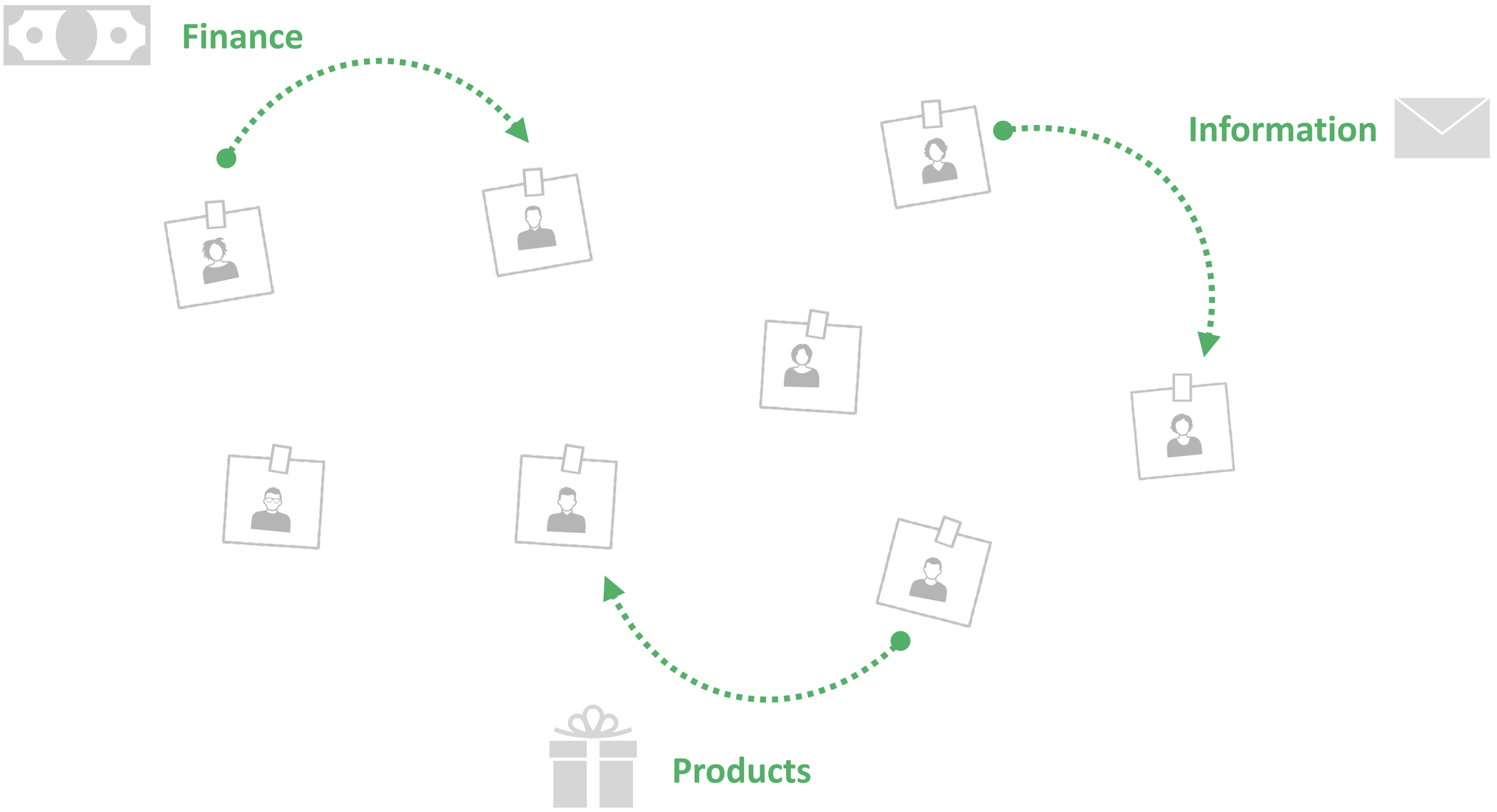
List of stakeholders

To get started, determine who needs to be involved and from this create a list of stakeholders who form part of the system

Actor Relations

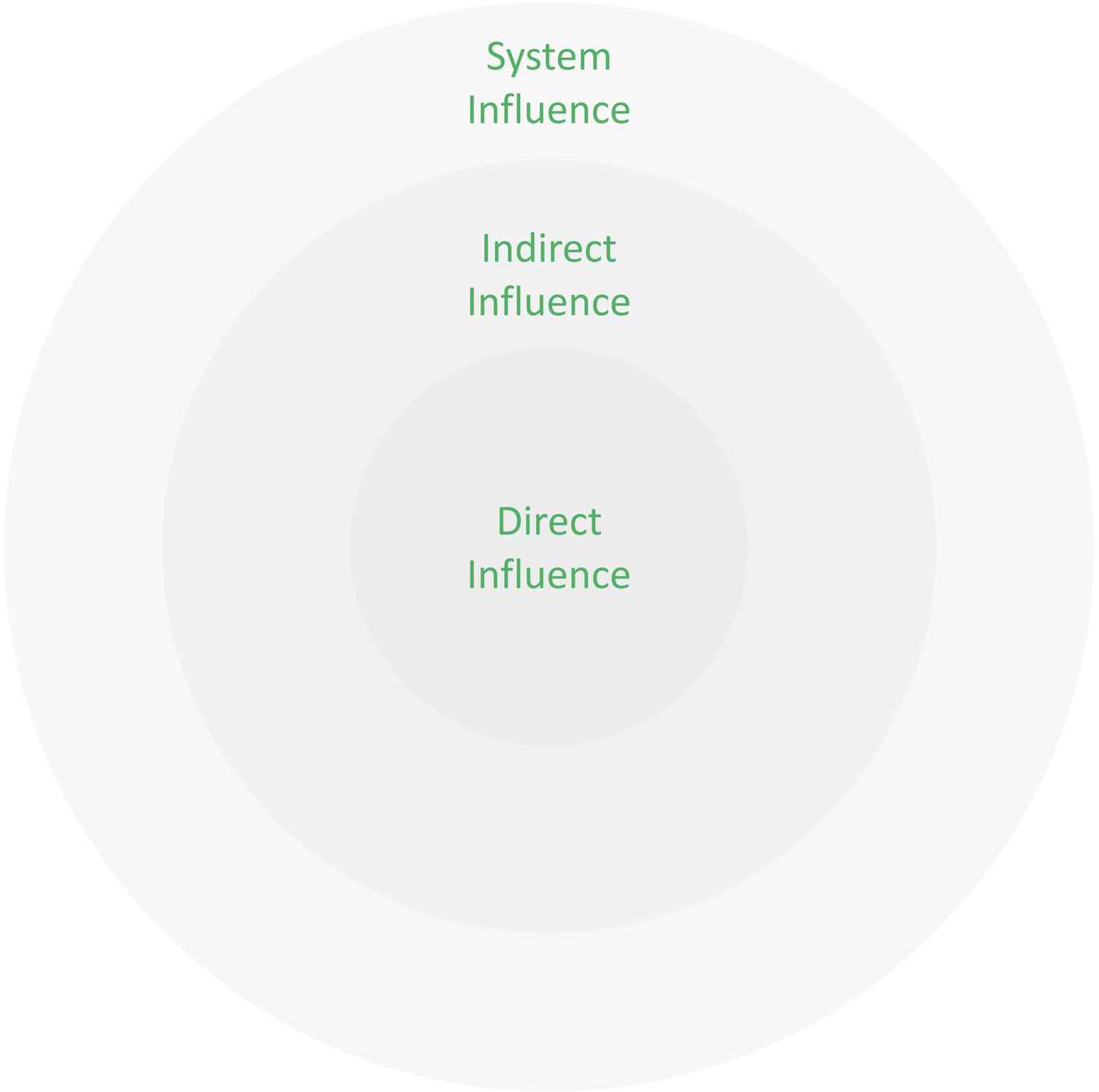
What are the connections between them?

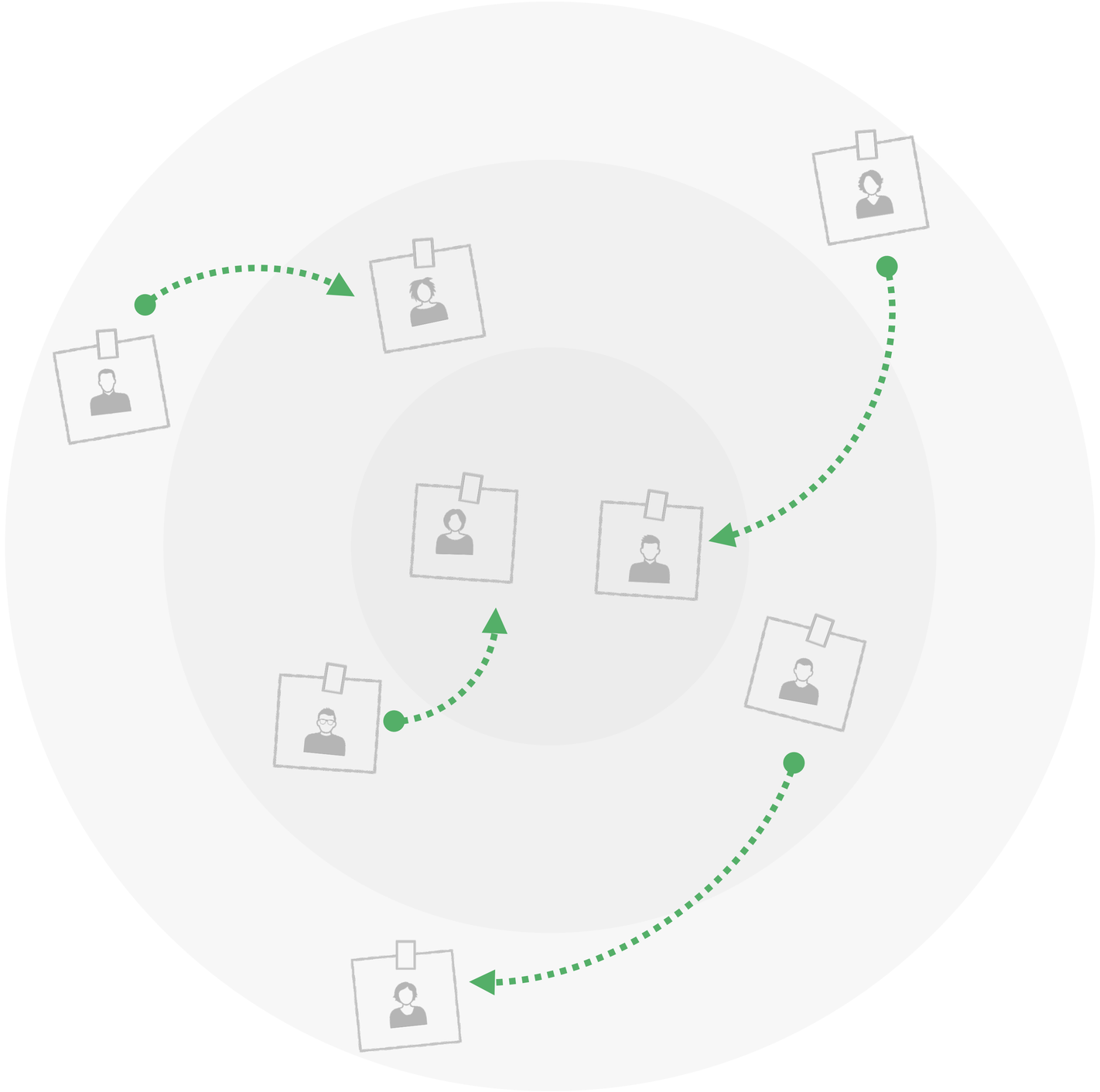



Finance
Information
Products

Determine Relevance

Different actors will have different levels of engagement with the issue of interest





Stakeholder Persona

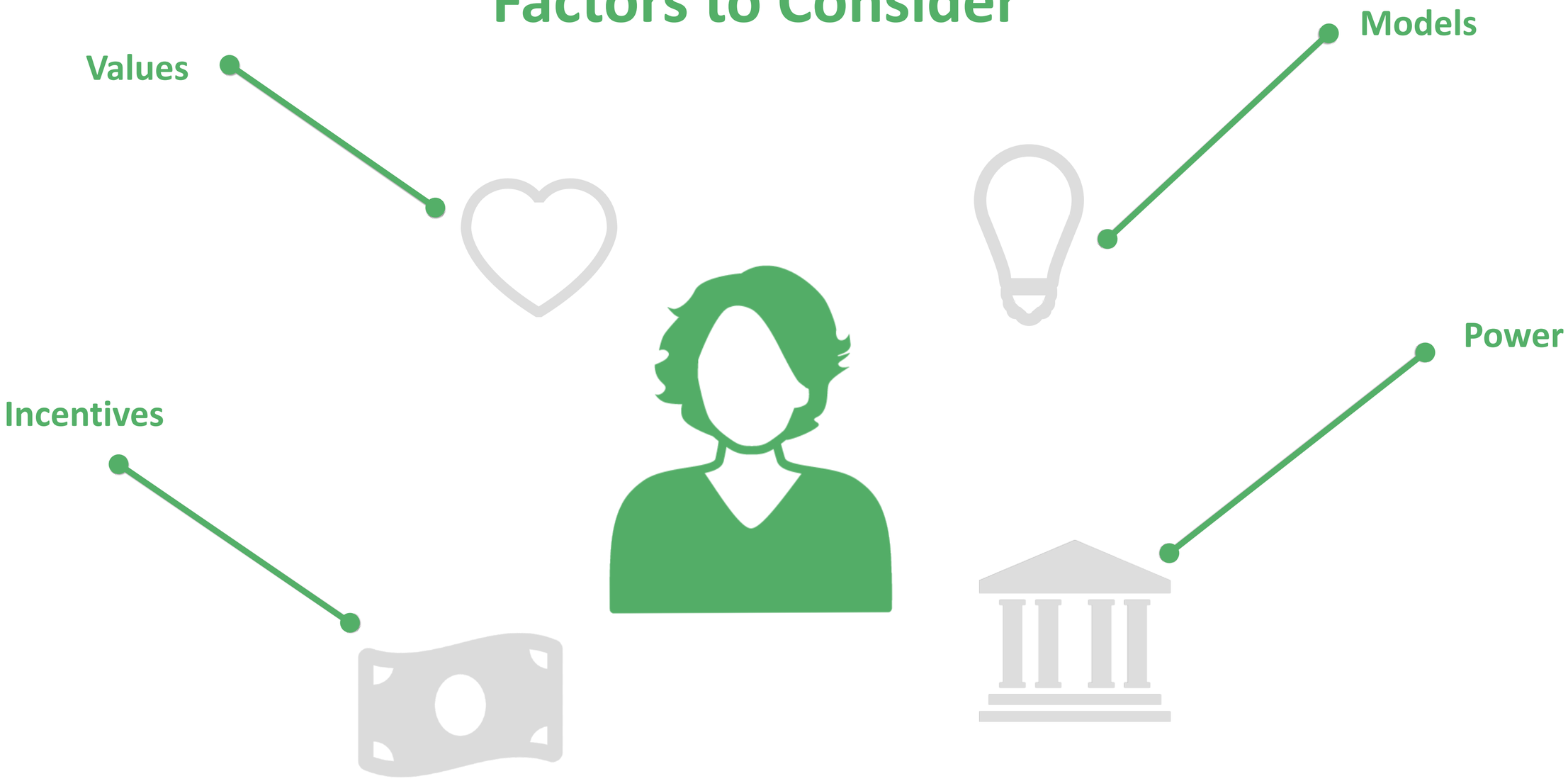
Now to get to know the actors

Ethnography

Get to know the actors in the system through ethnographic studies. Ethnographic studies involve completely immersing oneself in the lives, culture, or situation of the people or organizations we are interested in over some time. We enter and spend a significant amount of time in the real environment needed to be observed to gain insight into actors, the context they find themselves within and how they behave in that environment.

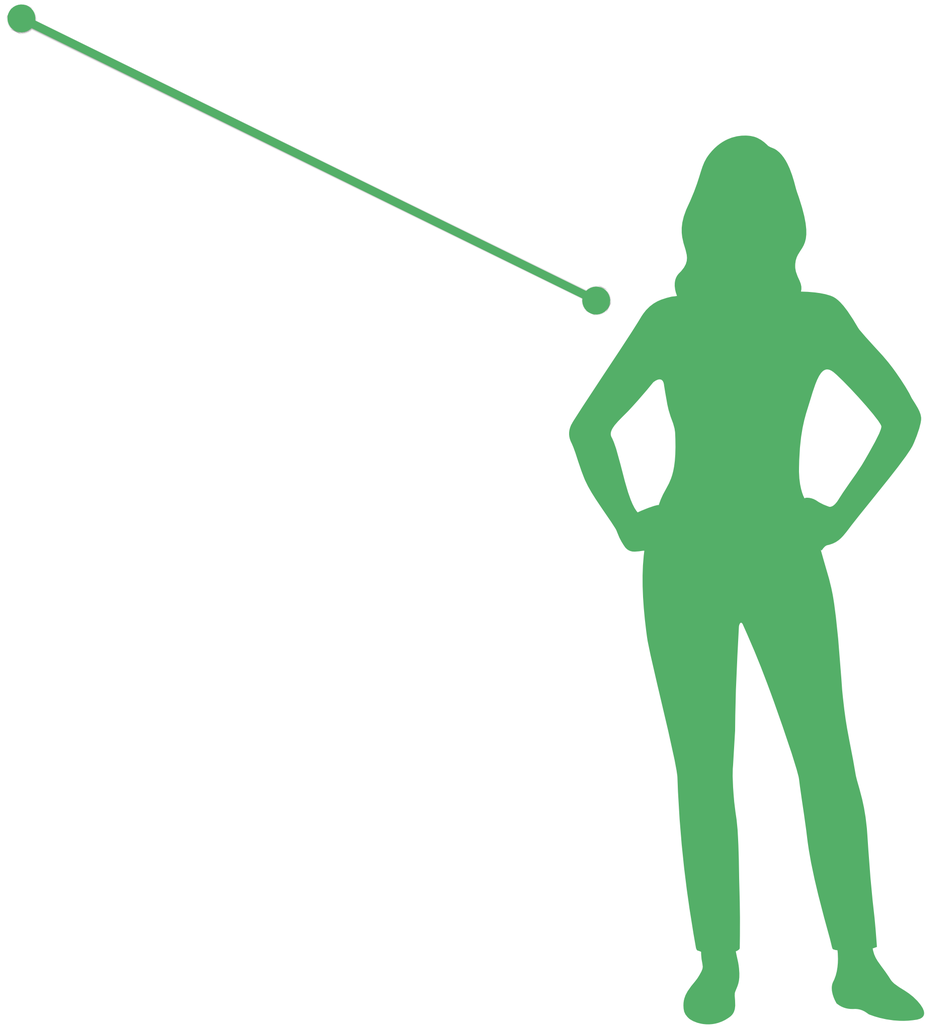
In the process, we try as best we can to not alter the context or project our meaning on to it. In order to understand not just what people say but also what they do the researcher must observe people as they go about their daily activities without disrupting them. Over time the insights drawn can be built up into a persona that captures key information while ensuring that it matches the underlying experience of the actors.

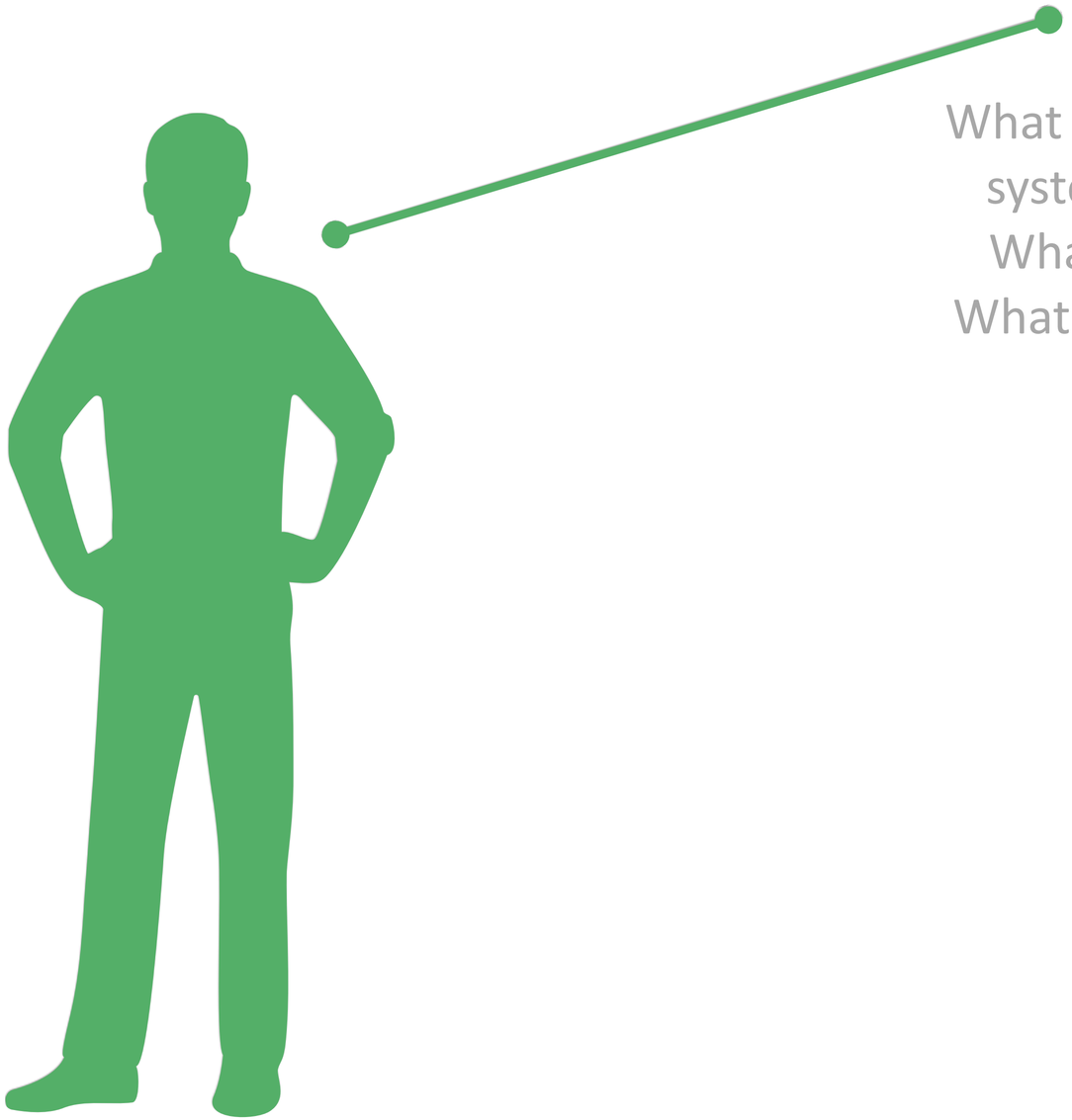
Factors to Consider



Values

What are the values?
What are the stories those values create?
How do those values create the assumptions?
What is the accepted paradigm?





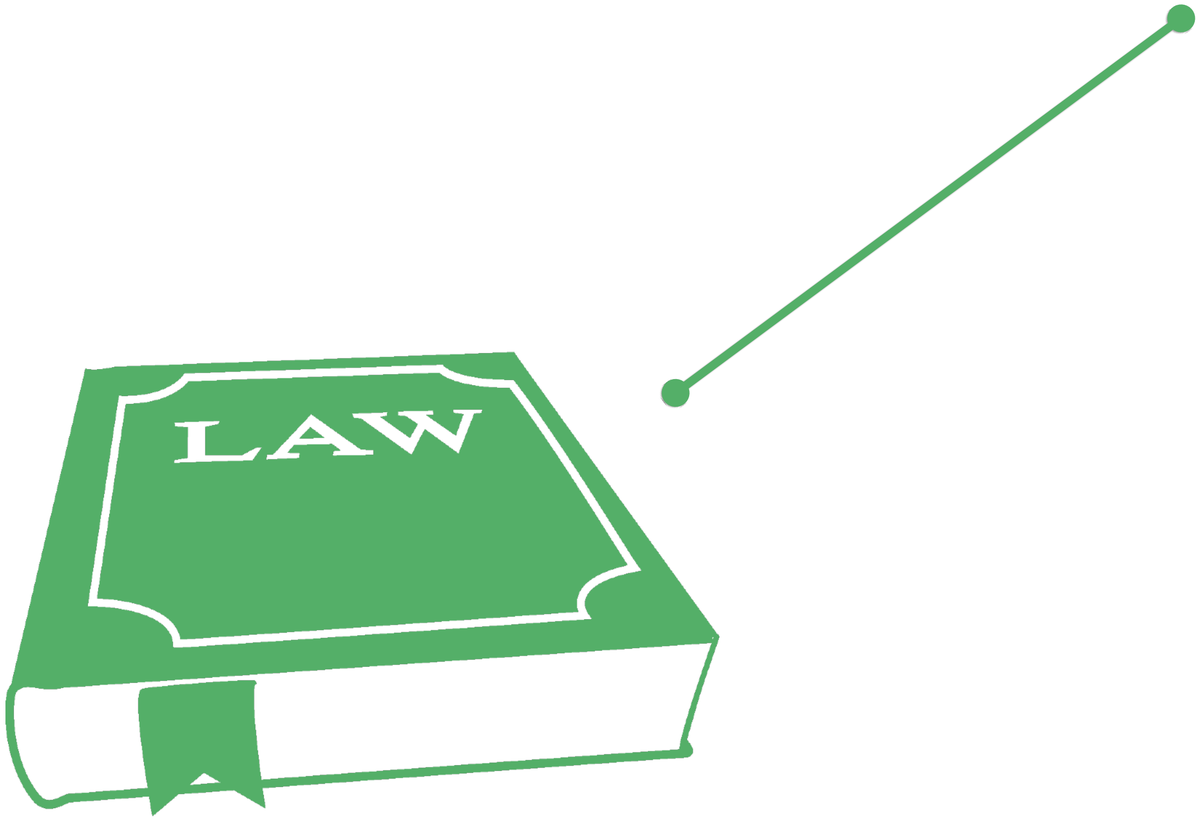
Models

What are the models people use to understand the system, who they are and what they are doing?
What are the concepts and the language used?
What are the perspectives created by the models?
What are the knowledge gaps created?

Incentive

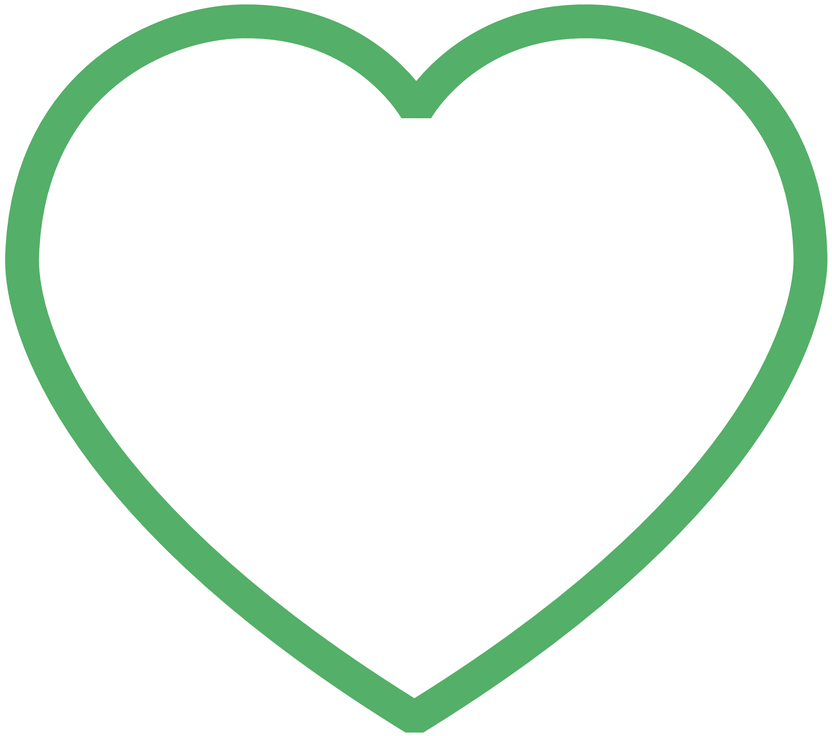
What are the assets and resources in the system?
How do resources flow through the system?

How do those flows create the incentives?
How do those incentives motivate actors?
Where are the potential points of cooperation
or conflict created by those motives?



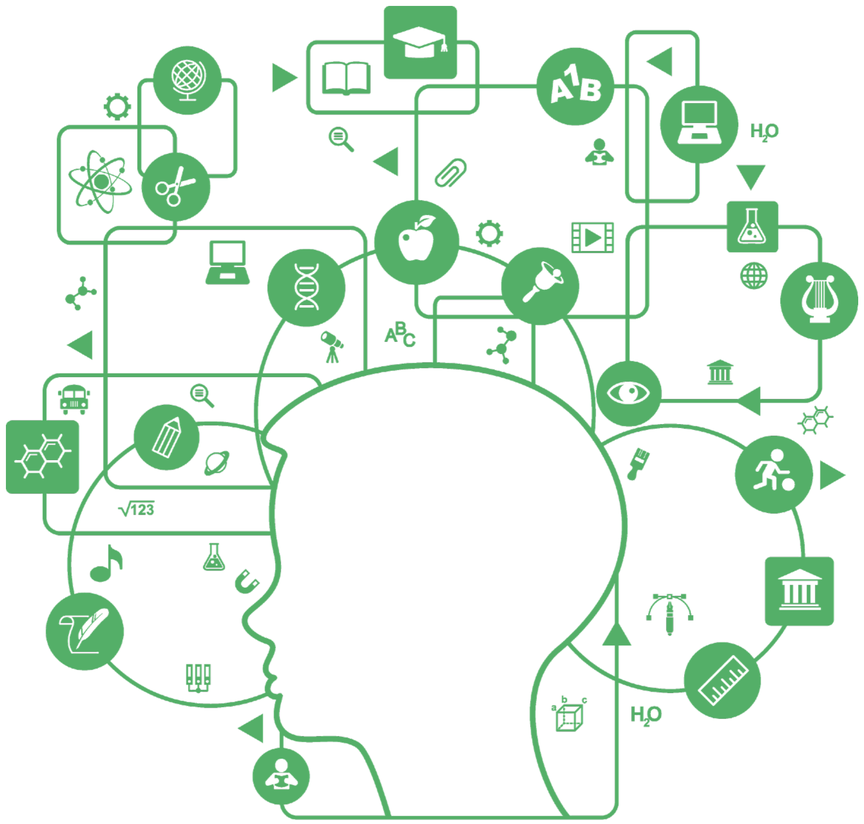
Power

What are the sources of power?
What are the sources of legitimacy?
What are the rules?
Who gets to alter the rules?
For whom do the rules favor?



Values & Models

Value Mapping

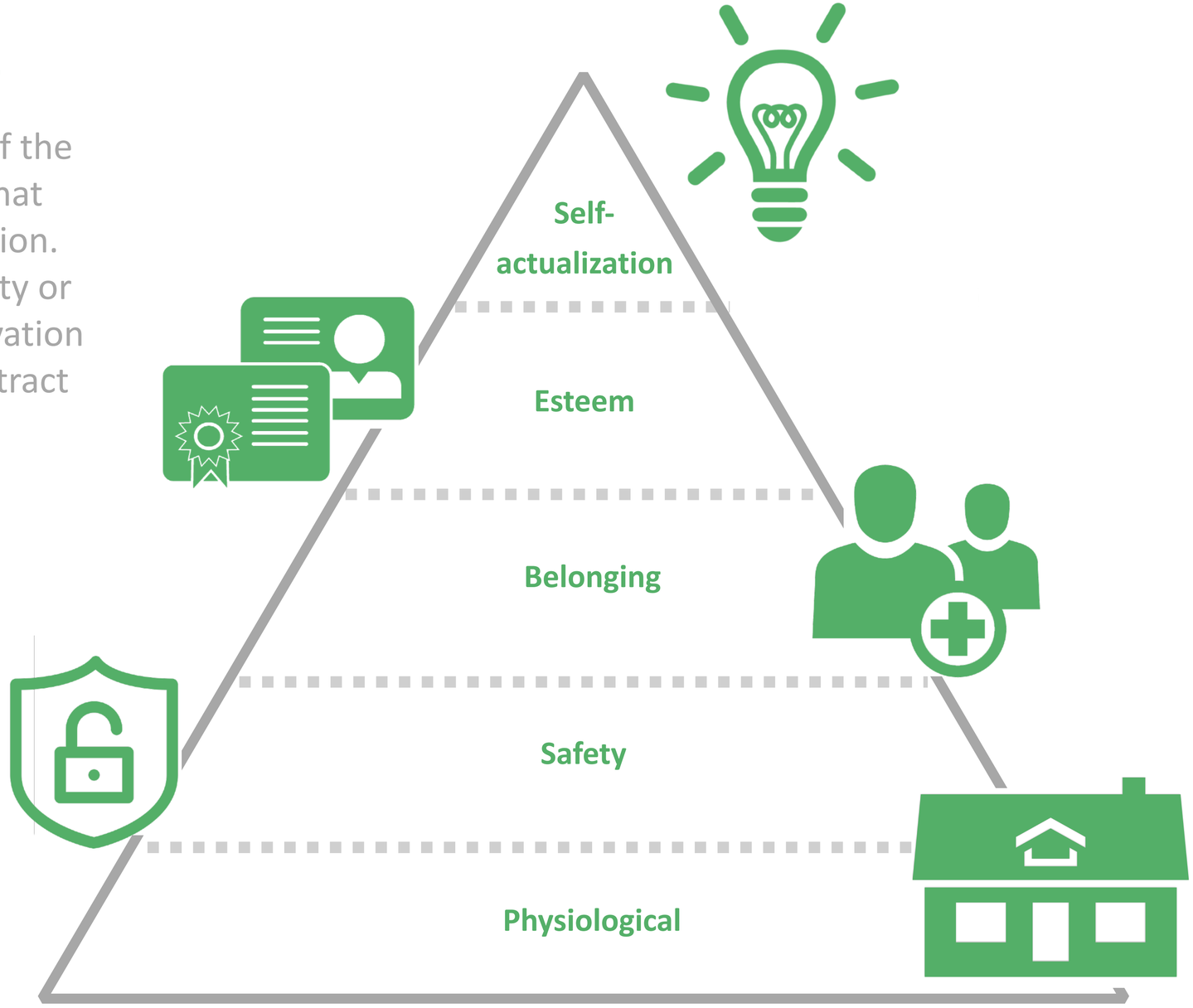


Mental models and the values that shape them are at the foundations of how we see the world and act upon it to create the environments we inhabit. Values are like a compass that directs our lives. They guide what we move towards or away from by defining what is of higher or lower value to us. Values rank what is good or bad, better or worse, and in so doing they give structure to our world. These rankings then work to motivate or demotivate us. To get a deep insight into the workings of the system we wish to change we are going to have to map these out; visualize the values and beliefs of the different actors in the system.

Values define our broad preferences concerning appropriate courses of actions and outcomes. As such, values reflect a person's sense of right and wrong. Values are, and probably always will be, a major source of conflict in the world, however, by learning how to elicit and work with values we can begin to understand what is important to the actors and why they do what they do.

Hierarchy of Needs

Values can be mapped in many ways, one of the most common is the hierarchy of needs that structures values in terms of their abstraction. People pursuing basic needs of food, security or economic welfare, will differ hugely in motivation and worldview to those pursuing more abstract motivation such as self-realization.



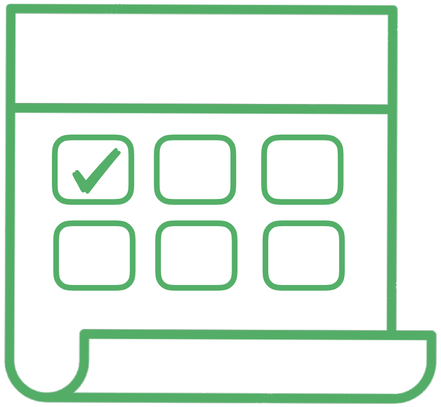
Motivation

The hierarchy of needs model helps to illustrate how values are what motivates us. Values are the "why" of what people do and can differ hugely - for one person going backpacking in Thailand makes no sense, for another it is a path to self-discovery. These values are probably more important than anything else in shaping what we do.

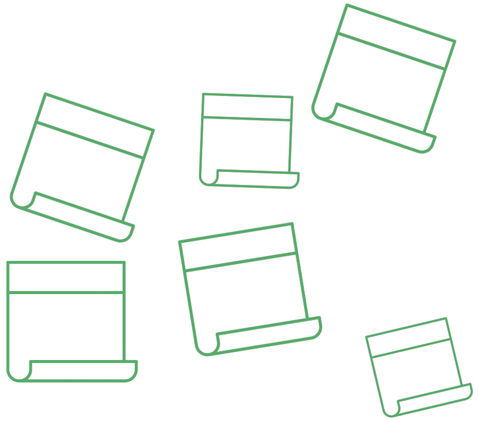
Our values might be something that we take for granted that we think is obvious, or that we've never actually articulated or written down. Revealing these values, however, can be very useful when trying to explain why things work the way they do. Once the values are mapped, they can be shared and act as a common reference point that simplifies and speeds up decision making.

How it Works

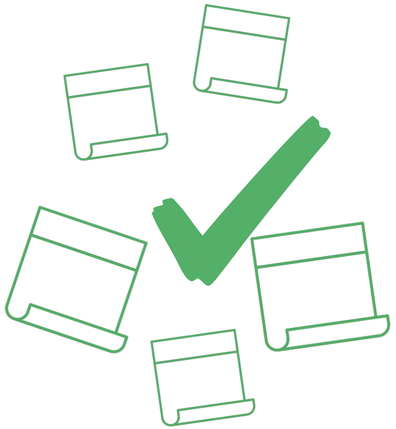
We can elicit and map values by using a value mapping work sheet. Create a sheet with different sections where individuals can write down what is of importance to them or not so important.



Have individuals fill out their values



Now compile these together and cluster them



See where the overlaps exist

Conceptual Models

Robert Pirsig in his famous book Zen and the Art of Motorcycle Maintenance illuminated the importance of models when he wrote: "If a factory is torn down but the rationality which produced it is left standing, then that rationality will simply produce another factory. If a revolution destroys a government, but the systematic patterns of thought that produced that government are left intact, then those patterns will repeat themselves."

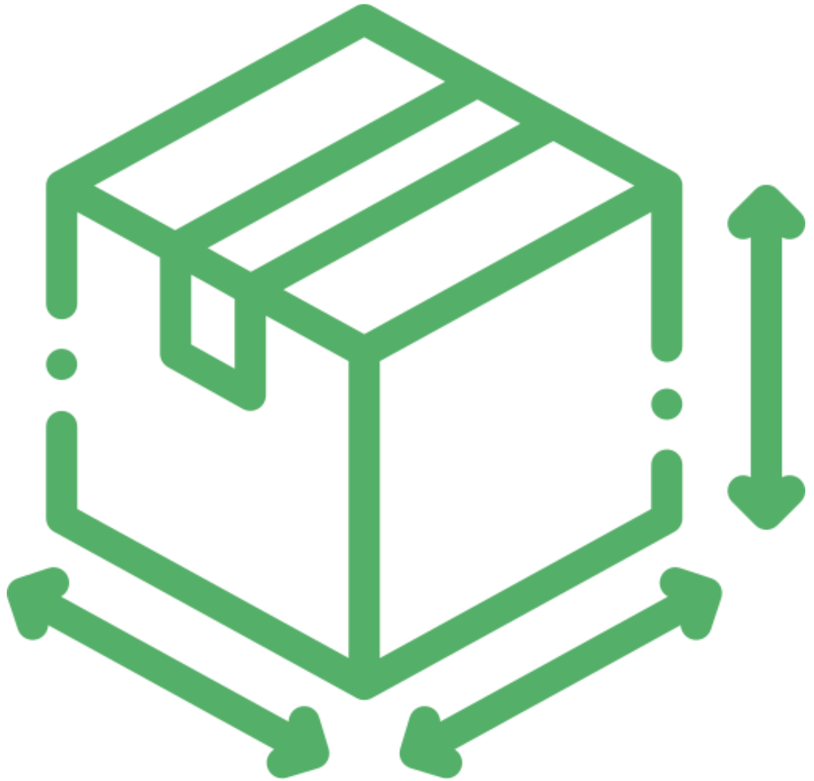
Mental models and the values that shape them are at the foundations of how we see the world and act upon it to create the environments we inhabit. To get a deep insight into the workings of the system we wish to change we are going to have to also add these to our map to represent the values and beliefs of the different actors in the system.

Thinking

All of these systems that we might be interested in changing are created by us, by the models that the people in the system hold and act upon. Virtually every problem we will encounter in the world can ultimately be traced back to a socio-cultural one. If you dig far enough into the water crisis, environmental degradation, inequality, or cybersecurity you will find that it is not really about lack of water, lack of land, lack of money or computer code, as it may appear, it is more about people and how they see the world; how our models and thinking constrain us to a certain subset of solutions.

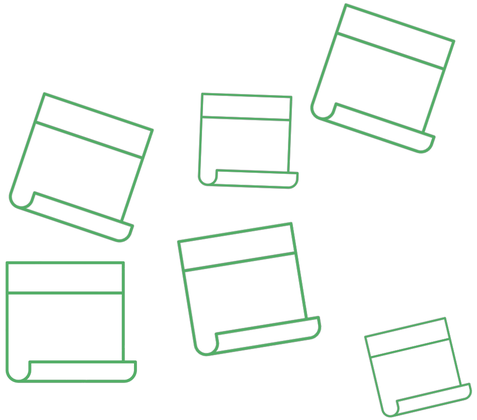
Boxes

Every community and organization comes to form its own culture, story and shared way of seeing the world. Biologists, doctors, accountants, engineers, each community has its own paradigm, assumptions, stories, and way of seeing the world. This is expressed in the institutional structures that we create and the result is a world of boxes. The problem is the gaps created between them, all those things that don’t fit into the boxes. We should be asking, what are the boxes that the paradigm and models lock us into? What are the knowledge gaps between them?



Eliciting Models

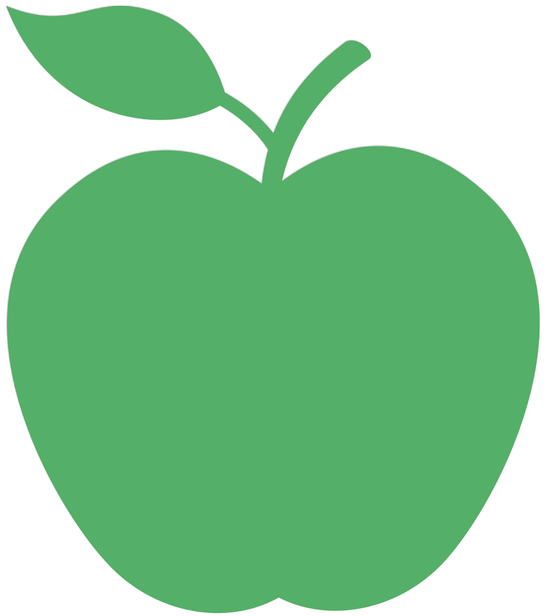
Create questions for people to fill out about how they understand the system



Cluster them to see where actor’s mental models align

Identify main concepts and themes

Incentives & Motivation



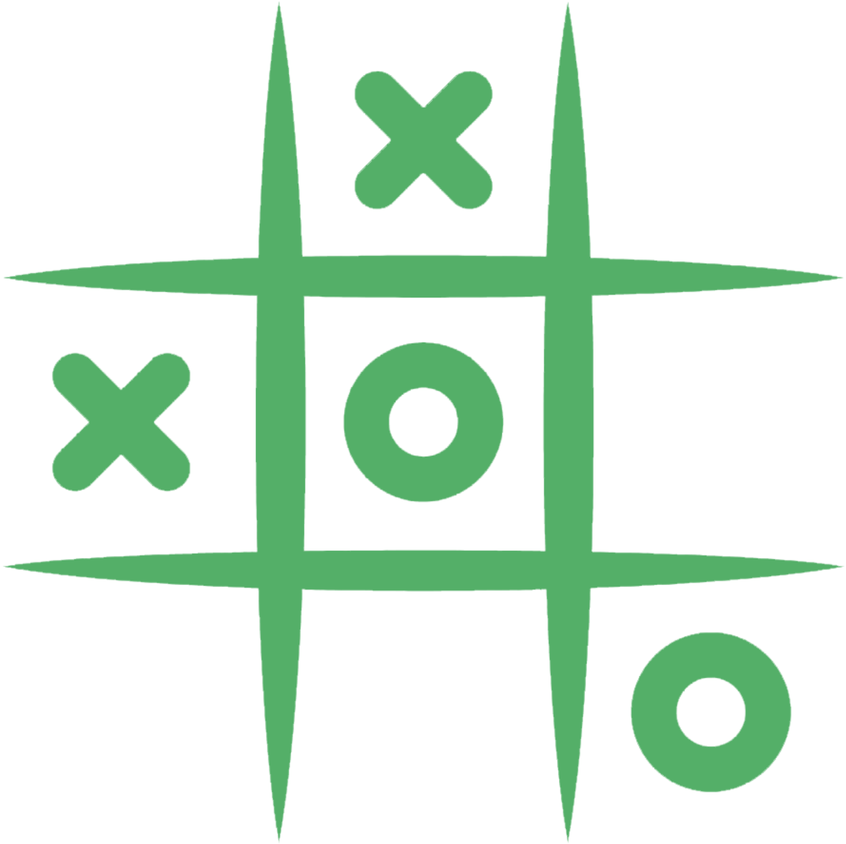
Overview

Charlie Munger once said, “Show me the incentive and I'll show you the outcome.” Understanding the structure of incentives in the system is key to understanding how and why it operates the way it does and why it continues on the same path - irrespective of what the stakeholders may say.

For every node on a system map, we will see that the node can have a state that may be deemed better or worse for that actor. The actors who have a stake in a given node are motivated to improve their stake; improve their value as they define it. This creates a set of motives and direction for their decisions and actions. Ethnographic studies, here again, are important to understand what it is people really value and the incentives they experience locally.

Games

In this context, we can understand the actors in terms of their goal-orientated behavior, i.e. each actor has some model as to what they value and they take actions to affect their environment in order to achieve more of whatever it is they define as valuable. As the actors pursue their valued ends they come in to contact and become interdependent in dynamics of cooperation and competition - we can call this a “game”. In game theory, a game is any context within which agents interact and in so doing become interdependent in attempting to achieve their valued ends. We need to get an understanding for not just the points of possible collaboration but also the points of competition and where they lie is largely a function of the structure of incentives.



Incentives

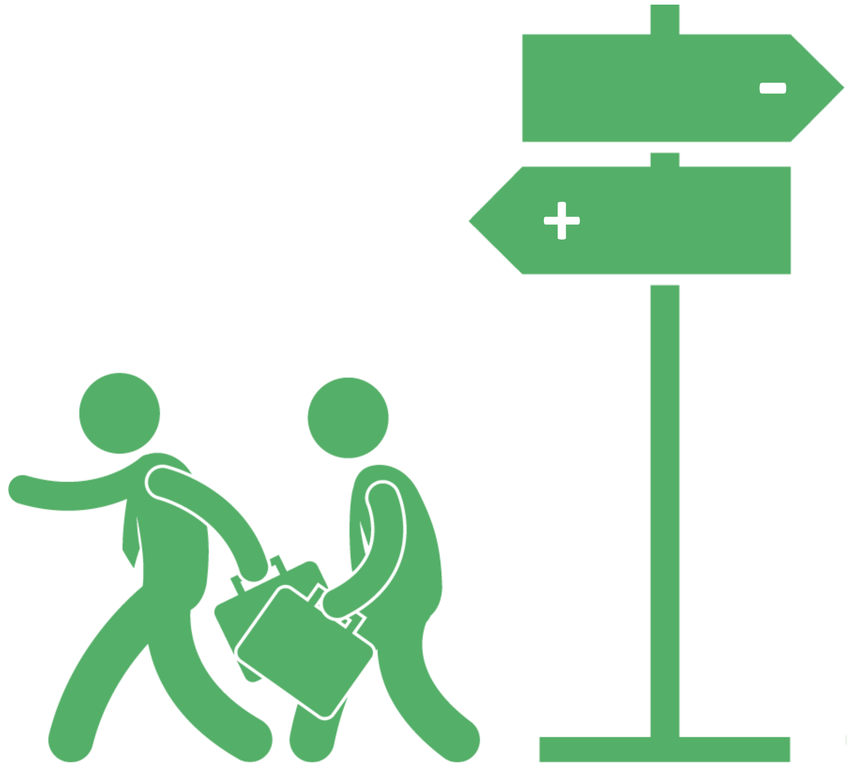
Incentive mapping is important because it lets us see the somewhat invisible fields of incentives that are acting on all of us everyday. In our investigation we should be asking: what are the resources in the system? How do they flow through it? How do those flows influence the actors? Take for example the flow of drugs and associated money through Central America that has distorted the social and economic institutions of many of those nations.

Investigating these incentives will tell us a lot about the underlying structure of why and where conflict, competition, and cooperation arise and why. It also points us in the direction of possible ways to alter those incentives to realize new outcomes.

Positive & Negative Incentives

If we want to change a system we need to be aware of how the incentives are working to either resist it or as potential sources for enabling it. A subtle combination of positive and negative incentives are used by organizations to direct us in different ways; to enable or inhibit actions.

Incentives can be both positive and negative. Positive incentives are rewarding while negative incentives are punishing. A positive incentive would be like a bonus payment for doing something, while a negative one could be a fine. For example, as part of environmental regulation, the government will use a combination of negative incentives such as banning certain polluting activities, but will also use positive incentives such as subsidies for certain activities that are seen to be beneficial to the environment.



Actor Incentives

What are the motivations of the actors in the system?
What do they want to achieve or do?
What are the outcomes they want to see realized?

Power Mapping

Overview

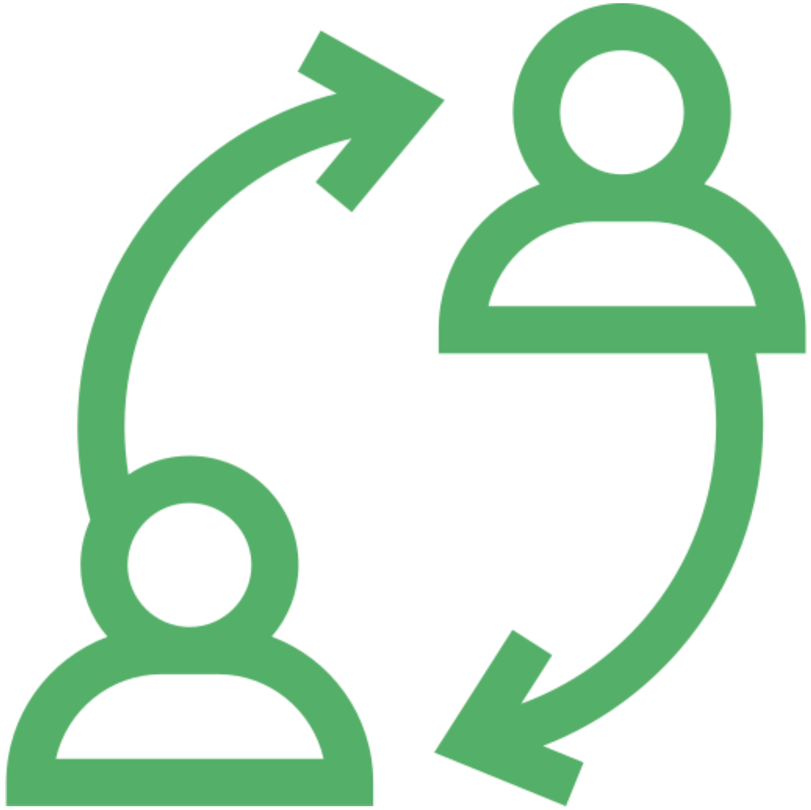
As Alex Nicholls once said: "power is what perpetuates systems.” Because of this systemic change almost always involves changes in power dynamics, it reveals new forms of power and challenges the status quo. Thus nurturing an ecosystem requires a deep awareness of power: Who has influence? What kind of influence do they have? Who does not have any influence? Likewise, we need to understand this power distribution not just in the abstract but in practice through ethnographic studies.

Power mapping refers to a set of tools and processes that enable us to analyze power relationships and start to create strategies for change. Power mapping is a visual method for representing the sphere of a person or group's influence in the system. The power map tool helps to visualize who we may need to influence, to clarify leverage points and where to try and build coalitions that may have systems-level influence.

What is Power?

Let's start with a basic definition. Power is the ability to make others do what you would have them do. The key question is; what are the means through which actors can realize their ends irrespective of the interests of others? There are many forms of power, force, money, norms, ideas, mass mobilization, etc.

Power is to social relations what physics is to objects, we may not like to talk about power but it is always there. Power is no more inherently good or evil than technology, it just is. Power is dynamic, like water, it flows like a current through everyday life. It determines who gets to make decisions and who decides the rules of the game. Actor mapping should involve an attempt to: identify the different kinds of power, who has it, what is the legitimacy for holding the different kinds of power and how does that affect the potential for change or create resistance to it.



Types of Power

French and Raven's Six Forms of Power

Legitimate

Seen to be legitimate and a valid source of authority

Expert

Perceived high level of competency and knowledge

Referent

Charismatic form of power through attracting others and loyalty

Reward

Capacity to provide others with incentives

Coercive

Capacity to exert force inducing others to act

Information

Capacity to control the flow of information

Influence

Determine the influence of the actors - which members are influential, important or have potential.

Identify their importance according to different dimensions of influence

Alignment of Interests

Try and determine the motives, objectives and goals of the relevant actors.
Are their motives and agenda aligned with the changes you wish to see take place.

High Influence

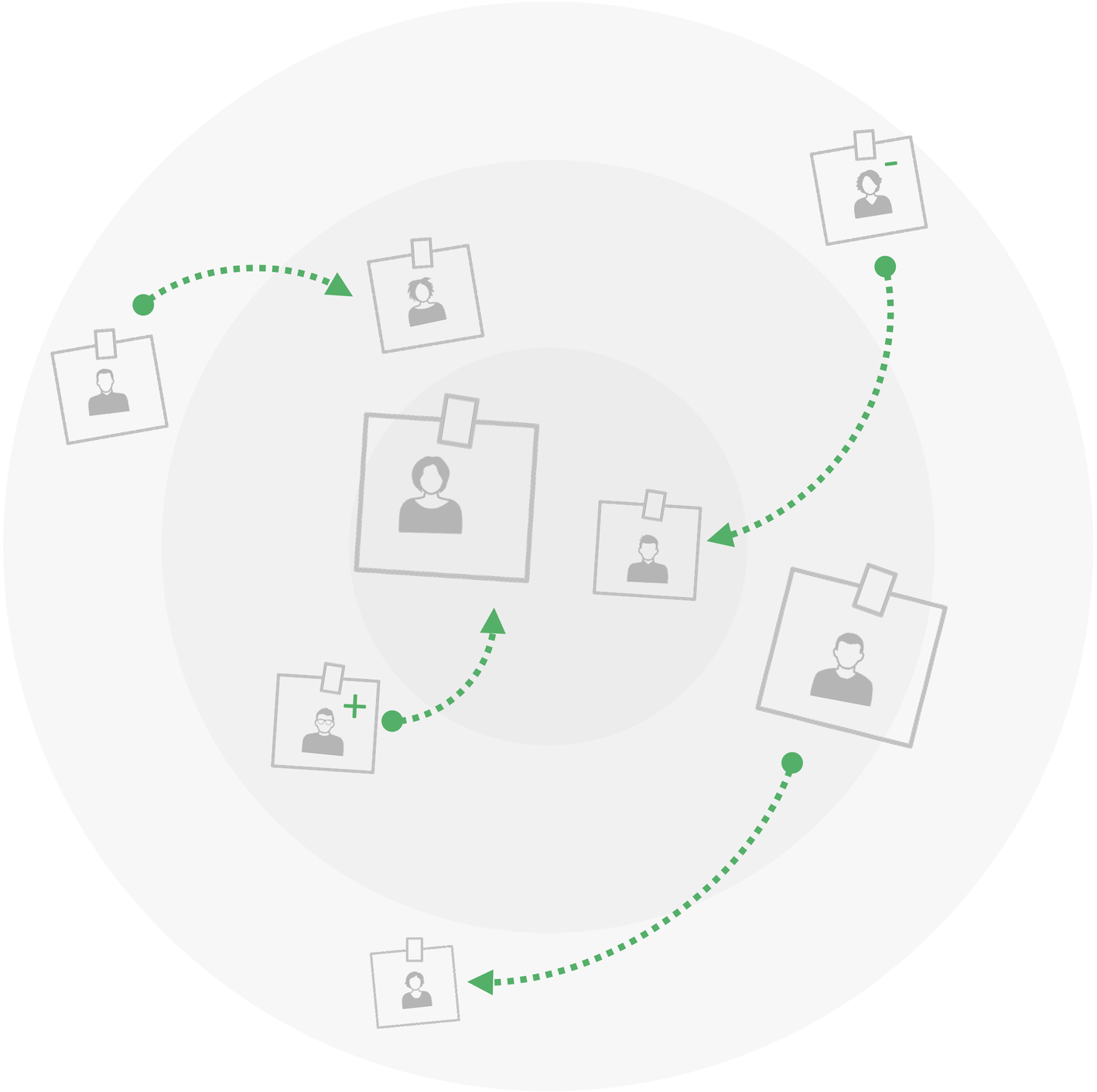
Oppose

Support

Low Influence

Map

Place the stakeholders on the map, scaling them according to their level of importance.



Observe

Now step back and look at the map from the perspective of the different actors involved.

Conclusion

References

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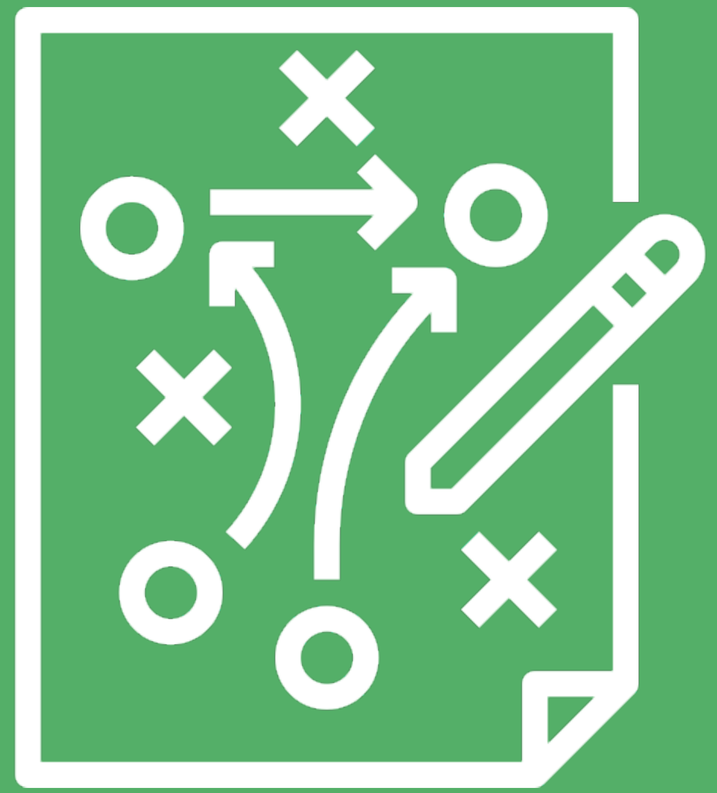
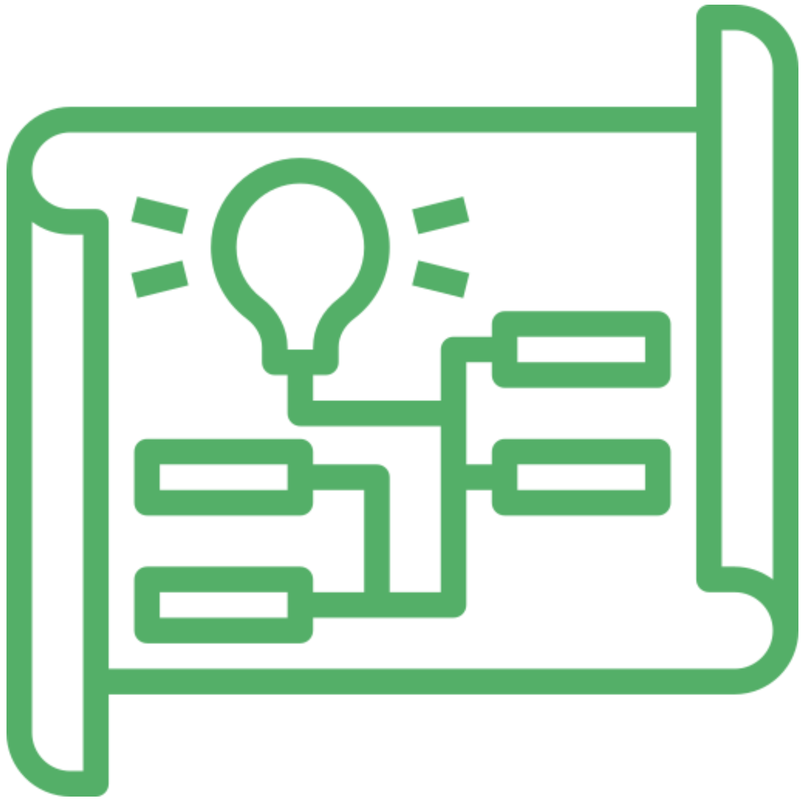
Causal Loop Maps

A Field Guide





Why System Mapping?

Systems mapping is a type of modeling that is designed to reveal the underlying interrelationships and structure of a complex system. System maps are powerful visualization tools that can help change agents describe and diagnose the current state of a given system; understand how system structure creates the observable outcomes; create a shared vision of the system; gain consensus about the problems and identify opportunities.

System mapping is about gaining an empirical understanding of what is before we engage in envisioning what could be or what we would like to be. However, systems maps should not be seen as deliverables or endpoints, rather they are tools of exploration, stepping stones on our path to understanding the system dynamics that underly complex issues.

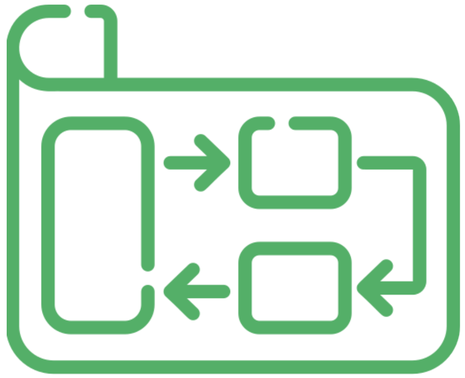
When to Build a System Map

- When we want to gain a deeper understanding of the context and identify gaps in our understanding of a system.
- When you want to try and identify leverage points to make smart choices about how to intervene effectively in a system for high impact.
- When we want to bring diverse stakeholders together to co-create a shared understanding.
- When we want to mitigate the risks of unintended consequences of an action and reduce the likely hood that we will create superficial solutions that do not address the real issues.
- When we have designed a solution, but it is working in unexpected or counterintuitive ways, and we want to understand it better.

What This Guide Covers

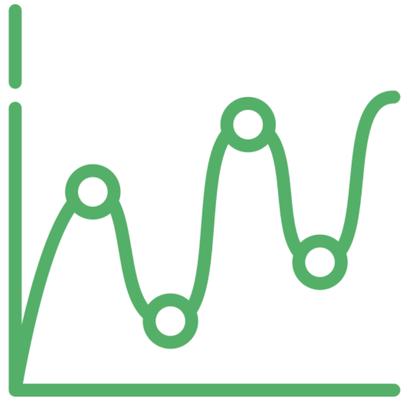
Causal Maps

We start by laying down the basic language of causal loop maps



System Archetypes

Systems archetypes illustrate common and reoccurring patterns of causal relationships



System Dynamics

Looks at how systems change due to internal stocks and flows

Iceberg Model

The iceberg model helps us to identify systems structure

Causal Mapping

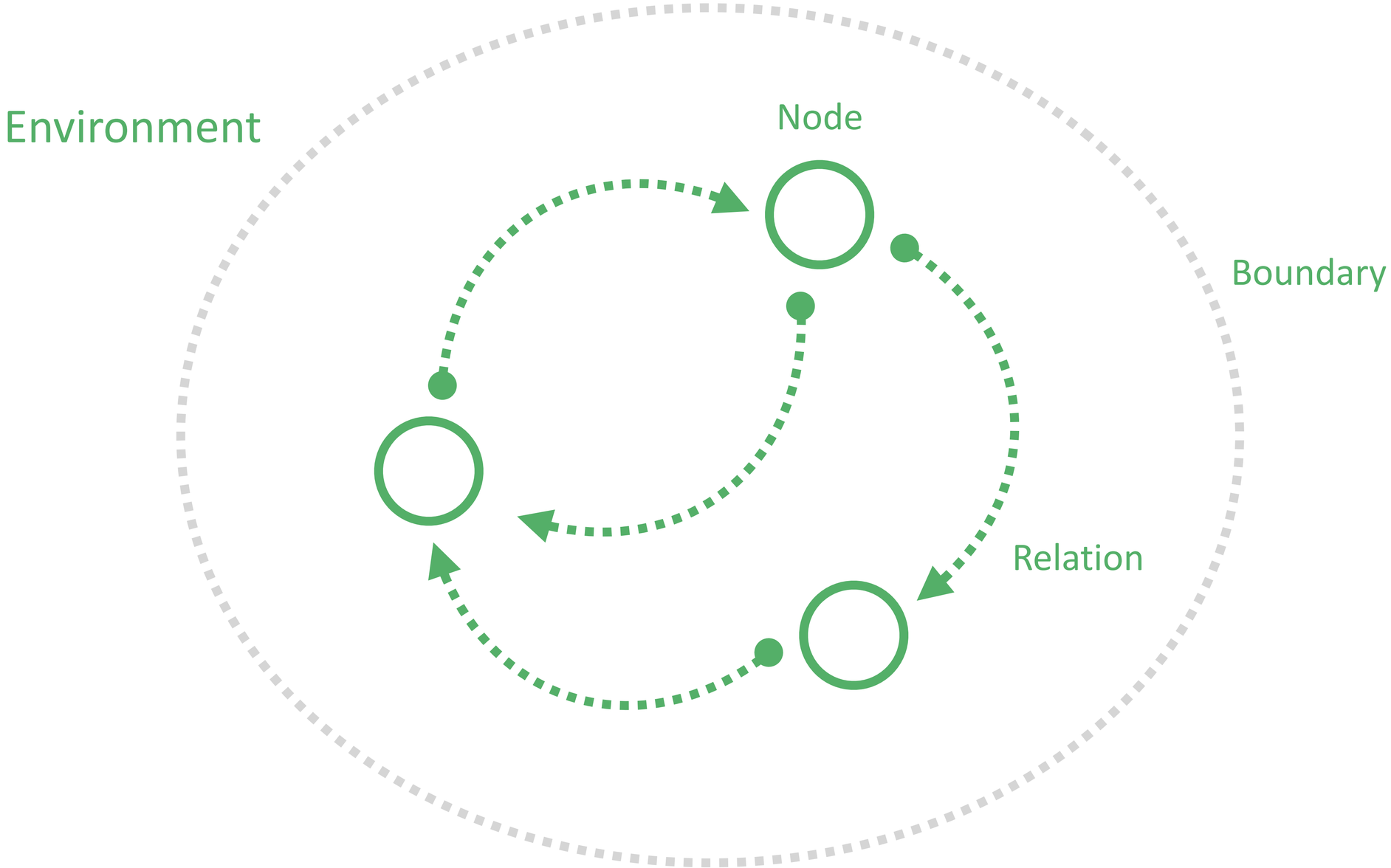
Framing

To get started we need to define the system of interest. We can’t map everything, so let's define what it is we are mapping first of all. Here we encourage people to spend time thinking about why they are creating the map and what is the system you are interested in. This will work to put a boundary around the system map which will define the title and create the context for communicating what it is you are doing.

For example, are we creating a map of the French healthcare system or just of the French health insurance ecosystem? The two are different and they work to contextualize and frame what we are doing. So first, let us invest time in defining what exactly it is we are interested in. Although we will be able to add different aspects and scales later on the aim here is to be clear about the initial focus of the map's attention.

Scope of Map

Set the system boundary, this may be a geographic area, a particular industry, a business function, etc. This is just an initial starting point, we can adjust it as we go along.


Environment
Node
Boundary
Relation

Define Nodes

A systems map first consists of defining the factors that are of relevance within the system. First, the mappers must brainstorm for all factors they see as relevant in generating the dynamics of the system. The nodes in the map are the outcome of an influencing dynamic. For example, ‘builders’ would not be considered a node we need to define something about them that we are interested in that can change. The number of builders in employment is an example of a node: they can influence and be influenced, their associated value can go up or down. It’s worth noting that nodes are not just nouns, they are things that can have a measurable quality or quantity.

Products in Stock

Ships in Port

Restaurants in Paris

Income = 11K

Urbanization = 70%

Obesity Levels = 40%

Variables

Causal maps define relationships between entities that affect each other. Thus we need to be able to define for all the nodes what is changing and be able to ascribe some value to this. For example, our map might be focused on obesity in Mexico. The map will work to draw a set of causal relations between different factors that are relevant.

Each of these factors should have a quantity associated with it. If we identify that the main drivers behind food habits are rising incomes, urbanization and globalization, we can then define the percentage of people who are obese, GDP per capita, levels of urbanization, etc. Thus all elements in the map should have variables associated with them. Similar elements should be aggregated.

Causal Relations

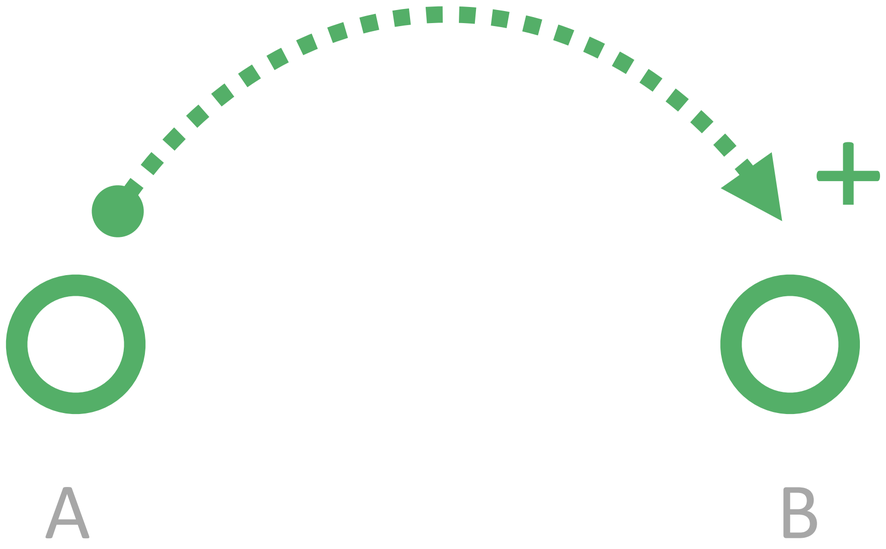
We now map the relations between those elements. Relations define causal connections, meaning if one thing changes this will affect the variables associated with the other that it is interrelated with, i.e. a change in the state of one will create a change in the state of the other node it is linked to. Ideally, these changes can be expressed as quantities. Nodes are not verbs, as the action in the map is in the causal relationships.

Types of Causal Relations

A causal relationship within a map is a dynamic, it defines a relationship of change. One node can influence another in one of two ways: positive or negative.

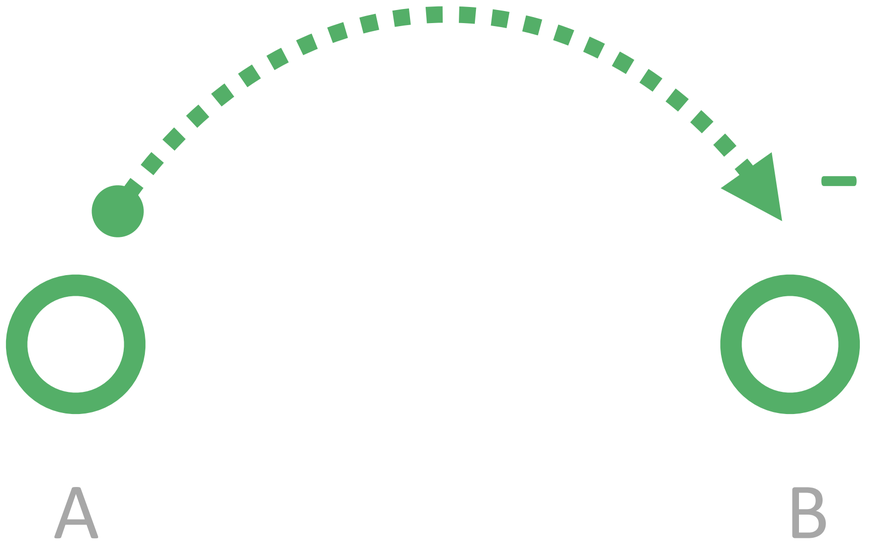
Positive

More of A leads to more of B



Negative

More of A leads to less of B



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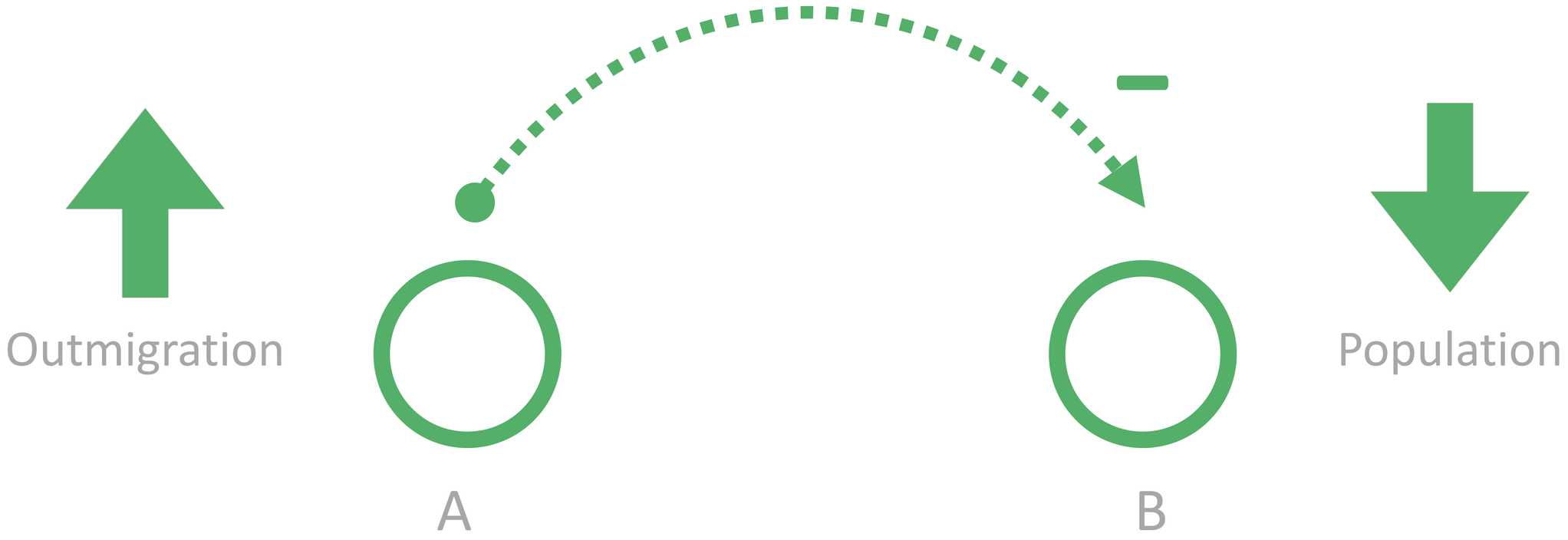
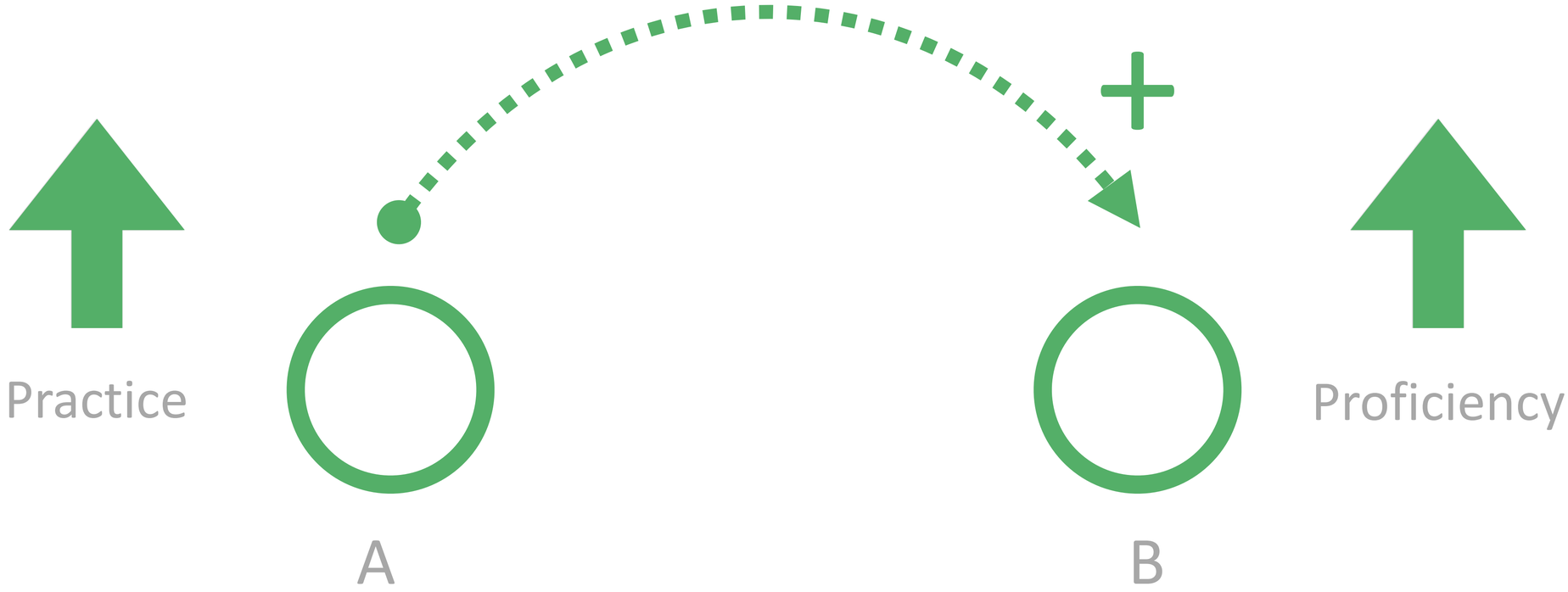
Negative Causal Relation

Example: more outmigration in a region will reduce the population



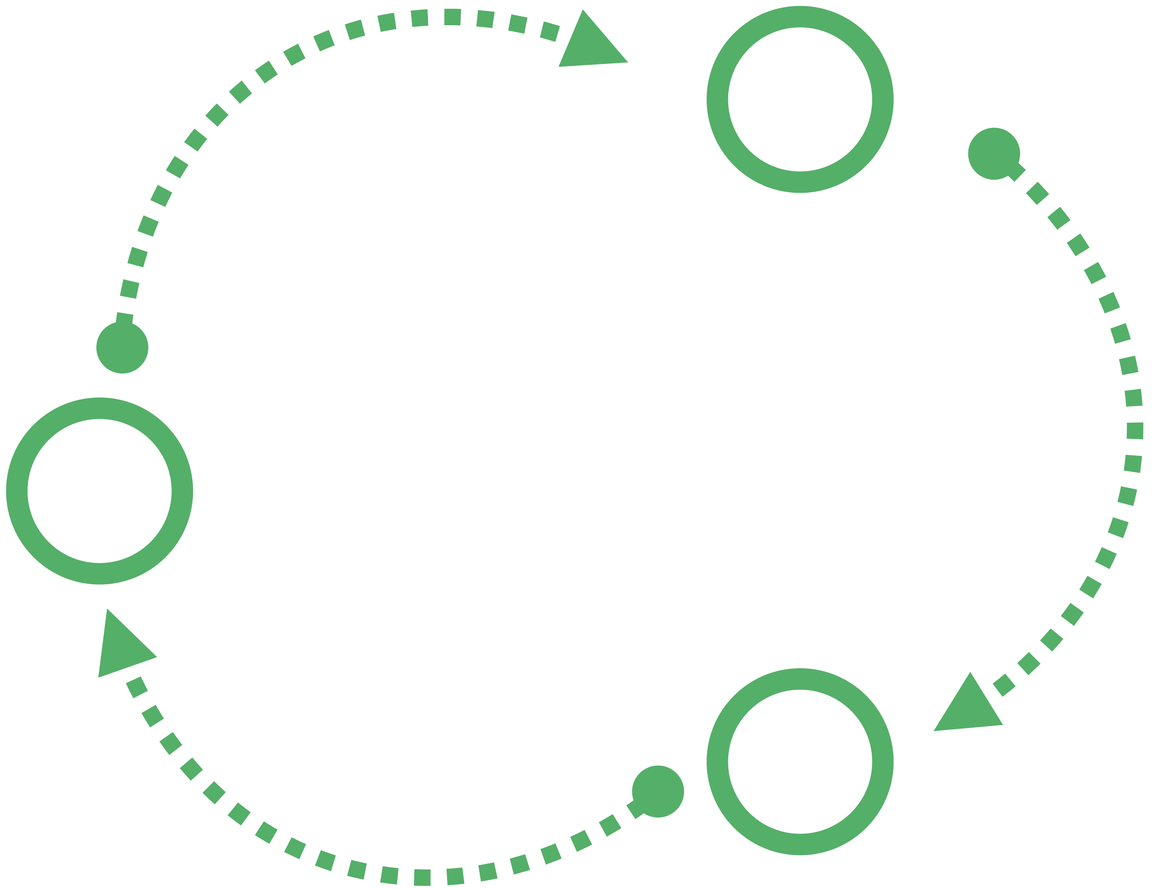
Positive Causal Relation

Example: the more you practice basketball the better you will get



Map

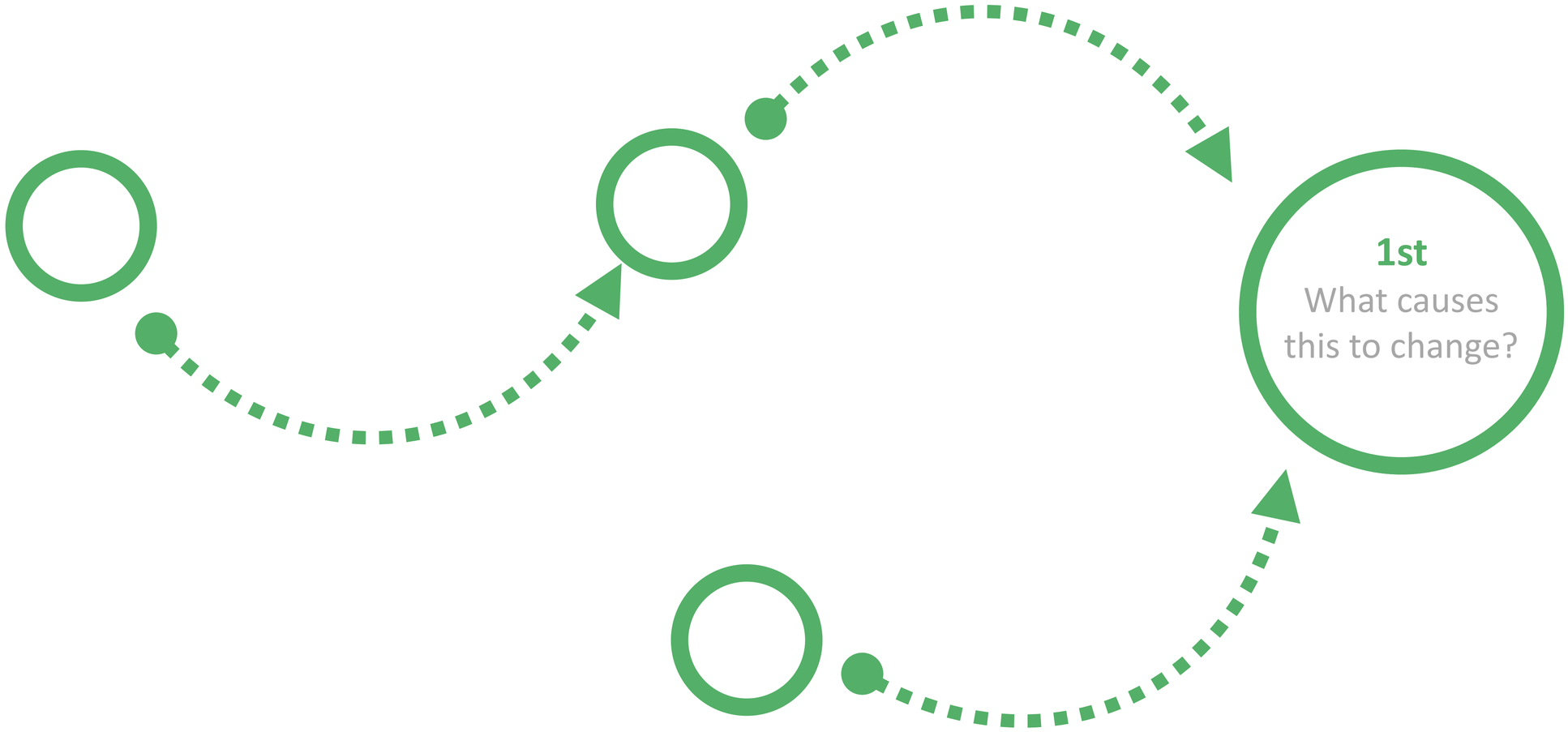
A set of causal relations between elements forms a causal map.

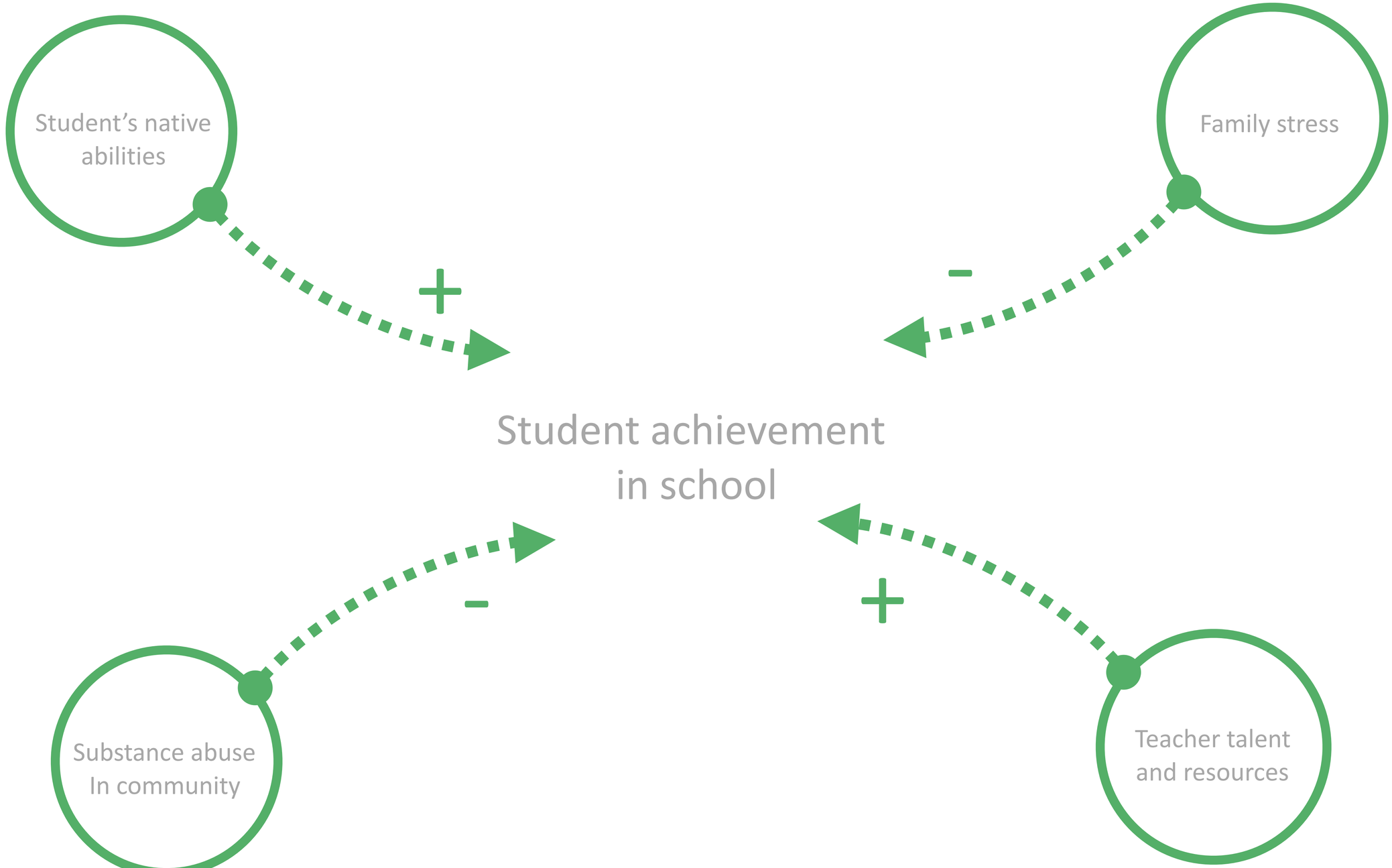


This icon will take you
to the explainer video

Getting Started Mapping

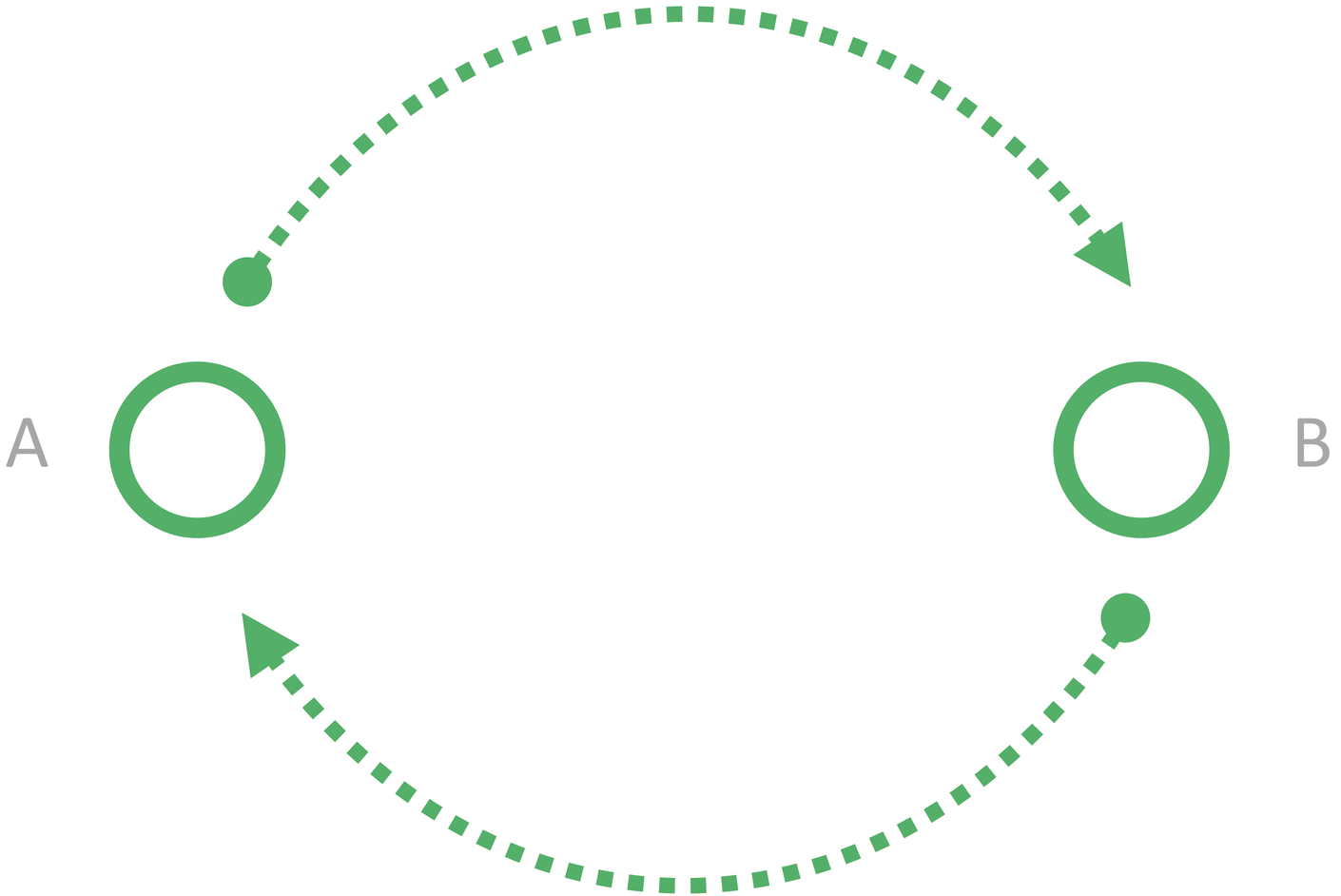
Get started mapping by putting down a single node and ask the simple question: what causes the variable associated with this node to change? That will be your next node. Then ask the question: what does this result from?




Student’s native abilities
+
Family stress
-
Student achievement in school
-
Substance abuse In community
+
Teacher talent and resources

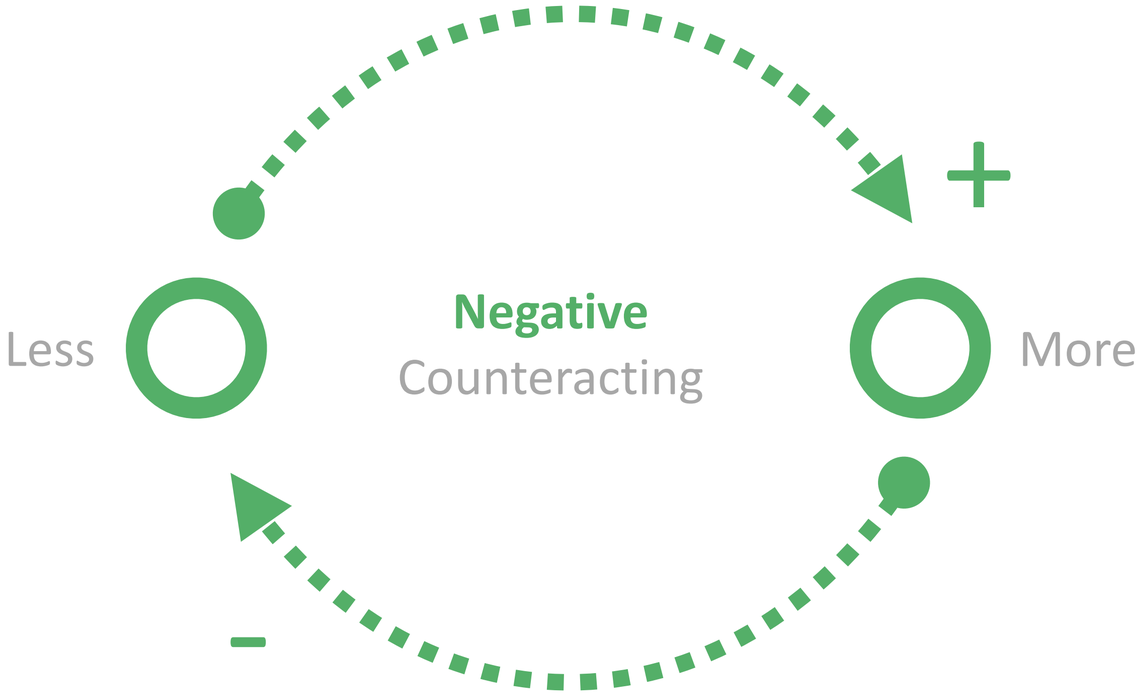
Feedback Loop

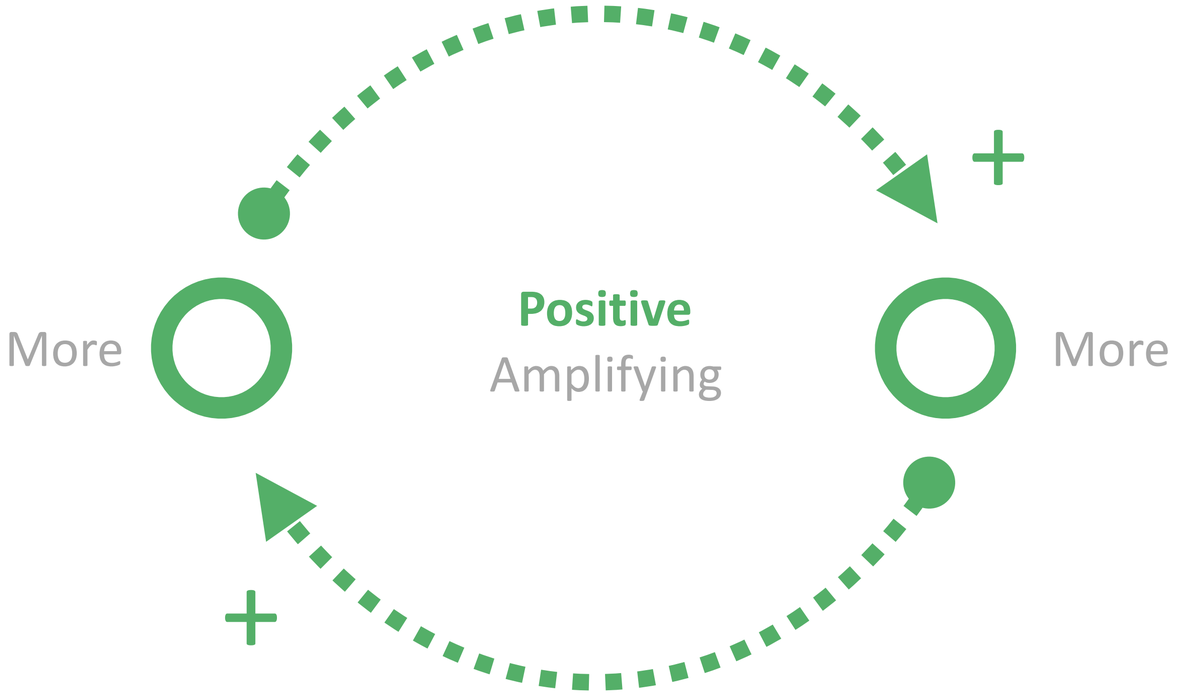
When an effect feeds back to its cause this is termed a “feedback loop”



Types Feedback Loops

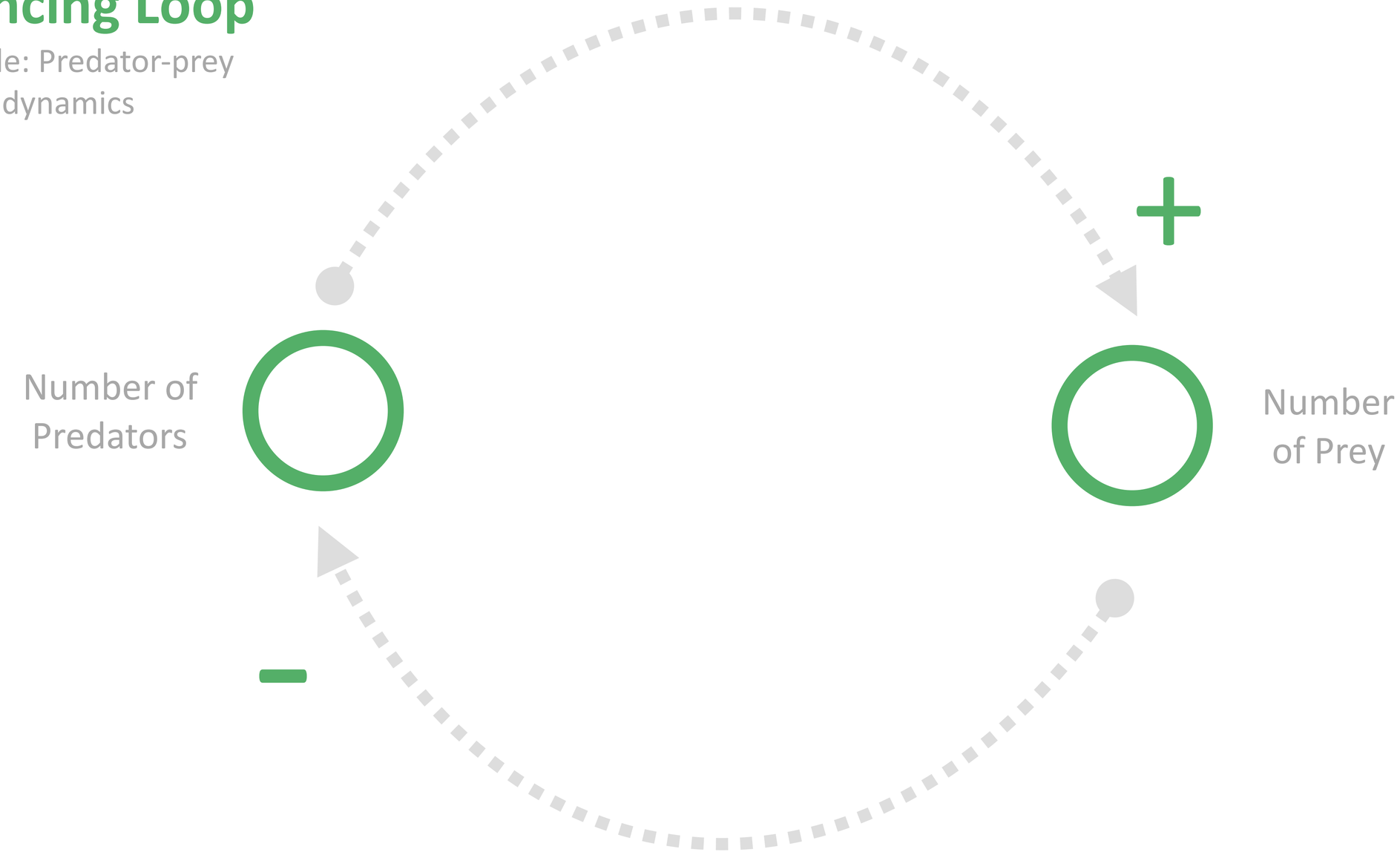
There are two qualitatively different types of feedback Loops: positive and negative





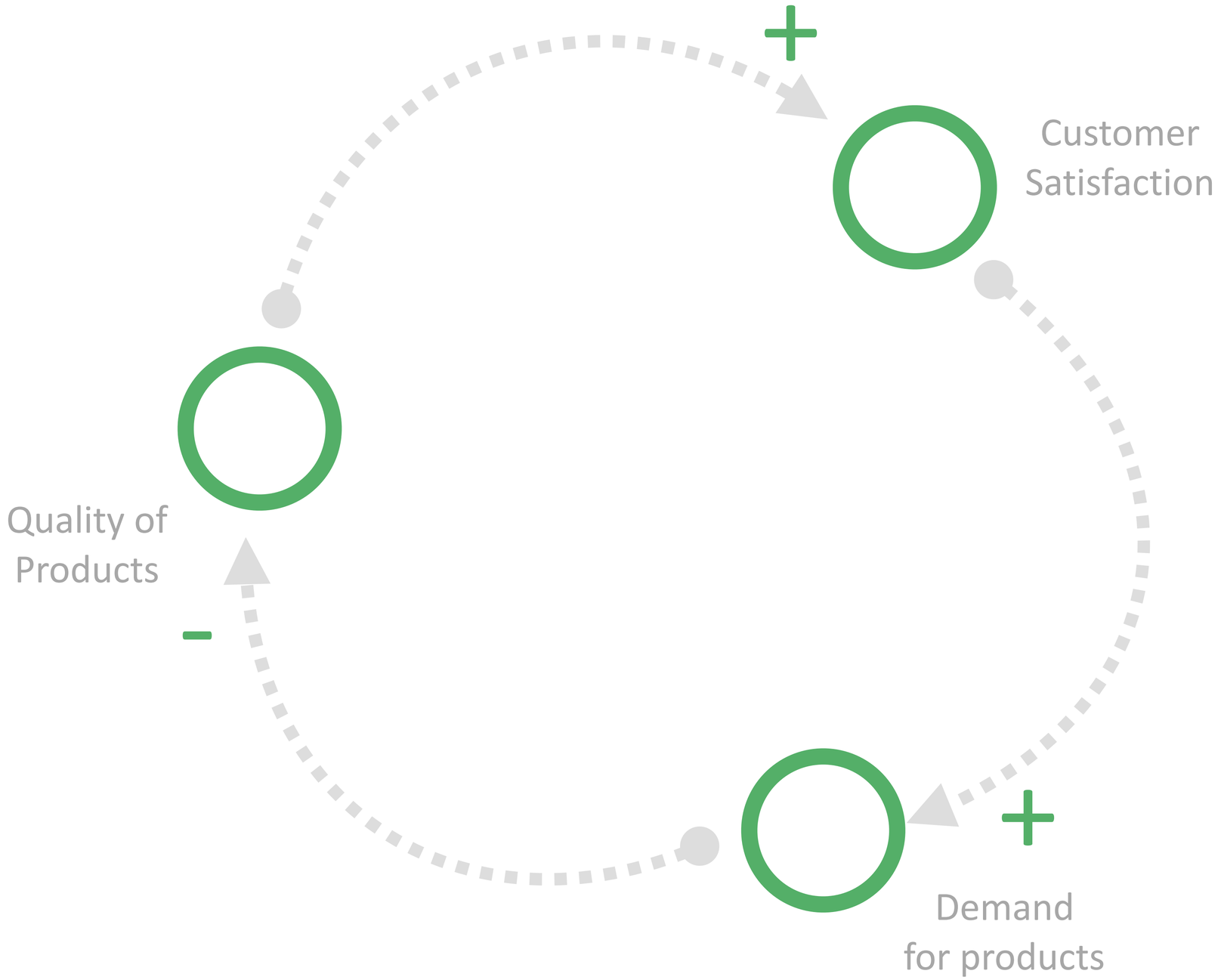
Balancing Loop

Example: Predator-prey dynamics



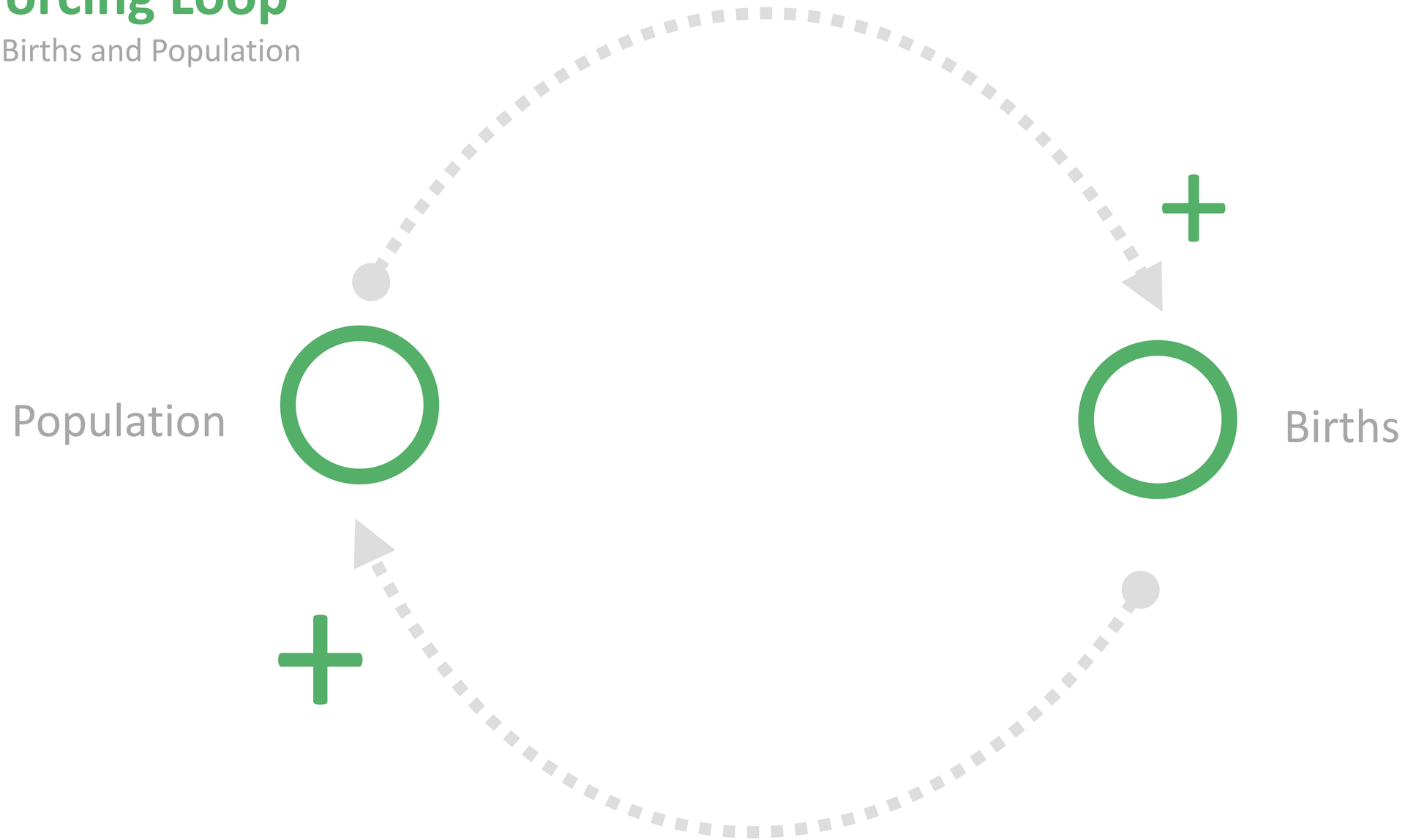
Balancing Loop

If a company produces a quality product customer satisfaction will go up, which will increase demand, which may reduce the quality of the product; as increasing quantity of production may reduce their investment in quality.



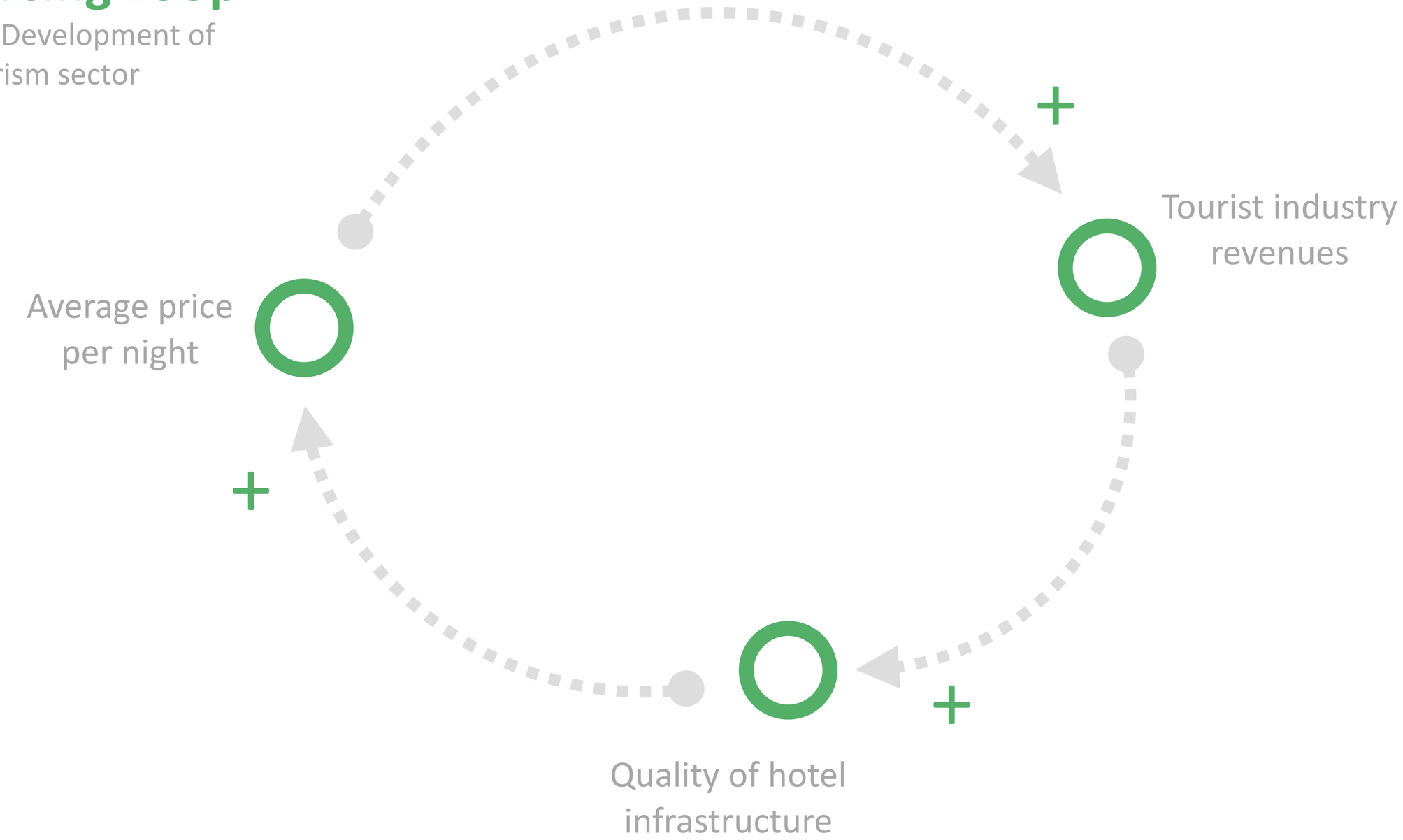
Reinforcing Loop

Example: Births and Population



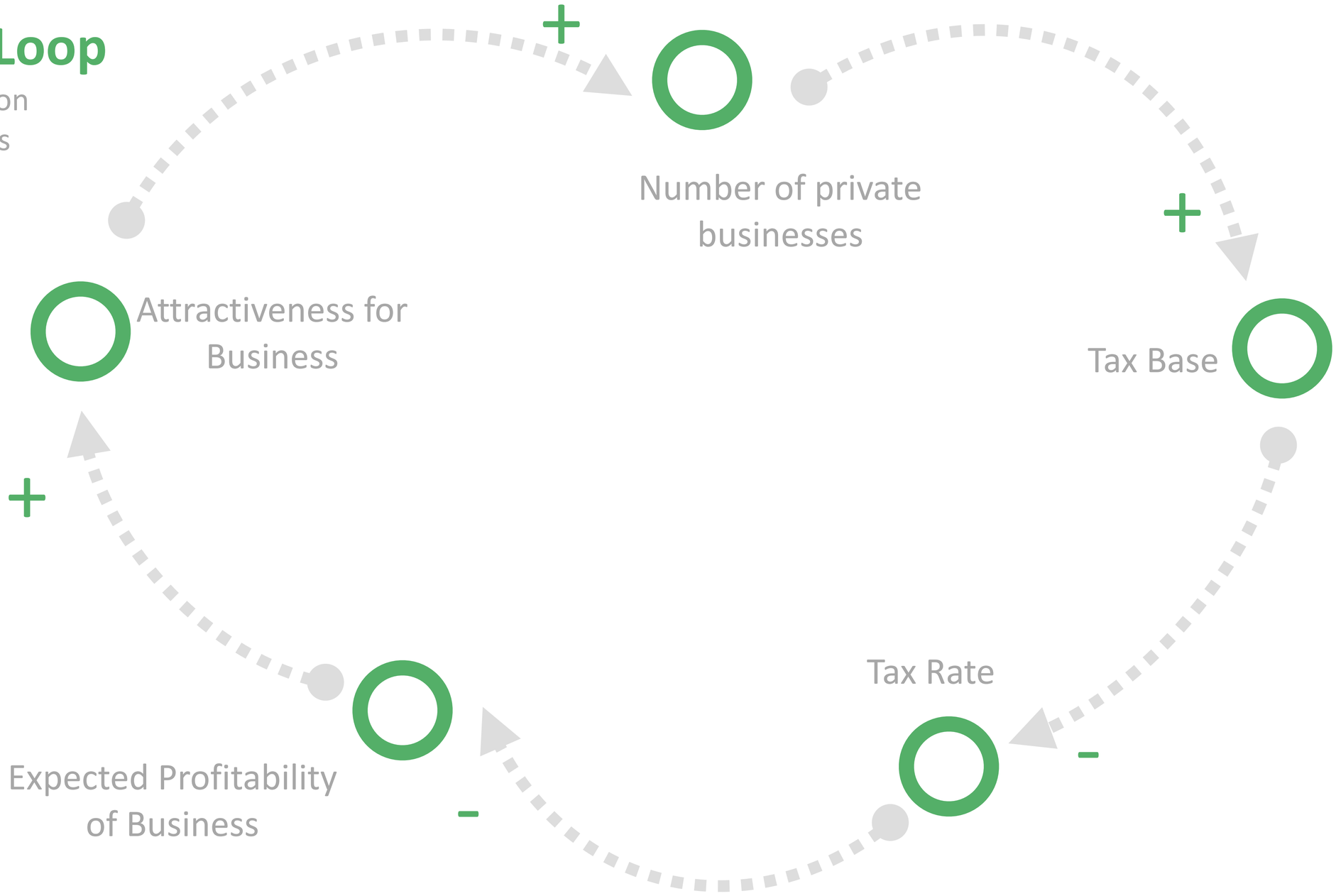
Reinforcing Loop

Example: Development of tourism sector



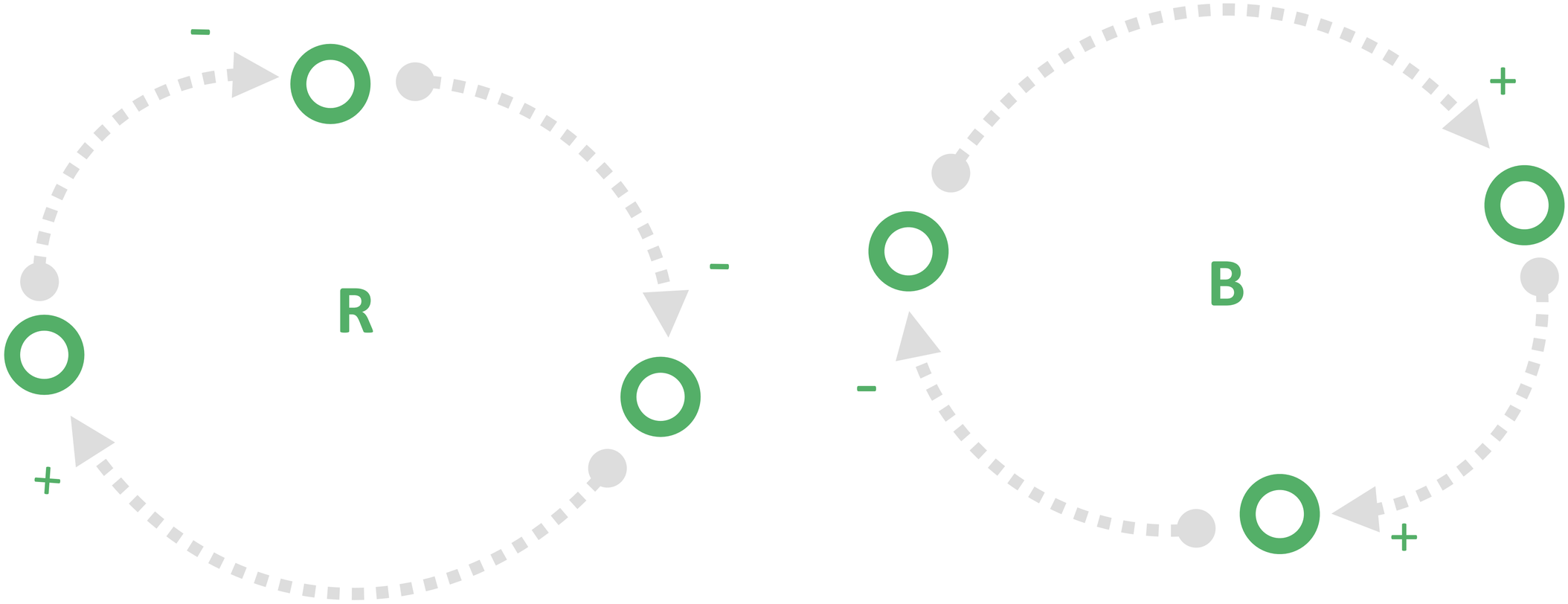
Reinforcing Loop

Example: taxation and businesses



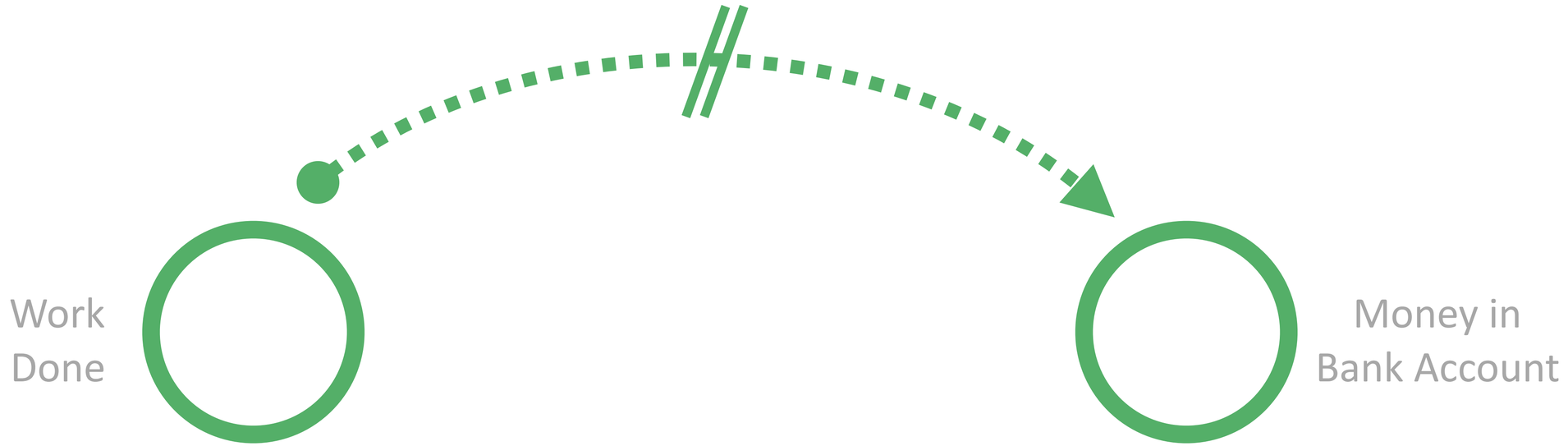
Identifying Positive vs Negative Loops

For each loop, count the number of negative signs: An even number of negative links is a reinforcing loop (R). An odd number of negative links is a balancing loop (B).



Delays

Causal linkages between nodes may not be immediately expressed; there may be a time delay before the effects are visible in the variables. For example, a poor diet now may not be expressed in health outcomes until some time in the future. Likewise, as illustrated below, given that you may not be paid until the end of the month, the causal link between the amount you have worked so far this month and the amount in your account will be delayed. This kind of time delay is often denoted by drawing a short line or double line across the causal linkage.



Tips for Building Maps

Bit by Bit

Build up your model in stages through a series of smaller maps. Each diagram should correspond to one part of the story being told.

Check Causality

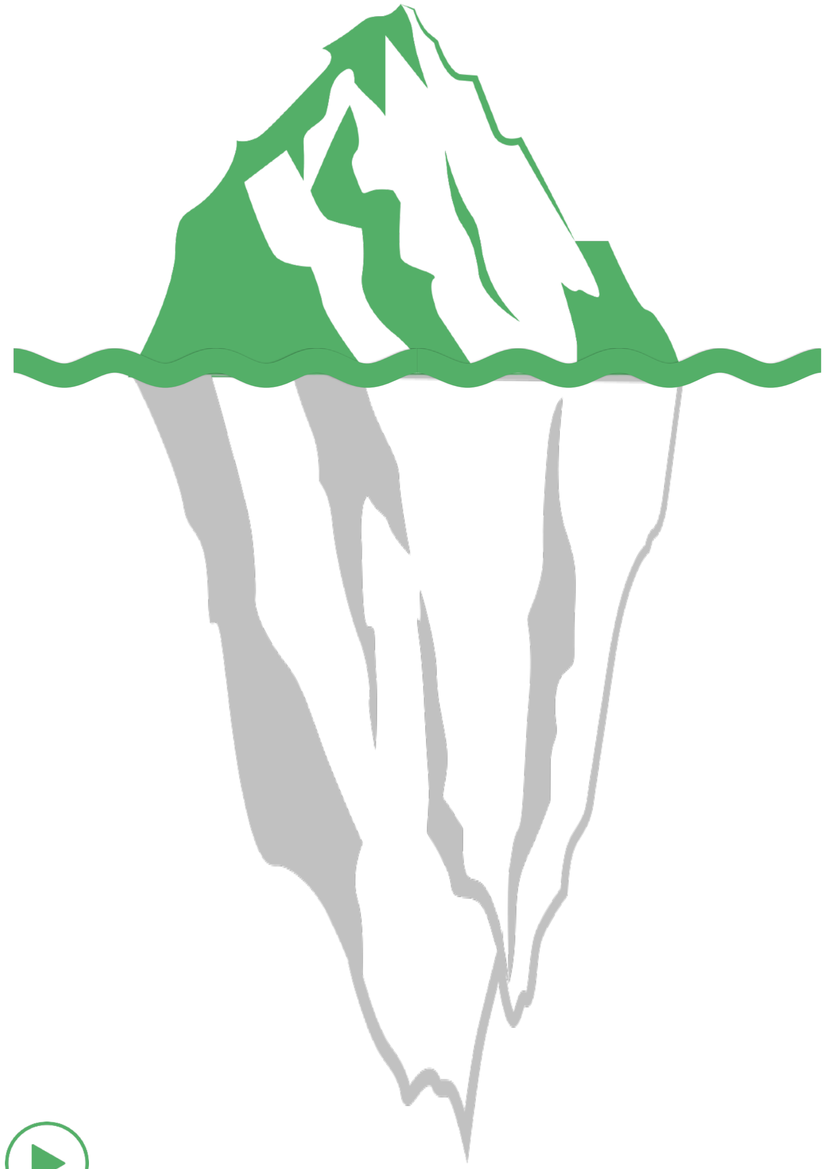
Make sure you have checked the logical linkages between the nodes; the connections may not be direct, you may need to add more linkages.

Think Dynamically

Remember to think in dynamic terms, e.g. ‘more of X leads to more of Y’

Tell a Story

Ensure that your map makes sense by telling a story for each loop, and check that the story matches the loop polarity.



Overview

An iceberg is used as an analogy to represent the underlying structures generating perceived events and issues; as it is known to have only 10% of its total mass above the water while 90% of it is under the waterline. The expression “tip of the iceberg” is used to connote that what one can see is only a small part of a whole situation, i.e. there is much more below the surface and what it looks like may be surprising.

Just like with an iceberg, a large percentage of what is going on in our world is hidden from view and the Iceberg Model tries to make this explicit by depicting it as a series of layers that sit beneath the everyday phenomena observed.

Why Use the Iceberg Model?

The aim of system mapping is to try and identify the underlying dynamics and structure giving rise to the observable system behavior. Thus for us to be effective in our mapping we need to be able to discern the different levels of the system to differentiate superficial outcomes from the underlying structure.

The Iceberg Model tries to illustrate the various levels of abstraction to a situation or organization; from the observable events to underlying patterns that generate these, to the supporting structure and ultimately the mental models used by an organization.

It is designed to help people to step back and identify the different patterns that the event is part of, the possible structures that might be causing it to occur, and finally, the mental models that are creating those structures.

Events

The observable actions and phenomena

Patterns

Describe trends over time

Structure

How the parts are interrelated to influence the patterns

Models

The mental models that support everything else in the system

Events

Above the waterline are the events. Events are markers in time where multiple variables are observed. They are the “what I saw” or “what just happened.” Events are individual activities or facts about the state of things in the system. The one minute snapshot of a current affair that we might see in the evening news is an example of an event within the Iceberg model; such as a new motorway being built.

If we apply the Iceberg Model to global issues, we could say that at the tip, above the water, are events, or things that we see or hear about happening in the world everyday; that there is a new president in Italy or that the price of commodities is up. The events that we hear about in the news represent the iceberg tip. Most of the world spends its time at the event level. It is how we perceive the world while being occupied with our daily activities.

Patterns

Patterns are the changes in variables that occur over a period of time. They are the trends that we perceive taking place over time. If we look just below the waterline, we often start to see patterns or the recurrence of events. This might be for example recurring oil spills or one's computer periodically breaking down. Patterns are important to identify because they indicate that an event is not an isolated incident.

Patterns answer the questions, what's been happening? or what's changing? When we make a statement like "it seems to be getting warmer in winter" or "the price of gas is going down" these are patterns that we are observing, a series of relationships between events. When we get to the pattern level, we can anticipate, plan, and forecast. It allows us to adapt to problems so we can react more effectively to them.

Structure

The structure supports, creates and influences the patterns we see in the events. Structures can be understood as the “rules of the game.” They can be written or unwritten; they can be physical and visible or invisible. They are rules, norms, policies, guidelines, power structures, distribution of resources, or informal ways of work that have been tacitly or explicitly institutionalized. They answer the question, what might explain these patterns?

It may not be easy to see the structure, but the patterns we can see tell us that the structure must be there. Structures are composed of cause-and-effect relationships. These are connections between patterns. For example, the underlying structure of a problem such as recurring oil spills might be our dependence on fossil fuels. But if you look at the root cause of such spills, you can start to understand and address long-term, sustainable solutions such as developing alternative energy sources that do not rely on oil shipment.

Mental Models

The mental model used to perceive the world is ultimately what generates the structures, patterns and events. Our models define the thinking that creates the structures that then manifest themselves in the patterns of events. Mental models are people's deeply held assumptions and beliefs that ultimately drive behavior. There is typically not just one pattern or structure or mental model at play; there can be many.

Mental models are the attitudes, beliefs, morals, expectations, values or culture which allow structures to continue functioning as they are. Mental models are ultimately what keep the structure doing what it does. They are the thoughts and processes of reasoning that need to exist to cause the structure to be the way it is. Mental models are typically difficult to identify in that they engender many assumptions that are never made explicit.

Example

An example of the iceberg model may be seen in one's health.

Event

Catching a cold would be an event.

Pattern

Catching colds more often when we are tired is a pattern

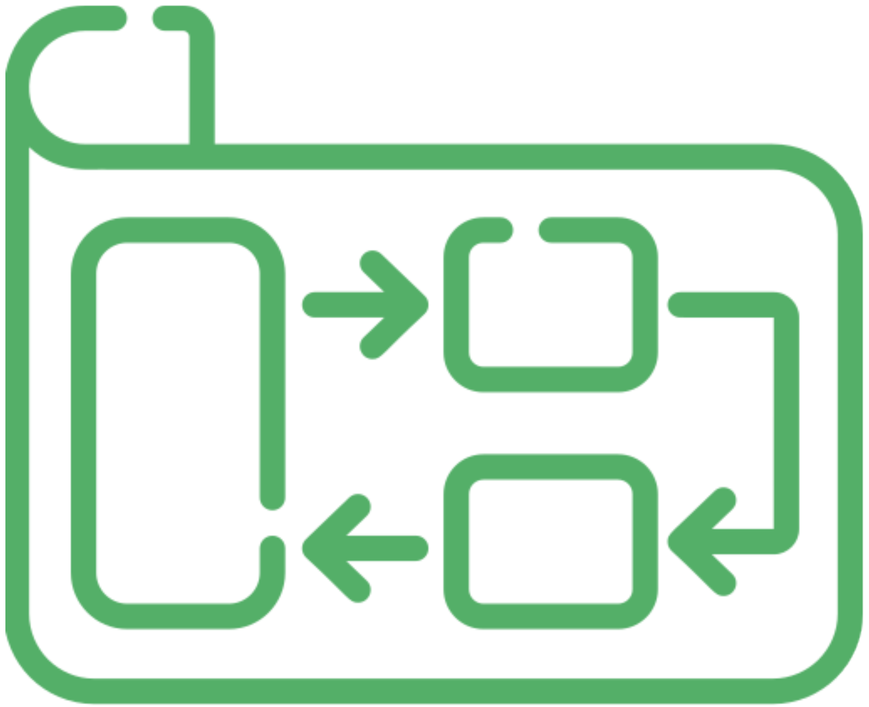
Structure

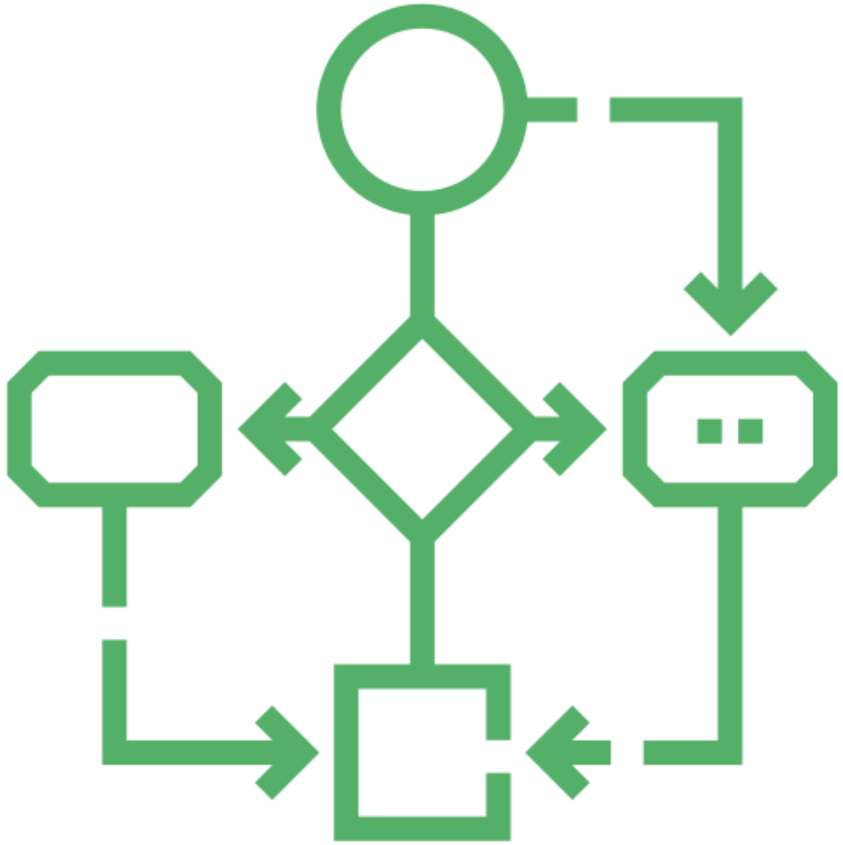
The systemic structures or causes for getting tired might include a lack of rest from excessive work

Models

This structure may be created by our mental model surrounding our identity as a hard-working person

System Archetypes





Overview

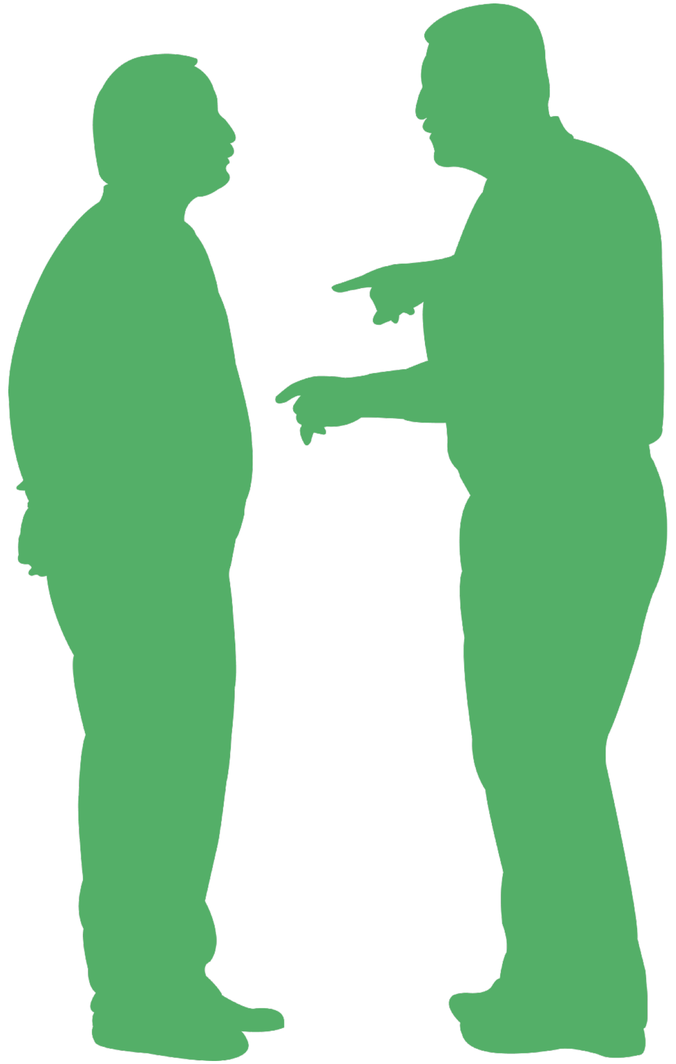
System archetypes represent commonly seen patterns of behavior in a system. These are regularly seen arrangements of causal relationships between the system's parts and feedback loops that lead to similar observable outcomes over time. Each archetype has a characteristic theme or storyline, pattern, and potential for action.

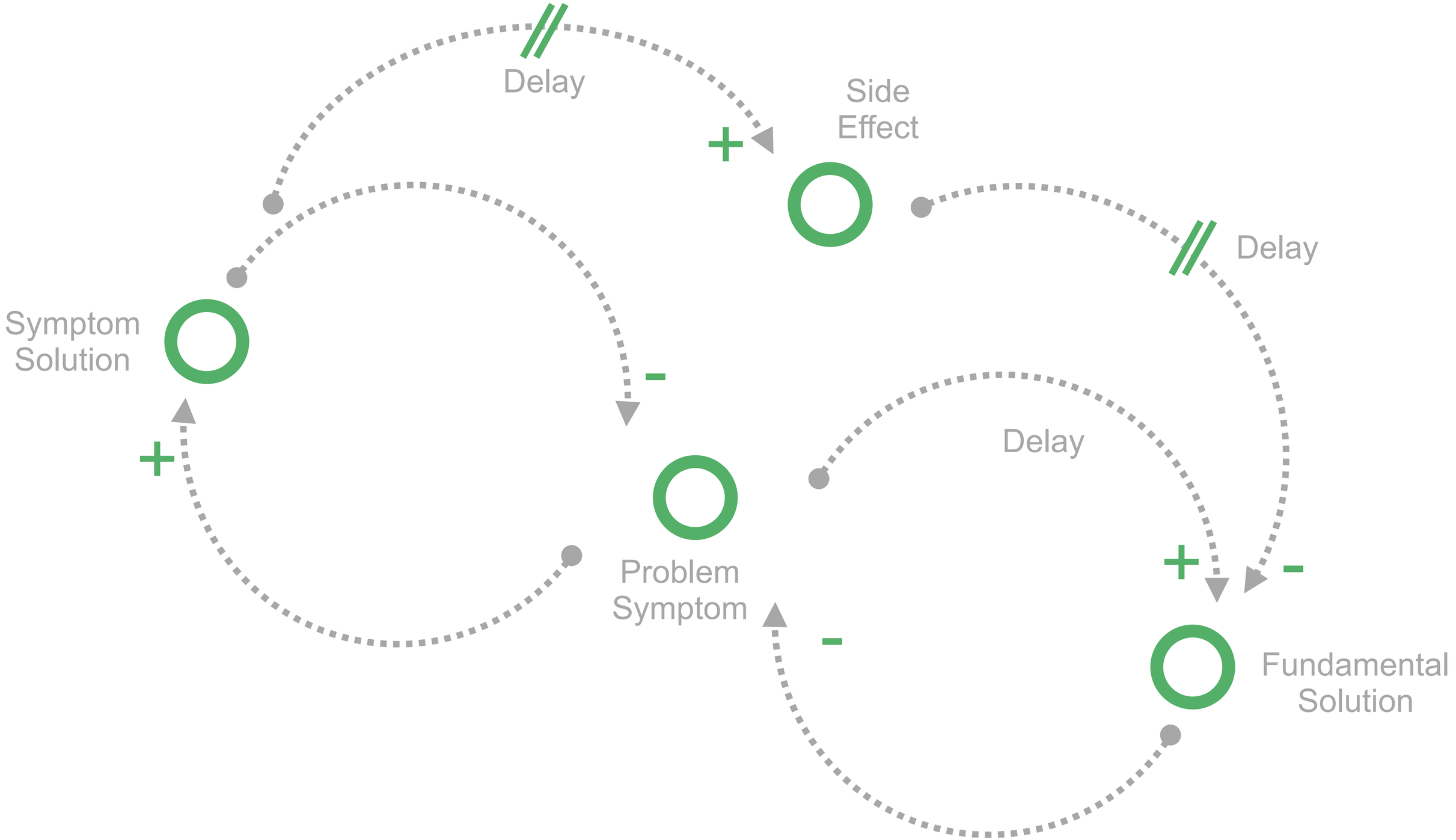
Being able to identify system archetypes in various situations enables a deeper and quicker understanding of that system, and can also help us design powerful intervention strategies. The following System Archetypes describe the most common generic structures seen within a wide variety of systems from economies and financial markets to natural resource management or reoccurring dynamics seen within political systems.

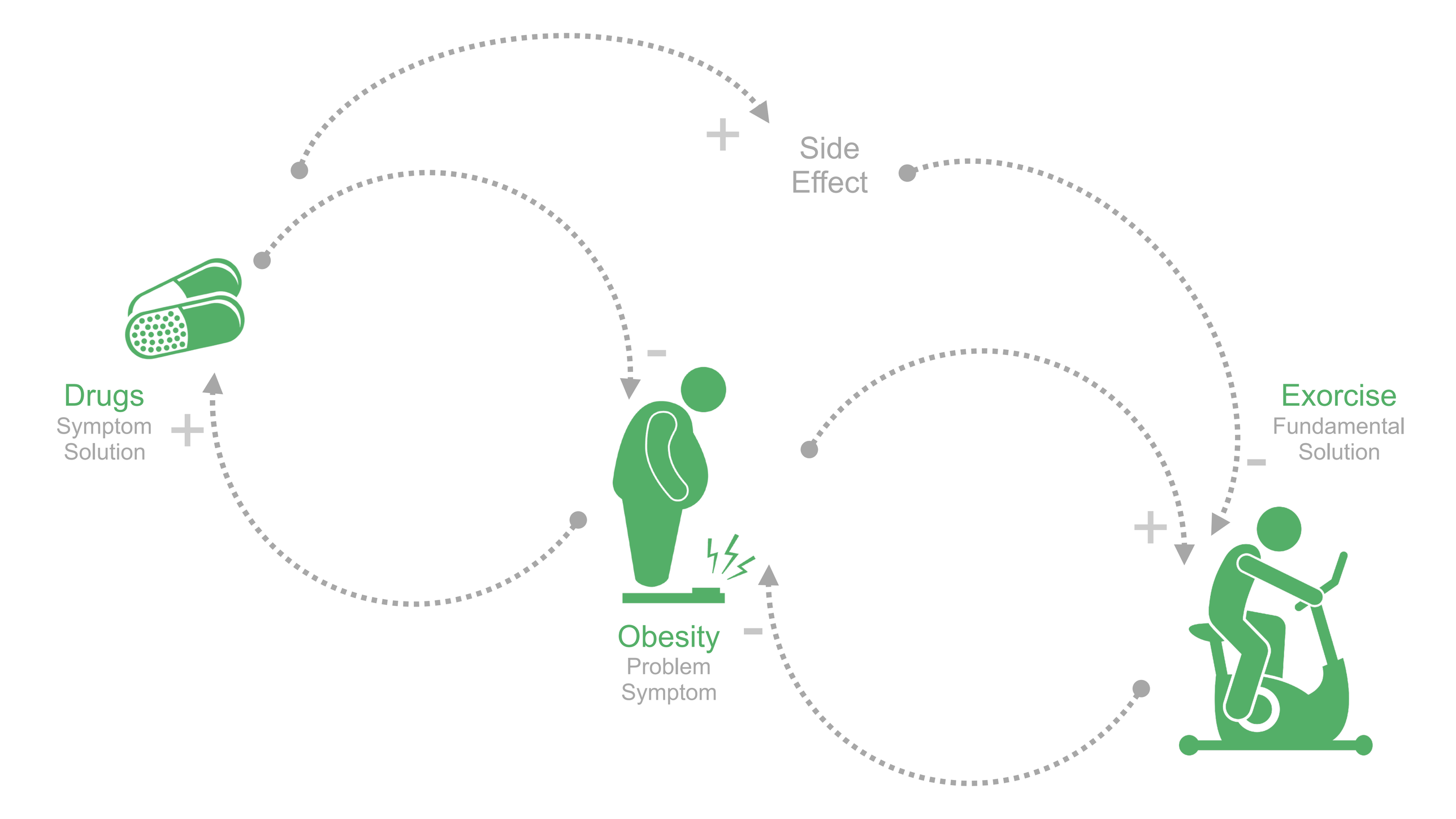
Shifting the Burden

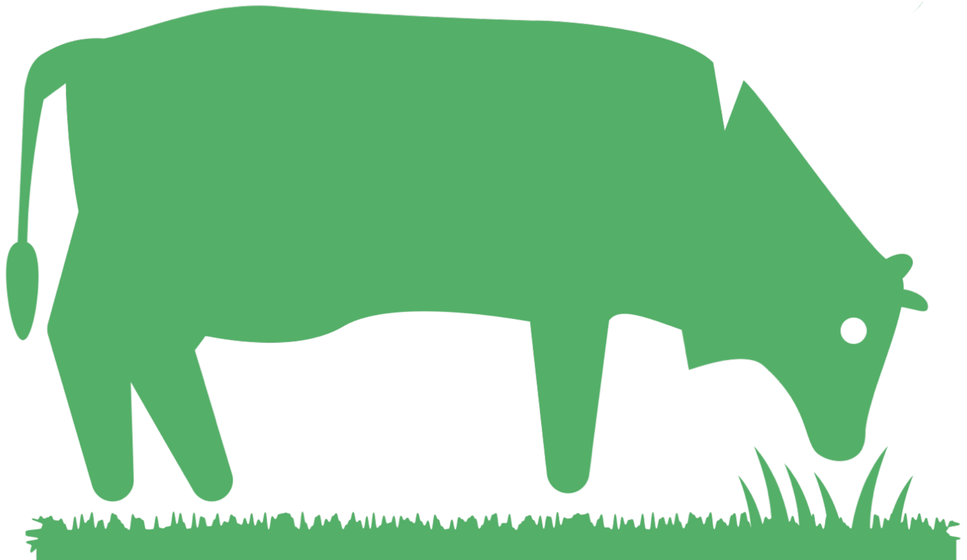
This system archetype consists of two balancing loops or processes (see next page for diagram). Both are trying to correct the same problem symptoms and bring the system back to balance. The above circle represents the "quick fix" symptomatic intervention. It often solves the problem symptom rapidly, but only momentarily. The bottom circle, which has a delay, represents a more fundamental response to the problem. Although the effects of the latter normally will take longer to become evident, the fundamental solution will have a far more effective outcome.

‘Shifting the burden’ structures are common in our lives as well as in organizations. In these situations, obvious symptoms of problems attract attention which often is dealt with by quick ‘fixes’ that make the symptoms reduced, at least for a while, however they reappear again later.




Delay
Side
Effect
Delay
Symptom
Solution
Delay
Problem
Symptom
Fundamental
Solution


+
Side
Effect
Drugs
Symptom
Solution
+
-
Obesity
Problem
Symptom
-
Exorcise
Fundamental
Solution
+



The Tragedy of the Commons

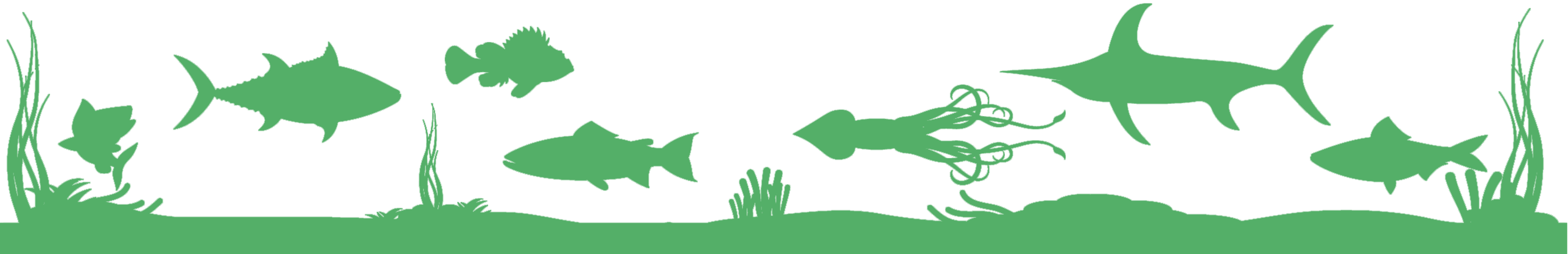
The tragedy of the commons is a socioeconomic dynamic where it is in the best interest of each individual to overuse a resource unless everyone else also does likewise. The dilemma arises when members of a group share a common good, such as an ecosystem, where this common good is rivalrous and non-excludable, meaning that anyone can use the resource but there is a finite amount of the resource available and it is, therefore, prone to over-exploitation.

The tragedy of the commons has proven to be a core dynamic within the management of many socio-ecological systems around the world, from the management of forestry to pasture and in particular fisheries many of which have collapsed due to over-exploitation and lack of solutions to this commonly seen systems archetype.

Fishing Example

Imagine a lake in rural Sudan where everyone is allowed to fish (see next page for diagram). The lake doesn't belong to anyone in particular and you can fish as much as you want. Imagine that there are two fishing companies in the area and that all those who fish in the lake belong to either company Z or company Y. The more fish company Z catches, the more profits they generate and the more they will increase their Fishing, as profits allow the company to hire more fishermen and buy more fishing boats. This principle is the same for Company Y and together both companies make up the Total fishing. In the beginning, both companies make good profits and provide a valuable service to the community.

However, when we look at the longer term we see that this system, if left uncontrolled, may result in some unintended consequences. If the level of fishing is not limited in some way, then it may eventually lead to a situation whereby more fish are being caught than are being naturally replenished, leading to a decline in the number of fish in the lake.



Company Z

Level of Fishing

Level of Fishing

Company Y

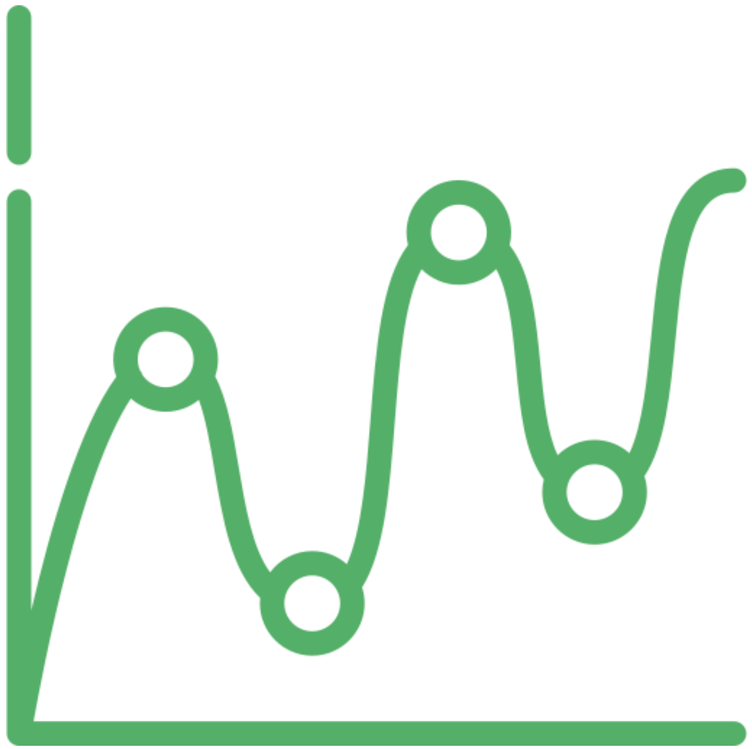
Total Fishing

Fish Population

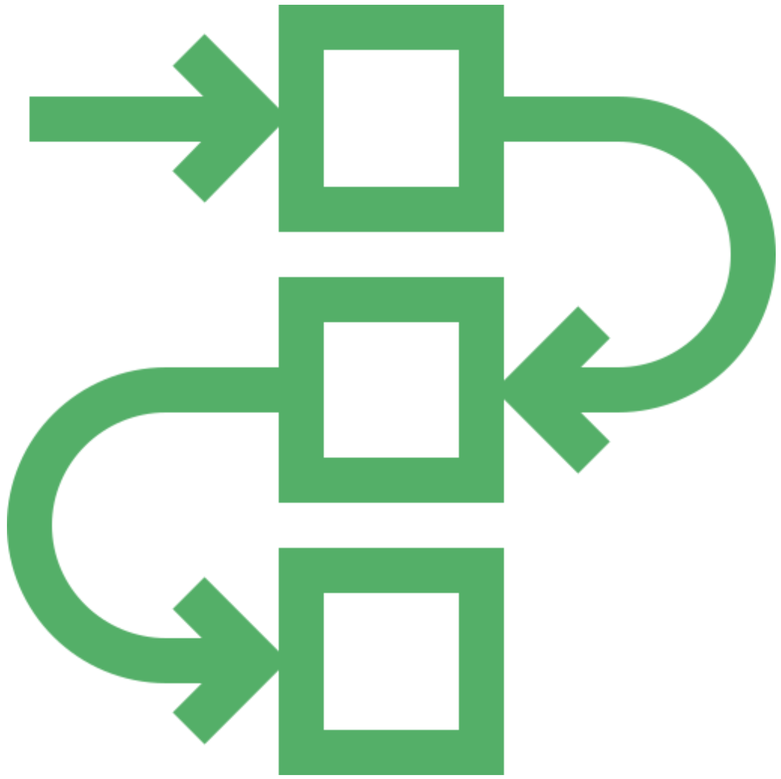
Success to the Successful

This archetype describes a dynamic where two people or activities require the same limited resources(see next page for diagram). As one of them becomes more successful, more resources are assigned to them. However, now the second one becomes less and less successful due to lacking resources, this “proves the right decision” to support the first one. Problems arise if the competition is unproductive and interferes with the goals of the whole system. Examples may be seen with a company that has two products giving success to the one that was initially successful.


A's Success
+
Money to Successful
-
B's Success
+
Resources to A
+
-
Resources to B



Dynamics

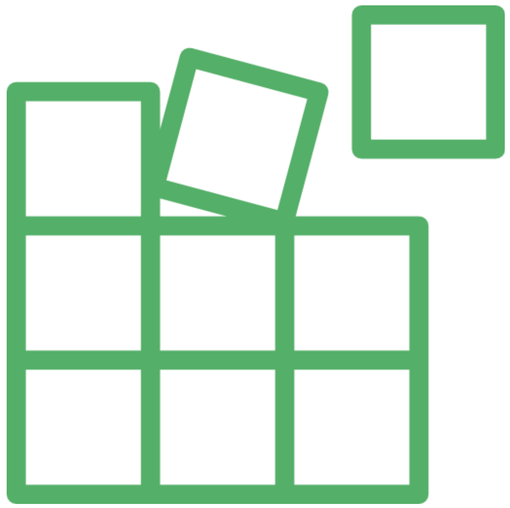


Overview

Stocks and flow diagrams are the foundation of system dynamics modeling as they let us look at and analyze the dynamic flows taking place within a system; whether this is information flows, the movement of products through a supply chain, or the flow of money through a financial system.

Causal loop and stock and flow diagrams are both very useful tools, but they differ significantly. CLDs are useful for gaining a high-level overview of a system, they are relatively easy to grasp and construct, and a good first step for systemic analysis.

Stock and flow diagrams take the analysis to a higher level of rigor. they shift the focus from cause and effects more towards dynamic flows, rates of change, build-ups and blockages in the system. Likewise, stock and flow diagrams help us take the next step toward creating a computer model of the system.



Stocks

A system stock is a store that can be quantified, e.g. a pile of sand or data in a database, the books in a bookstore. As a principle stocks generally change slowly, even when the flows into or out of them change suddenly. Therefore, stocks act as delays or buffers in systems.

Flows

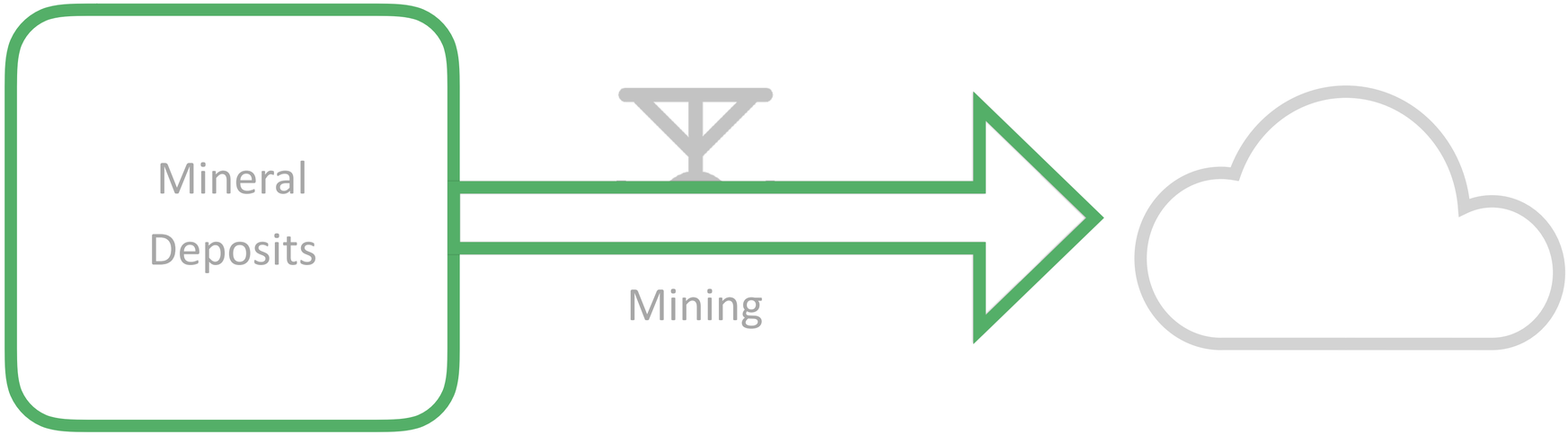
Flows are entities that make stocks increase or decrease, like a tap or drain affects the level of water in a bathtub. For example, an underground gold deposit is a stock, out of which comes a flow of ore through mining. Flows are filling and draining, deposits and withdrawals, growth and decay.

Stocks and Flows

Helps us to identify blockages and flows in the system

Illustration

Diagram of a stock of minerals depleted by mining



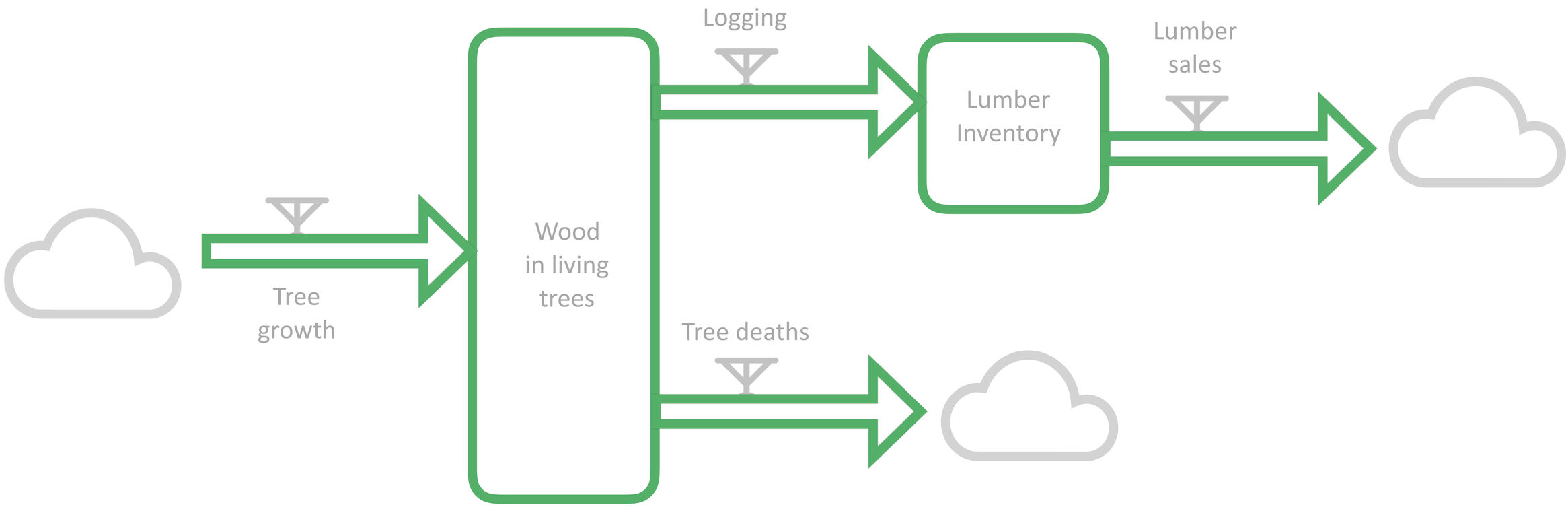
Stock vs Flow

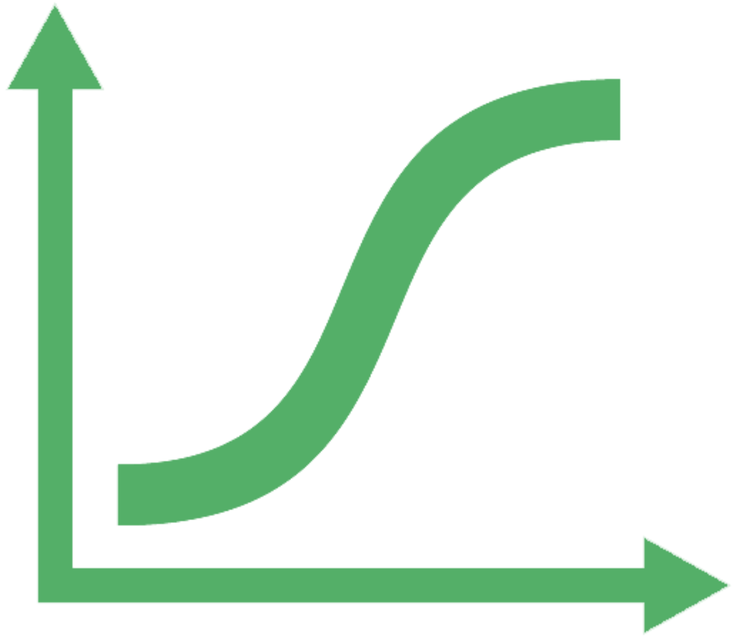
At first attempt it may not be too simple to distingue stocks from flows. One way of distinguishing a flow from a stock is to ask what would happen in the system if time were to halt. Stocks, which are accumulations, would go on existing, while flows, in contrary, would disappear, because they are actions.

For example, at any given moment, the money in your savings account, the attendees at a sports game or the number of goods in a warehouse are measurable and, thus, are stocks; they would continue to exist if time were to stop. On the other hand, the bank's interest payment per day, the production rate of units per hour, and the movement of people in and out of a sports game, because these are flows and thus relative to time, they would no longer exist.

Illustration

A stock of lumber linked to a stock of trees in a forest





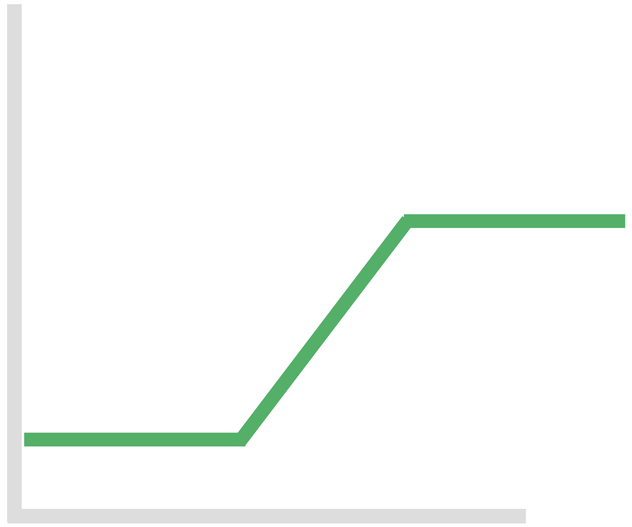
Behavior Over Time

Systems thinkers use graphs of system behavior to understand trends over time, rather than focusing attention on individual events. People also use behavior over time graphs to learn whether the system is approaching a goal or a limit, and if so, how soon or far away.

A behavior over time graph is a line diagram that shows how something has changed over a period of time. It creates a visual representation of what is happening in a system. Time is shown along the horizontal axis and the sizes of the variables are shown in the vertical dimension.

The aim is typically to gain a qualitative impression of the changes taking place rather than a detailed quantitative analysis. The pattern, captured by the form of the variable line, is important, as are the points at which that line changes shape or direction, while the precise numbers on the axes are often less important.

Principles



Rising

As long as the sum of all inflows exceeds the sum of all outflows, the level of the stock will rise.

Falling

As long as the sum of all outflows exceeds the sum of all inflows, the level of the stock will fall.

Stable

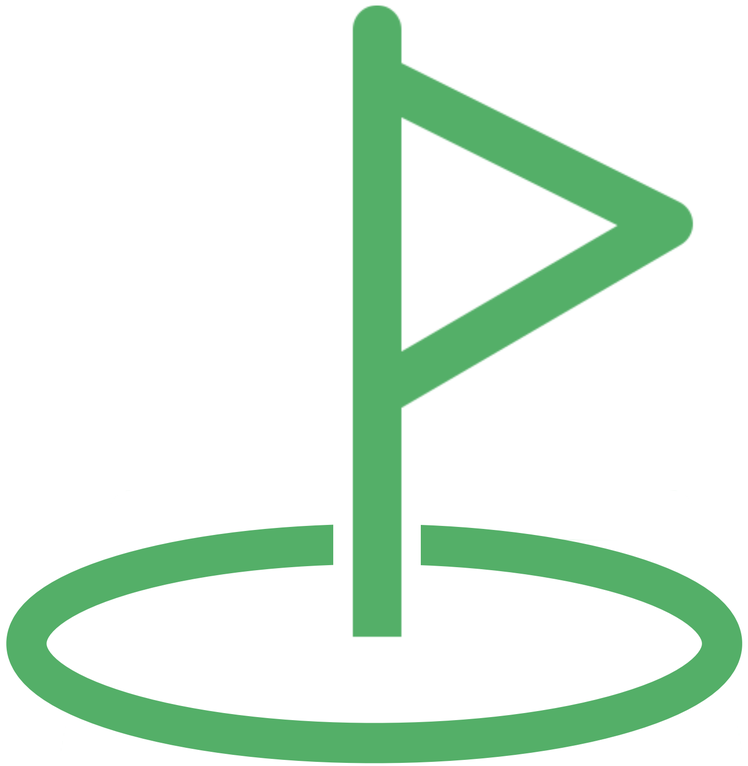
If the sum of all outflows equals the sum of all inflows, the stock level will not change; it will be held in dynamic equilibrium.

Stock and Flow Delays

The presence of stocks allows inflows and outflows to be independent of each other and temporarily out of balance with each other, creating delays. The time lags that come from slowly changing stocks can cause problems in systems, but they also can be sources of stability, thus both beneficial and detrimental. The time lags imposed by stocks allow room to maneuver, to experiment, and to revise policies that aren’t working. Soil that has accumulated over centuries rarely erodes all at once, this gives us time to think of alternative agricultural practices before the critical point of failure.

Time lags often lead to "overshoot" which is the occurrence of a signal or function exceeding its target. For example, we might think of a town that has discover gold under its ground. When the gold is abundant, the population grows quickly. However, as the population grows it depletes the supply of gold. When gold becomes scarce, the population is stranded without a functioning economy and drops rapidly as people leave to search for work at other locations. Thus stock and flow delays can lead to crisis states due to overshoot.

Iceberg Model



Conclusion

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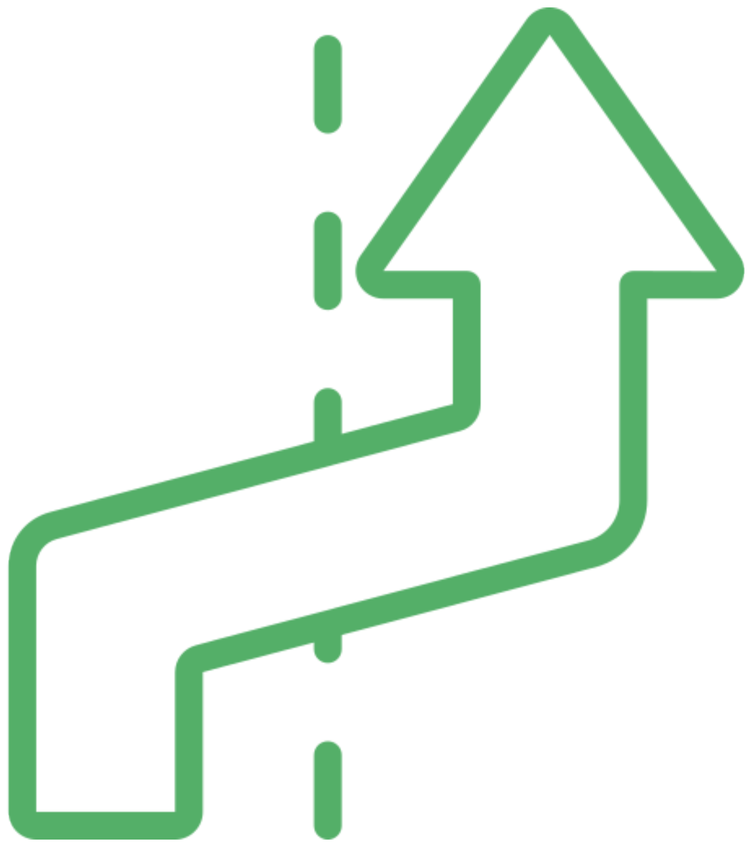
Multi-level Mapping

Overview

Systems change is about transitioning a system from where we are today to somewhere we would prefer to be in the future. To do this we need some overall vision of how the system is changing on its different levels. To get a comprehensive understanding of how a system is changing we have to look at the processes of change taking place on those different levels and how the different patterns, structures and processes of change interrelate across and between different scales.

One model for helping us to think about how change happens on these different levels is the multi-level perspective(MLP) a prominent framework for describing transition processes in complex socio-technical systems. This model has been designed to help us analyze and better understand the "long-term, multi-dimensional and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption.”



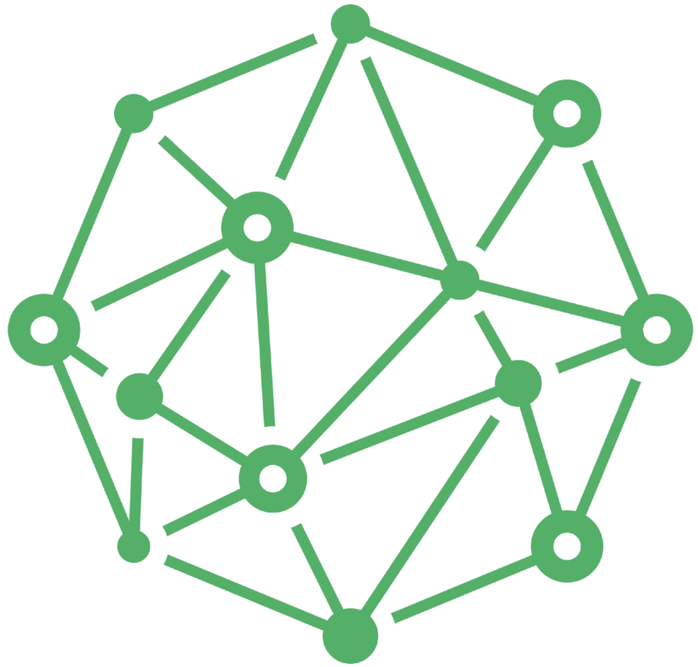
Transitions

The Multilevel model is designed to describe complex transition processes involving paradigm-shifting innovations. Examples of this might include the advent of modern computing, or the industrialization of agriculture. Such transitions are multi-dimensional, long-term, and fundamental change processes through which established sociotechnical systems shift to new patterns of organization; new modalities of production and consumption.

MLP is an analytical tool for generating an overall understanding of societal levels and the opportunities for, restrictions on, and possibilities of sustainable transitions. It is one model that attempts to deal with the complexities and resistance to change inherent in these major transitions; as such it also incorporates a theory of change.

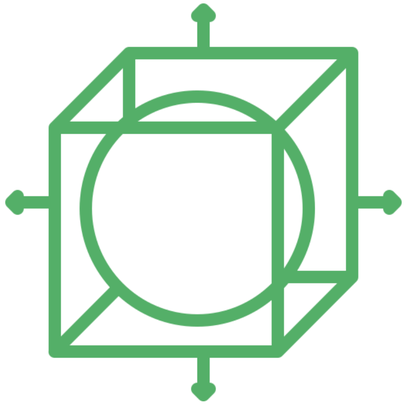
Wholistic Approach

The MLP is decisively holistic in nature for it does not search for any single solution as to how and why transitions may occur but instead takes a broad overview of different scales, dimensions, and time frames. This model takes a systems approach by starting with the perspective that, at any level, economies are organized into systems. In a system, every element is interrelated to everything else and in diagnosing problem situations as systems there can be many sides and multiple levels to consider; thus taking different points of view from different levels of perspective is beneficial.



The MLP model tries to capture the many interrelated factors to large scale system innovation. These kinds of changes involve the co-evolution of several related elements. They involve a wide range of actors. They are constituted of a multi-scalar, multi-modal hierarchy of activities at different nested scales. They are long-term processes taking place over decades or even centuries. They involve changes in the supply side - e.g. knowledge, technology, industry structures, and demand side - such as infrastructure, user preferences, cultural meaning.

Aspects of large scale sociotechnical systems change

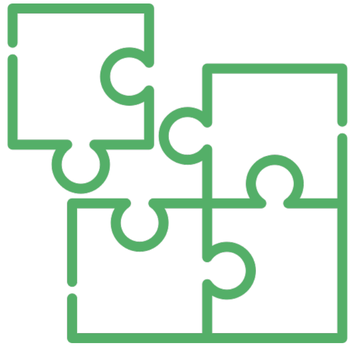


Multidimensional

Involves a wide variety of actors, institutions and technologies.

Multi-Scale

Change takes place on many different levels across different scales.

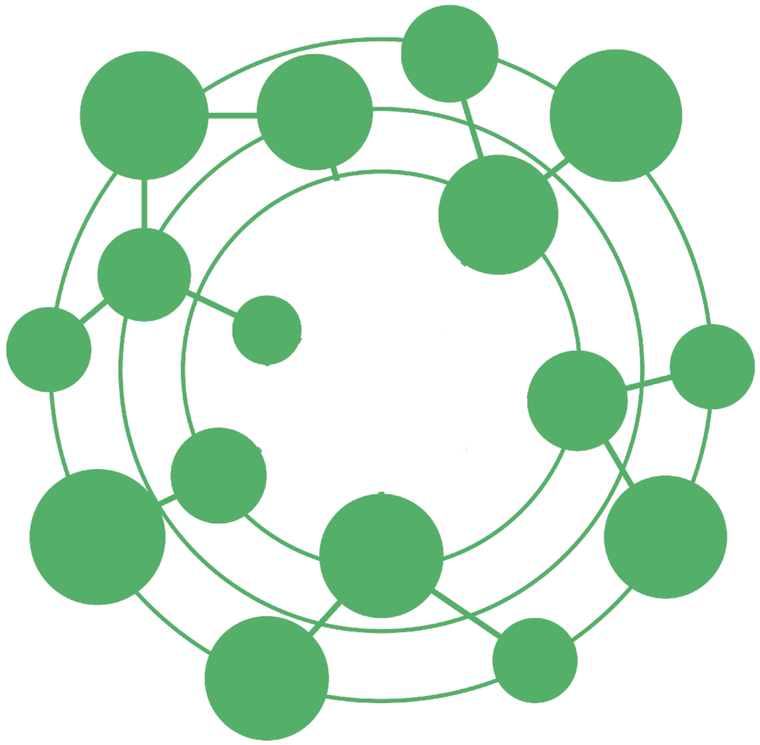


Co-evolution

Co-development of different systems, processes and elements

History

Prolonged processes that develop over the course of multiple decades



Multidimensional

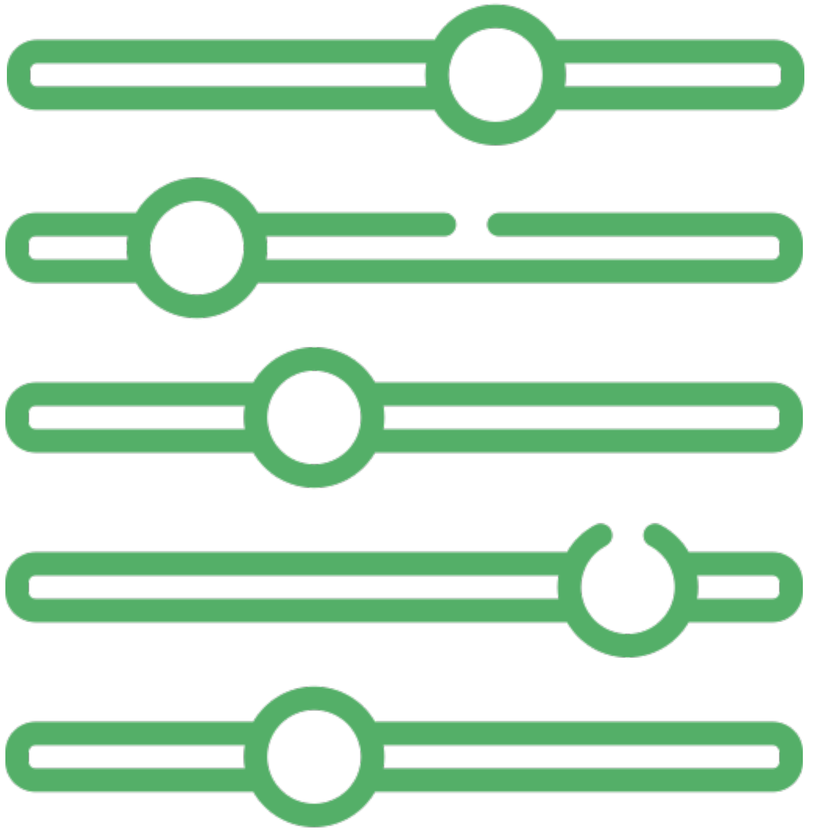
Traditionally we tend to think of innovation as happening through scientific and technological change; from scientific research centers and academia to R&D centers to tech startups and new companies. However, for a technology to have use it must be linked to social structures, human agency and organizations to fulfill a specific need. To get a comprehensive view we need to take a holistic approach that deals with the ‘seamless web’ where physical artifacts, scientific communities, social practices, and organizations are combined.

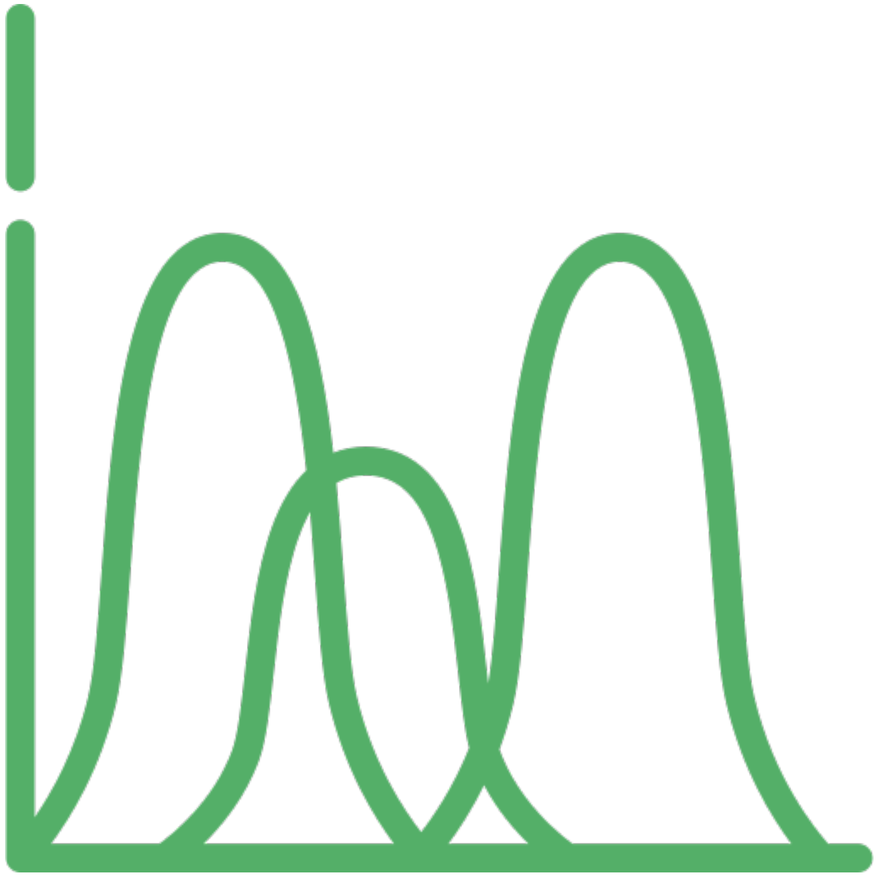
A transition is a structural change of an economy's systems and subsystems that is the result of a complex set of interactions between the technological, economic, cultural, political, ecological and social domains and takes place across different scale-levels. The systems that comprise the socio-technical paradigm include technology, supply networks, infrastructure, maintenance networks, regulation, cultural narratives, user practices, markets, etc.

Multi-Scale

As the name implies the multilevel perspective focuses our attention on how complex socio-technical systems exist on different levels; with those different levels having their own internal dynamics and rules. The focus is on how transitions occur through the interplay between processes that take place on qualitatively different levels.

Multi-level engineered systems are technologies that involve many different emergent levels to their overall structure. Urban infrastructure systems are such an example requiring many different levels to their design in order for them to function effectively. For example, office development requires telecommunications infrastructure, which rests upon an electrical power grid, which is dependent upon a national energy architecture, which in turn depends upon a transport infrastructure for the supply of fuels, etc. While all of this requires regulation, financial markets, national security, etc.





Varying Time Horizons

Transitions are long-term processes of change. Complete system-change can take many decades; case studies reveal them to often be between 40 and 90 years in duration. Thus we need to be looking across multiple time horizons and looking at how different - fast and slow - processes interact.

Change in complex systems is non-linear; the rate of change will vary over time. For example, the pace of change may be slow at the gestation period but much more rapid when a breakthrough is occurring. Due to the rigidity of technology infrastructure, economic and social institutions, cultural norms and regulation, change typically happens incrementally building upon past changes until a paradigm shift occurs rapidly.

Co-Evolving

Socio-technical transitions are co-evolutionary as different levels and different dimensions to the system have to adapt to each other's changes. The success of many innovations is predicated upon them “fitting” in with the changes in other parts and the overall paradigm. Technological developments occur intertwined with societal needs, wants and uses; diffusion happens not in a deterministic fashion but based on the interplay between the innovation, other changes in the system, and societal requirements.

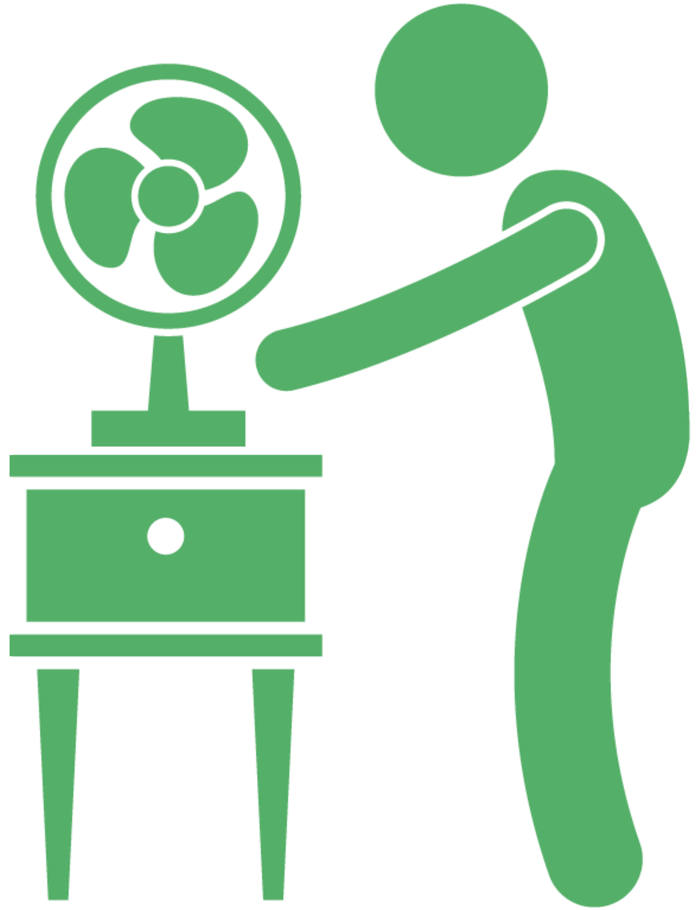
Co-evolution also implies emergence over time; the idea that as time moves forward and different systems interact with feedback, new contexts will emerge that could not have been predicted. The Internet of Things would be one such emerging socio-technical paradigm that will involve parallel developments in many different areas as it spans across cities, transport, supply chains, production, accommodation, etc. As these different systems co-evolve becoming connected and interconnected new service systems will become possible and new contexts will emerge.

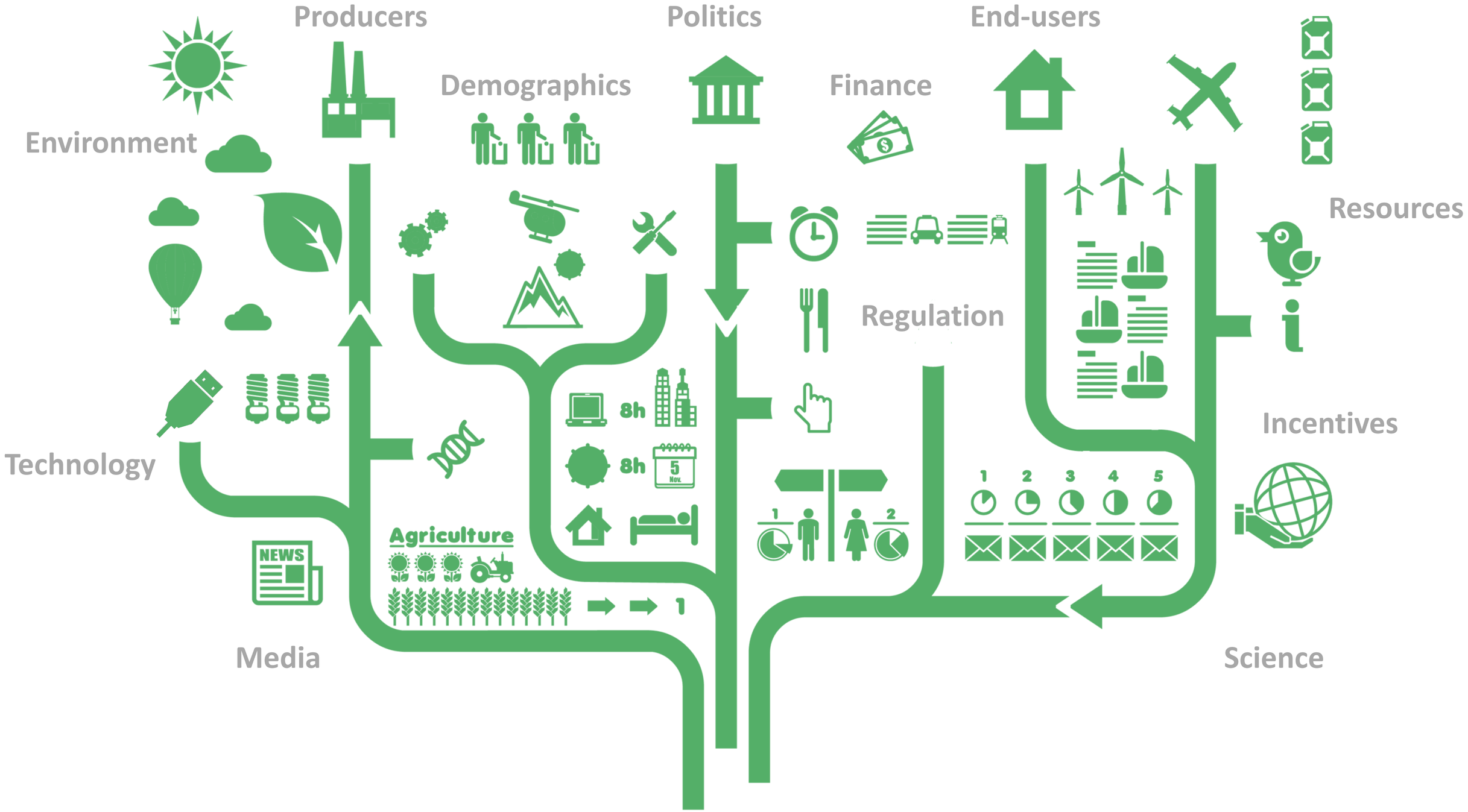
Multi-Levels

SocioTechnical Systems

The MLP is based on the idea of sociotechnical systems; that change within complex systems is multidimensional and we need to consider both the technical and social aspects in relation to each other. The ultimate functioning of almost all technologies will involve the interaction between people and technology. Whether we are talking about a mobile phone, a house or a subway station, the end throughput to the whole process requires these two dimensions to function together.

Sociotechnical systems is an approach to the study and design of complex organizations and technologies that recognizes the interaction between people and technology as a defining factor in the overall system's makeup and functioning. This is both on the micro-level of how an individual interacts with a particular technology, but also on the macro-level, referring to the complex nonlinear interactions between society's infrastructure and its socio-cultural domains.




Producers
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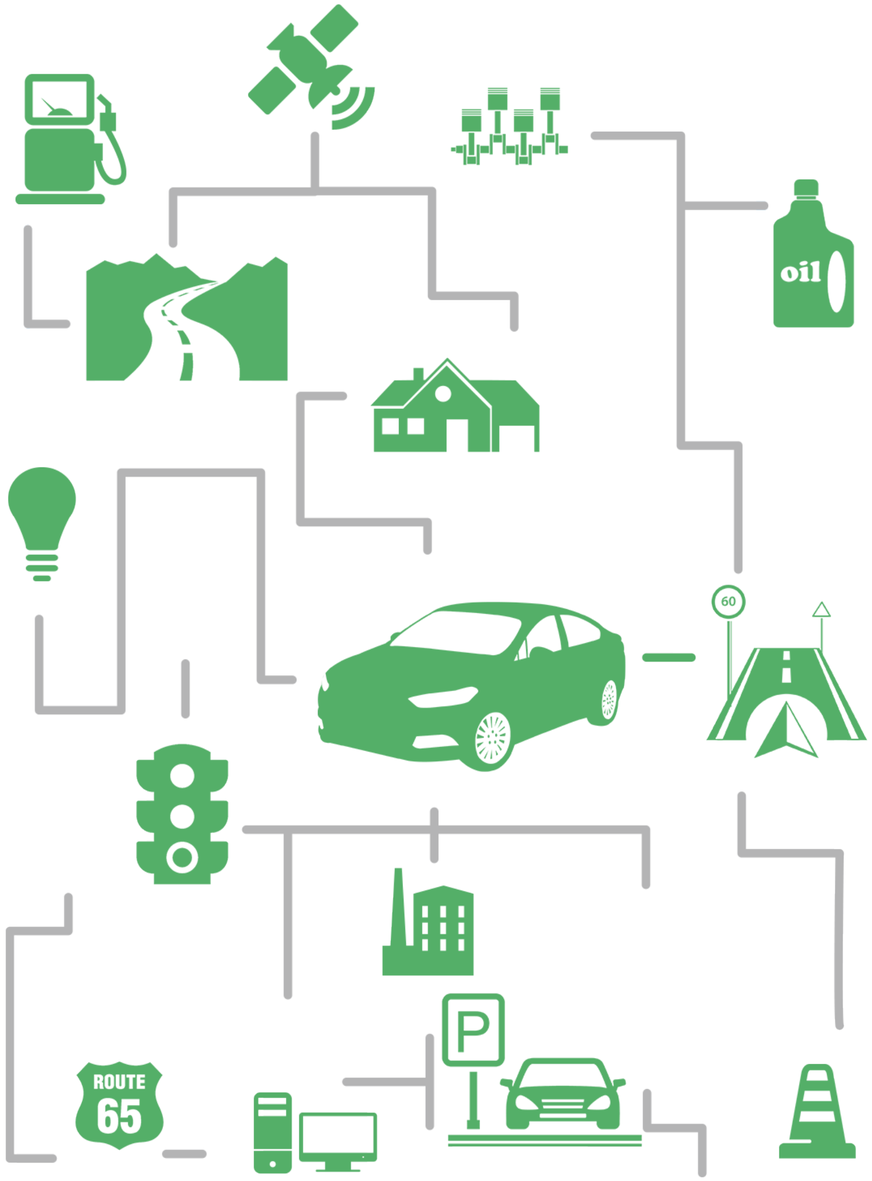


Paradigms

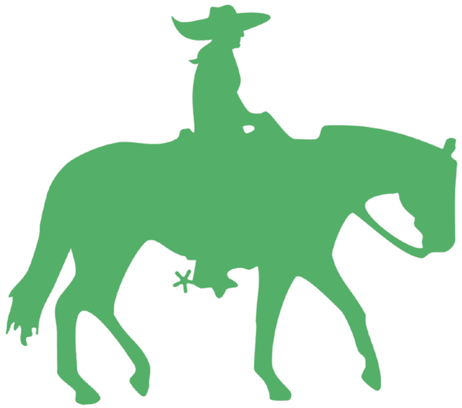
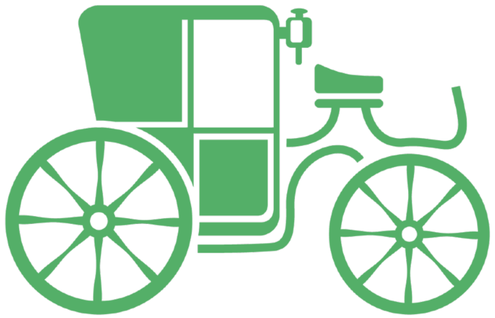
Because socio-technical systems are interlinked and interdependent they form an overall pattern or paradigm, within which technologies, economics, business models, social and cultural institutions fit and interoperate.

If we take the example of the automobile, the car is in fact dependent upon a whole transport paradigm. To get modern personal transportation required a significant number of interlinked changes to road infrastructure and traffic systems, traffic rules and regulations, symbolic meanings, marketing, cultural changes, fuels, the development of new infrastructure, changes in user behavior and mass production capabilities, and distribution networks, etc.

Regime

We can see how this whole system came to form and a certain paradigm or pattern emerged over time that we live with today as the dominant transport regime. A key idea of MLP is that a technology like a car, comes to prominence through its interdependencies and co-evolution with social-technical and institutional factors, creating a system called a socio-technological regime that supports and sustains that particular innovation.

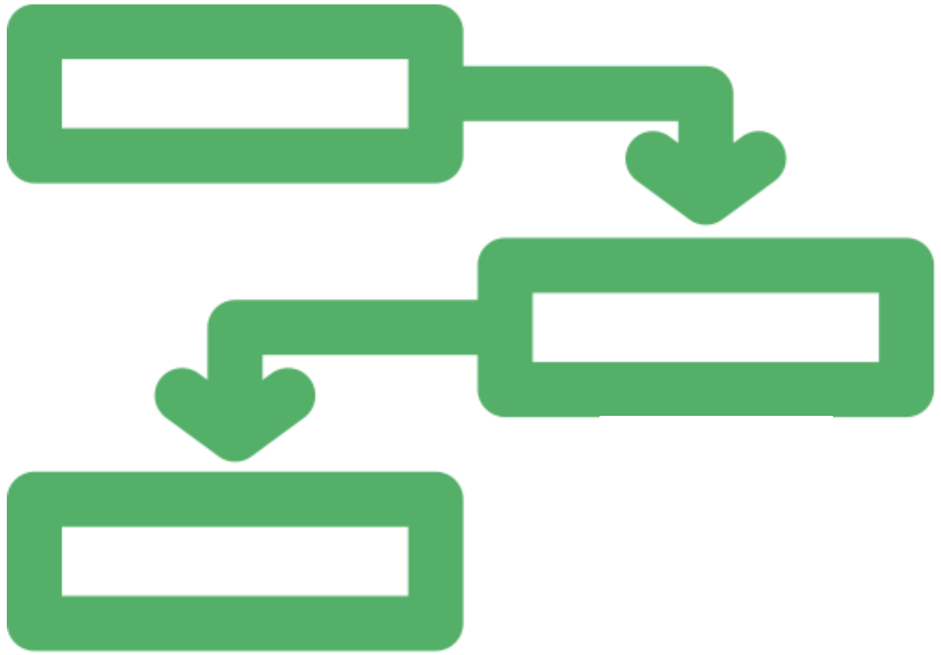
Over time these interdependencies in this pattern lock society into a particular regime. As a technology like a car matures people working in the industry - the car designers, researcher, managers, engineers and so forth - tend to develop common assumptions knowledge beliefs and habits about what is possible and legitimate as a transport solution.

Multi-Scale

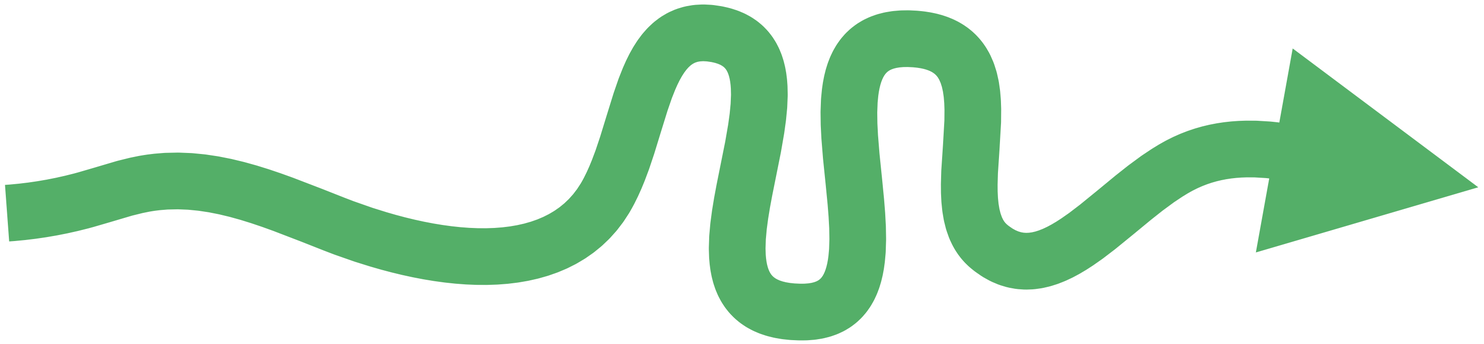
The focus of the MLP is on how transitions occur at multiple-levels through the interplay of processes at different levels. As illustrated below the model posits three heuristic levels on which change takes place. The macro-level (called the landscape), the meso-level (the regime) and micro-level (home to the niches).

Firstly, the landscape level is the broader overall social, economic and technological environment within which the system exists. Secondly, the regime level represents the current structures and practices characterized by dominant rules, institutions, and technologies that are self-reinforcing. Finally, the niche is defined as the place for new innovations where dedicated actors nurture the development of technological novelties.



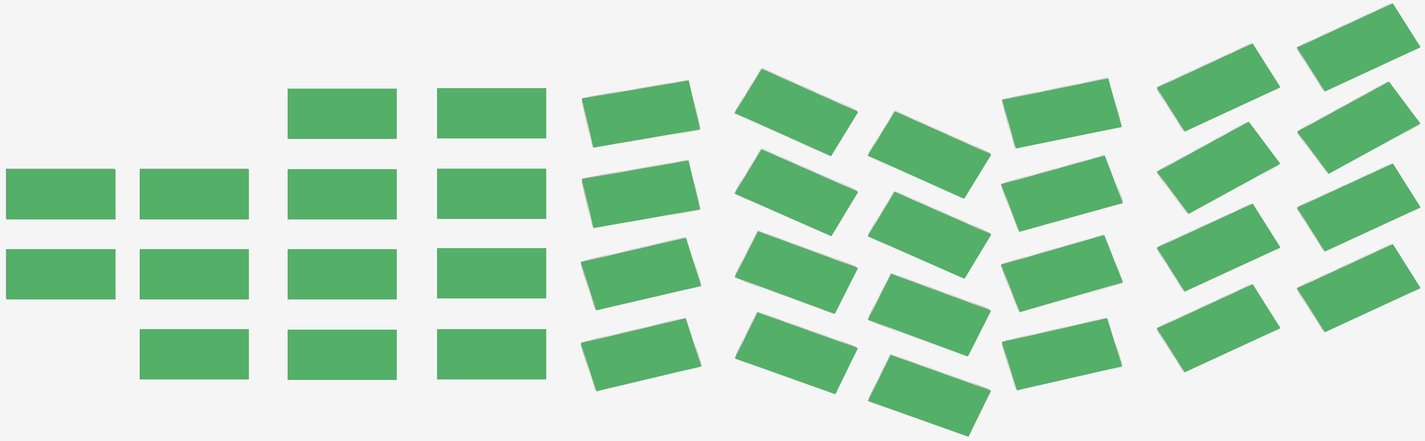
Landscape

Represents the overall environment within which the system exists.



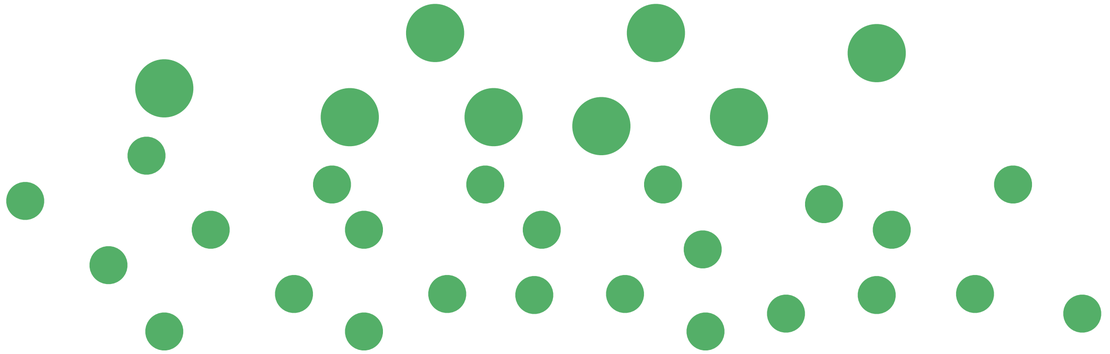
Regime

The persistent configurations that form the dominant pattern of organization



Niche

The margins that are home to new innovations, new models, communities.



Landscape

The landscape-level represents the overall environment within which the system exists. The Landscape forms the ‘external structure or context for interactions of actors.’ The landscape level is defined as the exogenous, broader contextual developments in underlying cultural patterns, geopolitical arrangements, macro-economics, macro-politics, etc. For example, the Industrial Age forms an overall technological context, likewise, the Anthropocene forms an overall socio-ecological context.

Here shocks to the system can occur through wars, economic crises, natural disasters, and political upheaval. Current major changes on this level may include; globalization, the environmental crises or the information revolution, all of which will persist over many decades and form the context to which our sociotechnical systems must adapt.

Landscape Examples

The Industrial Revolution (1770-1830)

The Green Revolution (1960-1980)

Globalization (1980-?)

Mass Production & Consumer Society (1930-1980)

The Information Age (1980-?)

Sustainability Crisis (2000-?)

Meso-Level

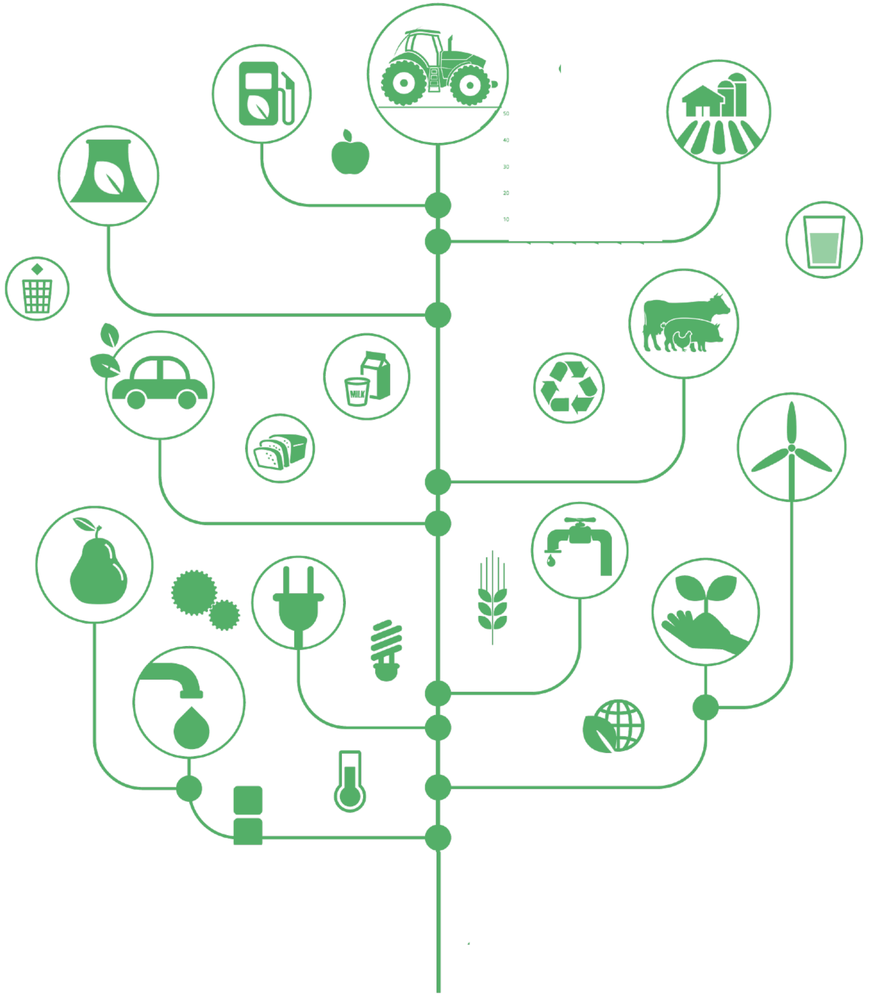
The meso-level is the locus of the “regimes" which are persistent configurations of markets, infrastructures, technology, policy and so on that have settled into stable configurations. From a systems theory perspective, the regime would represent the overall structure of the system within which elements find themselves, the way they are interrelated, the existing pattern to the flow of resources, the rules, policies, and protocols that structure this. The socio-technical regime is dynamically stable, i.e. innovation still happens, though along a predictable trajectory and incrementally.

The incumbent systems at the mesa-level involve dominant configurations for relating and logic. For example, scientific paradigms, infrastructure, markets, and technology; all of which have established institutional logic. The "logic" of these groups can be defined as the socially created, historical patterns of values, assumptions, beliefs, rules and material practices by which individuals create meaning and organize their material living.

Meso-Level example

One example of a mesa-level regime may be seen in the complex web of our current industrial food systems connecting many multiple sub-regimes within processes of production, distribution, and consumption. Beyond this, the existing food system regime is also related to other regimes such as water, transport or energy, and is thus linked to the stability and norms of these regimes as well.

At present, there are many rules and regulations that foster or inhibit alternative methods to be used in food production. Many social norms that keep conventional food systems in place, such as the existing infrastructure of global food production and distribution networks, as well as social values and economic incentives that are influencing many people to buy the cheapest products. The result is the perpetuation of a logic of commodified mass production and an agro-industry food system that encourages the standardization of farming practices and production qualities.



Micro-Level

The micro-level is the home of the "niche" innovations, new models, communities, or local networks on the micro-level. The niche is defined as the “locus for radical innovations” where dedicated actors nurture the development of technological novelties.

The niche fosters and incubates innovations that differ fundamentally from the prevailing regime and usually require landscape developments that open windows of opportunity at the regime level. From a systems theory perspective these may be seen as the emerging new elements. Niches are locations where it is possible to deviate from the rules in the existing regime to create new paths.

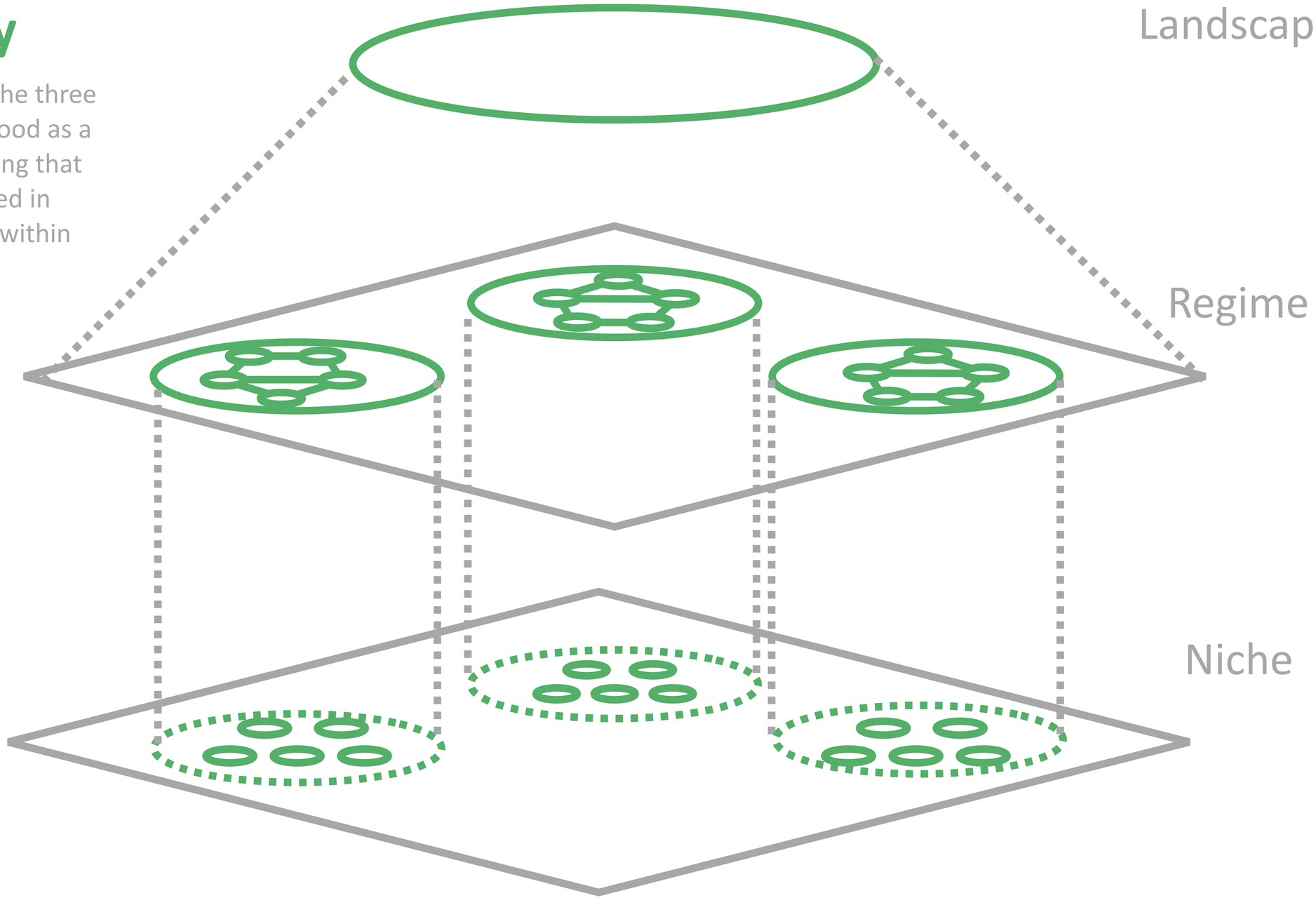
Micro-Level

Because the performance of radical novelties is initially low, they emerge in ‘protected spaces’ to shield them from mainstream market selection. This protection may take different forms. For example, it may take the form of an R&D lab funded by a company or it may be a new innovation that is supported by government subsidies.

The niche hope that their novelties will eventually be used in the regime or even replace it. This is not easy, because the existing regime is entrenched in many ways. Radical novelties do not easily breakthrough as often they do not fit with the context. Nevertheless, niches are crucial for system innovations, because they provide the seeds for change. Niches provide space to build social networks that support innovations. Those operating on this level try to expand the network of linkages in which these innovations can function and take hold.

Hierarchy

The relationship among the three concepts can be understood as a nested hierarchy, meaning that regimes are embedded in landscapes and niches within regimes.



Path Dependence

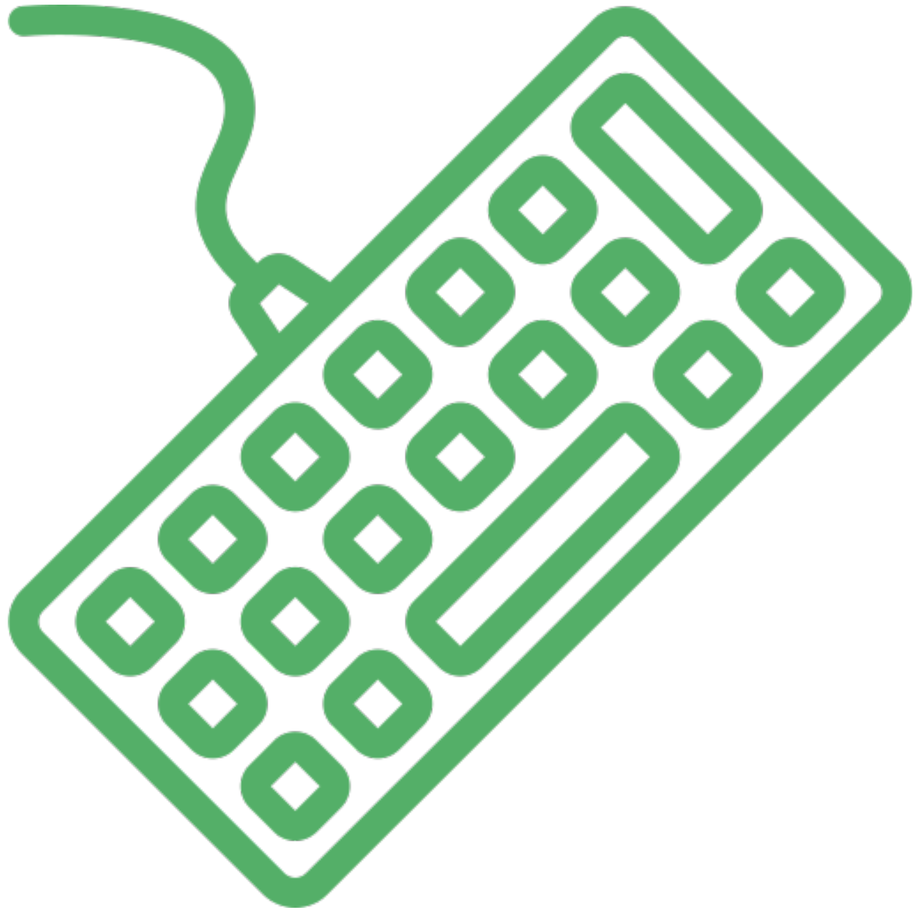
Path Dependence

The concept of Path Dependence is used to capture the way in which small, historical contingent events can set off self-reinforcing mechanisms and processes that “lock-in” particular pathways of development. The result is that the current set of decisions faced for any given circumstance is limited by decisions made in the past that may have locked us into a given paradigm that is now expensive for us to get out of - even though the past circumstances may no longer exist or be relevant.

Path dependence means that even though previous choices were made on chance or limited information with better options now being available, it is often still easier to simply continue upon a pre-existing sub-optimal path than to create an entirely new one. In other words, the present is rarely a clean slate, instead, there is typically some socio-technical regime that we are locked into - in some respects - and getting out of it will be more costly than staying in it, thus creating inertia. Path dependence has huge implications for transitions as it creates inertia to change.

Example

When we look around us we can see that many of our systems of organization are a product of a path dependent process. For example, we can ask, why do we still have the QWERTY keyboard that was designed for typewriters when it is not the most efficient for today's keyboards? Why do we still use the standard gauge train track designed two centuries ago for horse-drawn coal carts to run today's powerful trains when it is far from optimal? Why is it so difficult for us to switch to renewable energy sources? Why do businesses all cluster in a particular area like Silicon Valley when there is nothing special about that particular location? All of these examples are because the choices we made in the past as to what technology or system we adopted influence the choices we make today.



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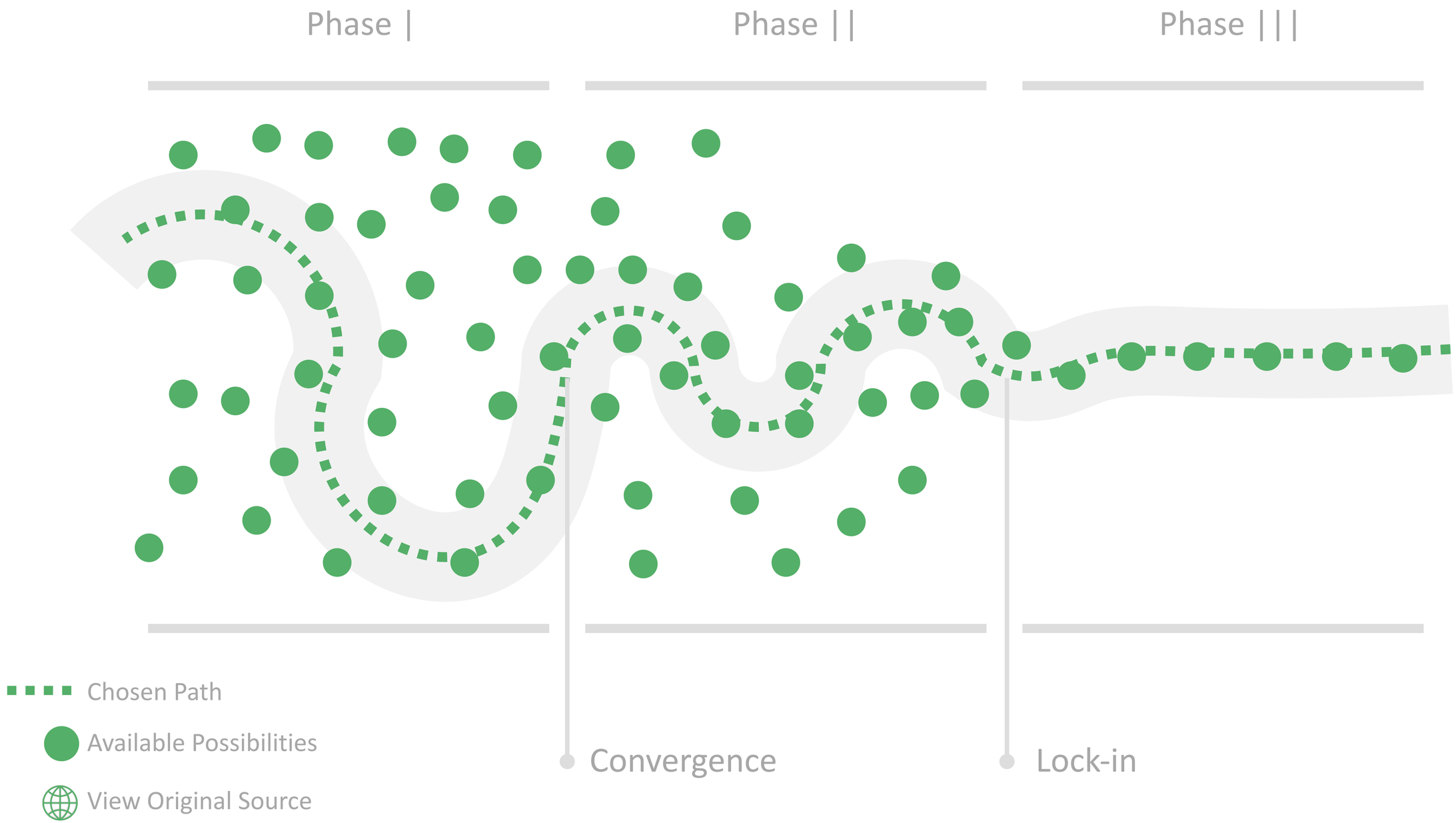
Phase |
Phase ||
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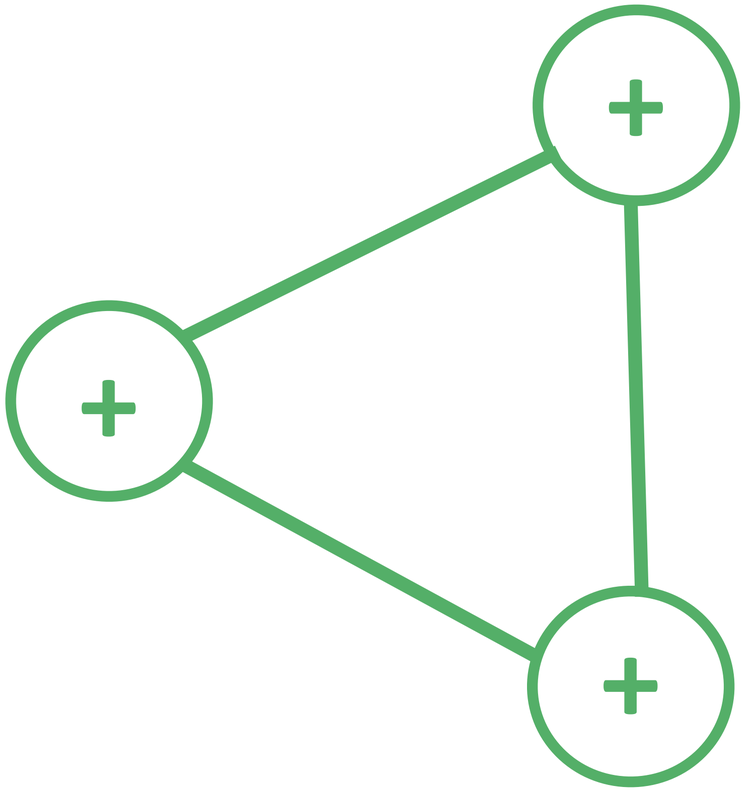
Chosen Path
Available Possibilities
View Original Source
Convergence
Lock-in



Network Effects

The basic theory to path dependency is that it is a product of a self-organizing process where some small initial event - maybe arbitrary in nature - comes through positive feedback to create a lock-in effect. This lock-in effect leads to negative externalities and inertia the result is a particular course of events that are difficult to change in the future.

Network effects are central to lock-in. Network effects result when there is a dynamic where the more people that adopt a certain technology the more valuable it becomes. The value of the system is primarily in the fact that everyone has decided to adopt that system so it is highly interoperable, giving it extra value due to this interoperability. For example, social media platforms have huge network effects making it difficult for us to simply create a new social network and for everyone to go and adopt that because it is better.

Protectionism

Once a pattern has become dominant and part of the meso-level the regime will then work to resist change and throw up barriers to innovations that challenge it. Economies of scale initially protect the incumbents and a network of third parties that have formed around it will reinforce its workings; with little incentive to support new alternatives.

In the case of the car, lifestyles and attitudes co-evolved with the evolution of the car as the dominant means of transport. This was reinforced by media and popular culture as signs of individual freedom and success, as well as public policies such as taxation and regulation which the car evolved with; the result is an uneven playing field for other potential solutions. Now innovations have to compete not just with the car, but with this whole system of social, physical and institutional factors that have co-evolved with the car and this tends to lock society into a particular trajectory even when it has become suboptimal.

Lock-in Effects

Network effects create technological ‘lock-ins’ which prevent innovation that disrupts the status quo. Once an industry has grown to maturity there are a lot of sunk costs; this is not just in terms of the fixed assets of a company but also in terms of the education and training of personnel, of mindsets, of organizational hierarchies, etc.

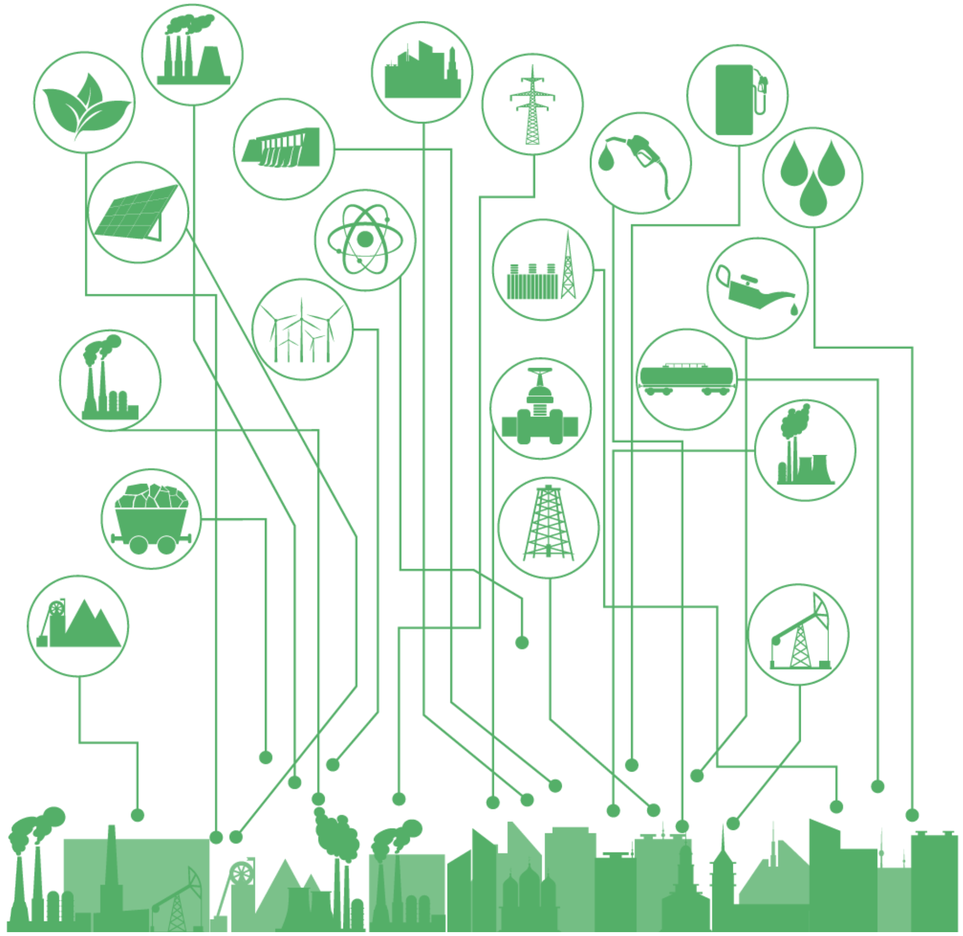
There is also a "rich get richer" effect - the systems archetype of success to the successful. This means once you have become a large player within an industry you will gain certain advantages just by the fact that you have been successful and are now large. For example, pharmaceutical companies may get to sit at the table when regulators are formulating a new drug policy or tax regime, however, the founders of the yet unknown startups in the industry will not. In the evolution of sociotechnical systems, there is no level playing field, the breakthrough and dissemination of technological innovations is dependent on more than their respective benefits.

Carbon Lock-in

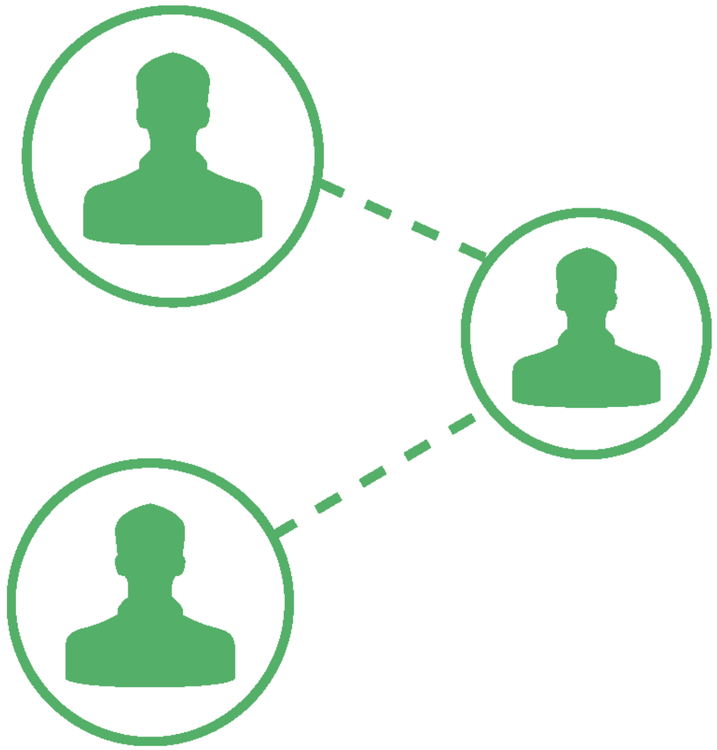
An example of this might be what is called Carbon Lock-In. This refers to the self-perpetuating inertia created by large fossil fuel-based energy systems that inhibit the adoption of alternative energy technologies.

Now that we have built up sophisticated machinery for extracting and processing petroleum and the combustion engine has become a default technology, the industry is being subsidized by economies of scale and the network effect; meaning because of historical events we can produce a barrel of oil very cheaply.

If you now have a barrel of oil, you can use it to do almost anything, from making raincoats, to greasing your car’s wheels, to trading it on a futures market. It is interoperable across a wide set of technologies giving it the network effect, an attractor and creating inertia.



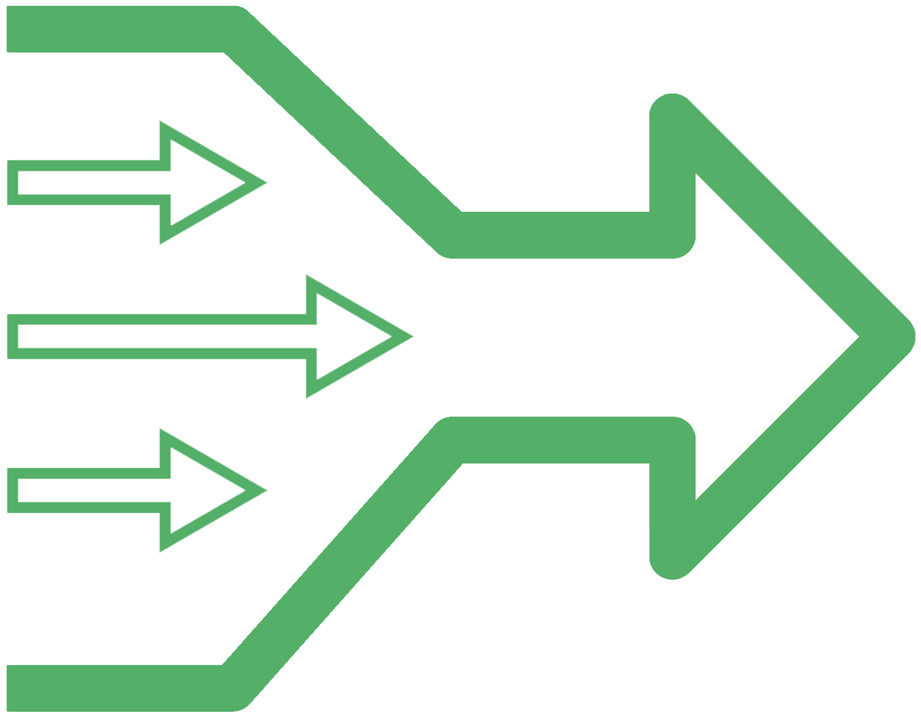
Stakeholders



The MLP has also been found to be a valuable tool for stakeholder analysis. This is because it can differentiate regime and niche actors, who may be seen to behave in different ways and offer different perspectives on the sustainability transition.

In the example of the energy and transport sustainability transition, it has been found that niche groups - citizens concerned about environmental issues - were more open to talking about demand management policies and modal shift, while regime groups - automotive and energy companies - preferred technological innovation.

Thus those at the niche level avoided only considering a ‘techno-fix’ transition in which there was a simple reproduction of current power structures and the continued dominance of personal motorized transport, and instead also considered radical technological, institutional or behavioral reconfigurations of this sociotechnical system.



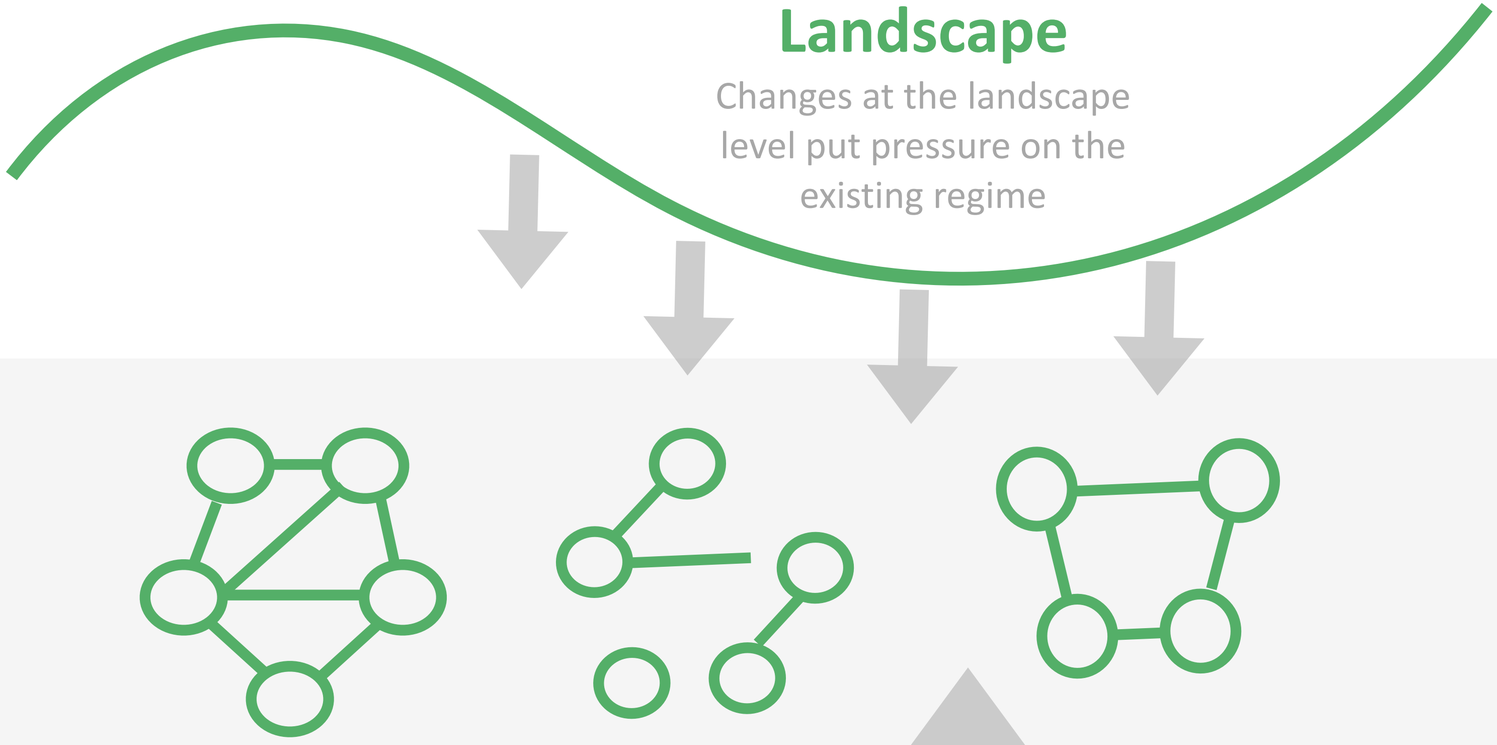
Transitions

Overview

The multi-level perspective not only provides us with a way of mapping out a system on its different levels but also provides us with an account of change; how transitions may occur within socio-technical systems. In general, the MLP model attributes socio-technical transitions to the interaction of stabilizing forces at the regime level with destabilizing forces from both the landscape and niche levels. Transitions are seen to appear when a prevailing socio-technical regime starts to display stress from multiple dimensions. More specifically this is seen to proceed given pressures from both above, as the landscape changes in some way, and from the niche, where a key innovation occurs that could become a dominant design.

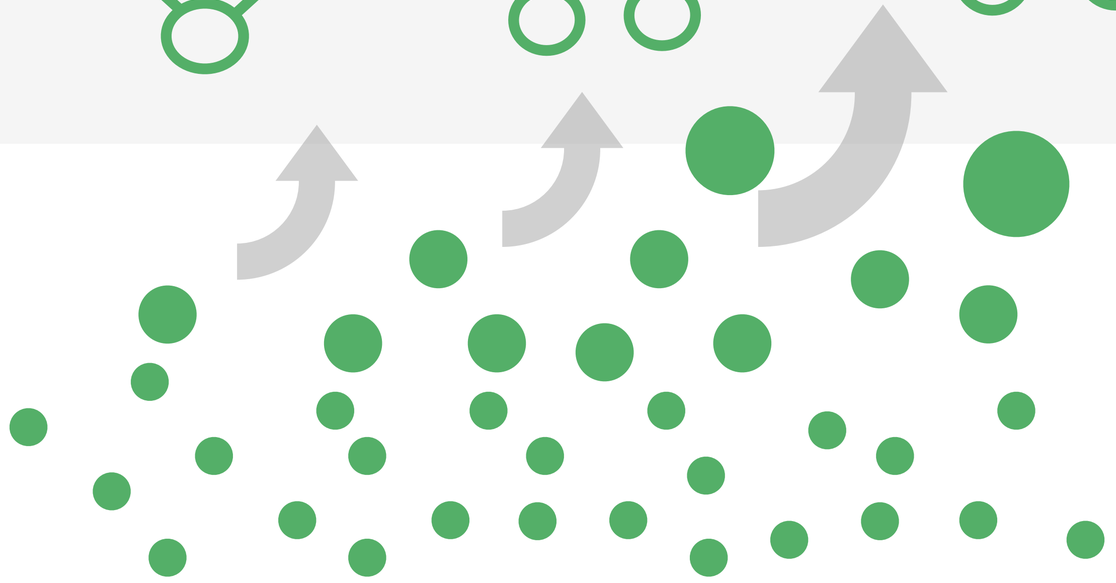
Landscape

Changes at the landscape level put pressure on the existing regime



Regime

Destabilization of regime creates a "window of opportunity" for niche innovations to break through



Niche

Niche innovations build up momentum through support, learning and improved efficiencies over time

Disruption

First, the current system has to be disrupted in some way from the landscape level, i.e. a change in the environment. This may include change in society's dominant values and beliefs, a new technology paradigm such as the internet, or concerns over climate change in the example of the car. These disruptions coming from the landscape level create windows of opportunity for new and alternative solutions to gain market share, for example, the electric car.

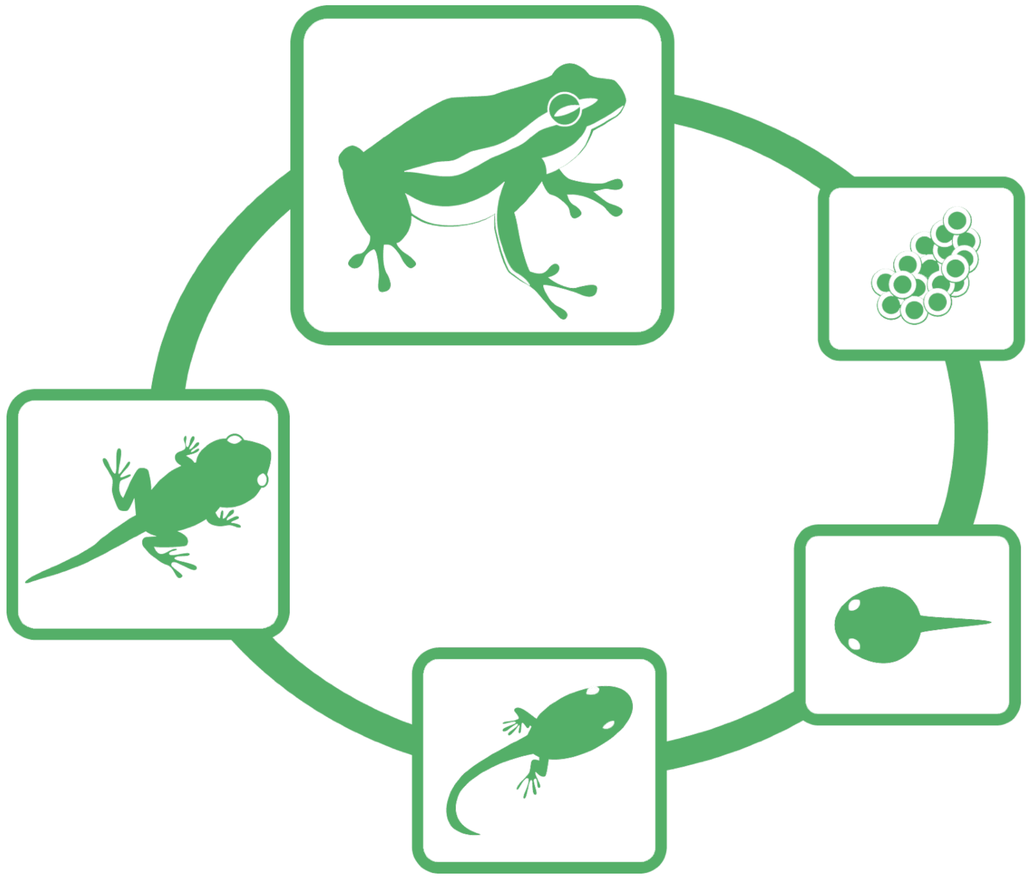
However, success is certainly not guaranteed, the elements of the niche level need to be mature enough, become aligned and stabilize into a coherent pattern. Even if there is pressure on the regime to change coming from the landscape, if niche-innovations are not mature and structured adequately, the incumbents may well respond by altering the course of development paths and their innovation to simply absorb them within the current regime.

Window of Opportunity

As long as the regime level is aligned and stable, alternative novelties will have few opportunities and remain grounded in particular niches. However, when stresses, mismatches, and contradictions start to show in the regime, this creates ‘windows of opportunity’ for the break-through of radical novelties into the prevailing regime. This is seen to require landscape developments that open windows of opportunity at the regime level. Frank Geels proposed a four-phase approach. The first phase sees the emergence of an innovation, created out of the existing regime. At phase two development then occurs at the niche level. Breakthroughs into the meso-level then occur at phase three.

A number of possible circumstances can act as windows of opportunity for the diffusion of new technologies, such as; internal technical problems in the existing regime that cannot be solved by refinement of existing technologies; problems external to the system, such as pressure groups like environmentalists; changing user preferences, when existing technologies cannot meet user needs, etc.

Stages of Transformation



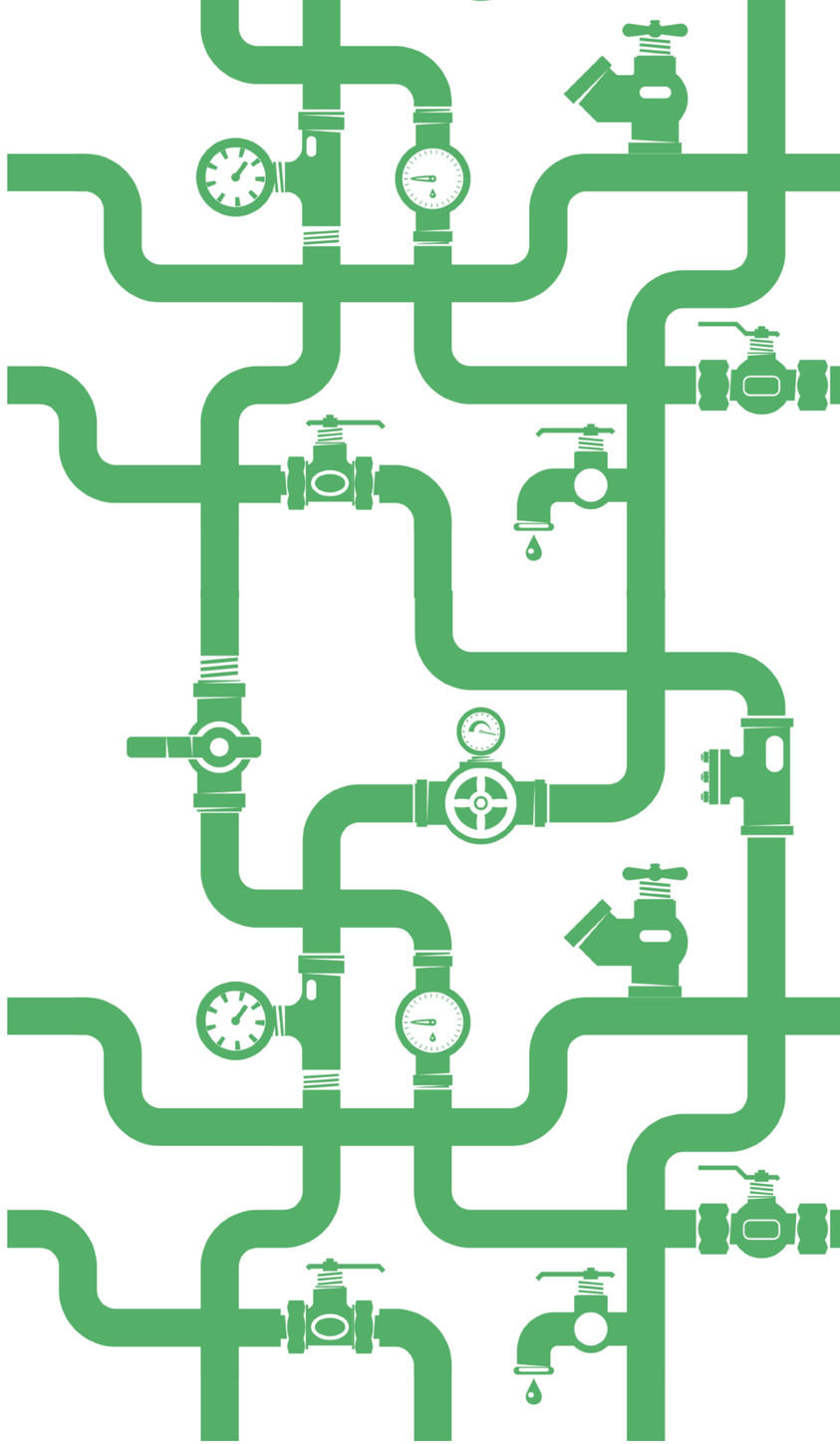
From many case studies of industry reorientation by Frank Geels, he identifies several stages to the change process. As he notes it seems to always start with resistance - in the beginning, the incumbents say something along the lines of, "it can't be done," "it's too expensive," "the problem is not caused by us it can't be addressed by us."

Then gradually in the second phase, if the pressures begin to build, they start hedging as they still do the mainstream strategy but to protect some investments they will start investing a little bit in alternatives. The third phase would be diversification when they start to see opportunities and start to seriously go for markets with innovation races occurring. Then in the fourth phase only do you get a full reorientation when the new logic is embedded in the economic strategy.

Example

In a study entitled The transition in water supply and personal hygiene in the Netherlands (1850–1930) Frank Geels uses the MLP to interpret the transition from surface water to piped water in the Netherlands. This transition is a good illustration of the co-evolution of technology and society, involving technological innovations, such as piped water infrastructure, soap, toilets, baths, as well as cultural, political, economic and behavioral changes.

By the mid-19th century, problems in the water supply regime were getting bad, as expanding urban populations discharged their waste in canals and surface waters. Local conditions in some specific cities provided space for the first piped water systems in the 1850s. Problems in the water supply regime grew more serious in the 1860-70s, but public officials in other cities did not adopt the new niche. Instead, they sought solutions within the existing regime. Only after wider economic, cultural and political landscape developments in the 1880-90s could the niche breakthrough and realize larger transformations.



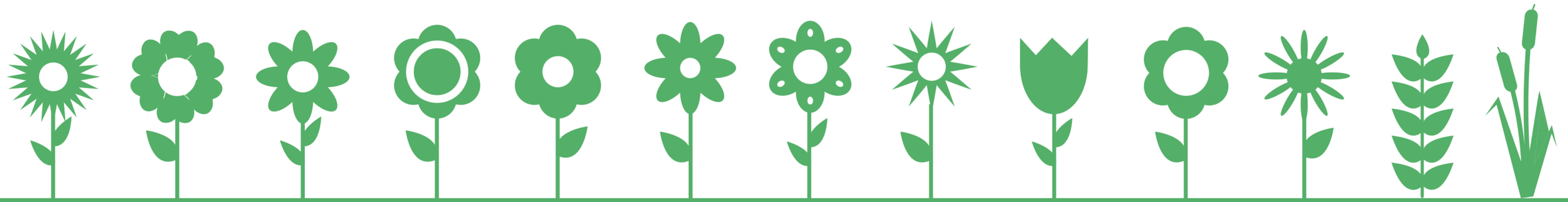
Evolution

Overview

Transitions are co-evolutionary and multi-dimensional technological developments that occur intertwined with societal needs, wants and uses. The transition process within the MLP model is an evolutionary one as it draws upon evolutionary economics.

Transitions in the MLP model can be understood in evolutionary terms. Here the landscape is the environment, the regime the current set of solutions and the niche the new variants. When the environment changes the system requires new solutions that are better suited to the environment and it selects those from the niche level.

Within this paradigm, evolution is seen as ultimately a search mechanism; the means through which a complex adaptive system searches for the appropriate solutions to the challenges of operating within a given environment.



Selection Process

The process of economic evolution is performed similarly to that taking place within natural ecosystems. This process involves a number of key stages; firstly, the generation of variety through cross mixing and invention; secondly, adaptation, whereby products and services are exposed to their operating environment in order to reveal their functionality; finally, selection whereby functional variants are selected to become more prevalent within the economy's future life cycle.

1. Variety

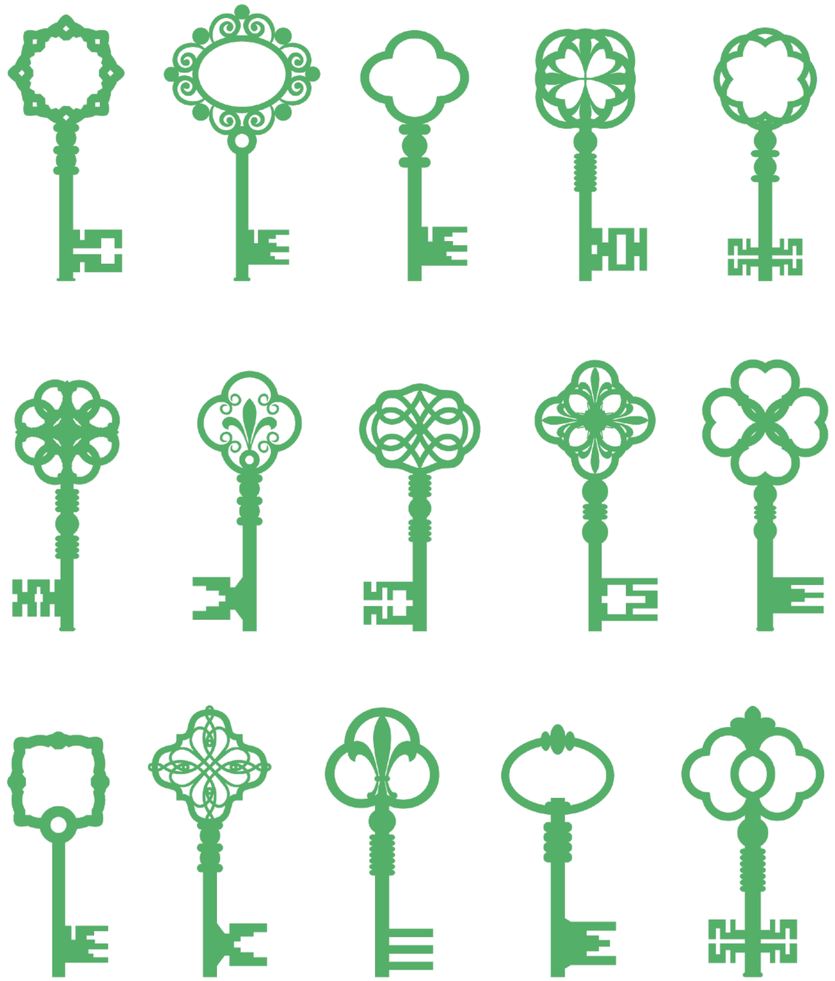
2. Selection

3. Replication

Variety

Enabling this process means developing open platforms that enable diverse variants to interact and cross mix. For example, the rise of the Internet and YouTube have put all our music on the same platform right next to each other. The result of this has been a great acceleration in the production of mash-up mixes between all types of very disparate music; many of which do not work but some do. Co-working and business incubators are based on the same idea of having an open space for the interaction between disparate activities, ideas, and expertise, to enable cross-pollination.

For this reason, it is important to maintain a stock of diversity within the system for the sake of innovation, but this is not the only factor. We also need to create and foster weak links between disparate domains so that we can get a greater diversity of cross-mixed variants, and the diversity between these variants will be less superficial.



Adaptation

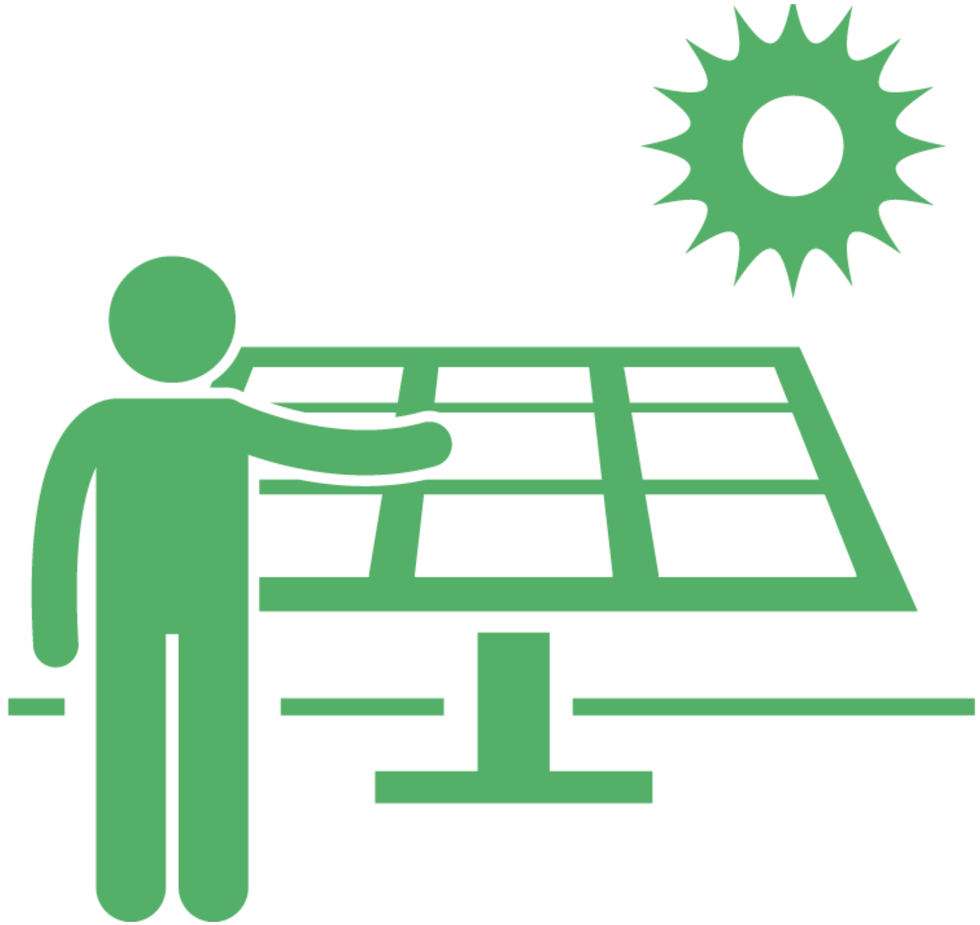
Next, these variants need to be put into their operating environment. To adapt, they need to be fully exposed to that environment but given sufficient time and space to develop and exhibit all of their capabilities – this may take time. It takes time to develop a new product in a market or a new industry within an economy. If we think about evolution within ecosystems, new creatures are typically fostered for a prolonged period before being exposed to the full requirements of survival.

A new agile approach to product development called MVP, standing for minimum viable product, is one approach to this process whereby new very basic solutions are rapidly developed and are deployed as soon as they have the minimum requirements to function within their operating environment. In this way, we can start to receive immediate feedback as to the system's viability and possible future trajectory without the need for significant investment or foresight.

Operations

All variants ultimately must be exposed to the same environment in order to see how well they perform, although the traditional narrative surrounding evolution is one of competition, a vision of every one against everyone else, however this is only really true in very simple relatively isolated environments.

Most products, services, business or individuals within advanced economies fail or succeed within that environment, based not only on their own capabilities but also on their capacity to interoperate and coordinate with other systems. Within environments of heightened interconnectivity, this capacity for interoperability is very important.



Selection

Lastly, selection has to be performed on the set of elements based on their functionality. Ultimately, all products, services, and economic institutions have to serve some function for someone who is prepared to pay for it. Every time we purchase an item and cast our vote for that product or service, we are tipping the balance in favor of its continuing to exist, while the balance of all the other products on the shelf that we did not select is very gradually tipping in the other direction.

In that simple act of choosing, some product or business has lived on to become more prevalent within the next life cycle to the system while others have come closer to being discontinued and thus becoming less prevalent in the future. In evolutionary terms, socio-technical regimes function as a selection and retention mechanism. Each of these social groups has its own distinctive features and its own ‘selection’ environment.

Conclusion

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Reference and Resources

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