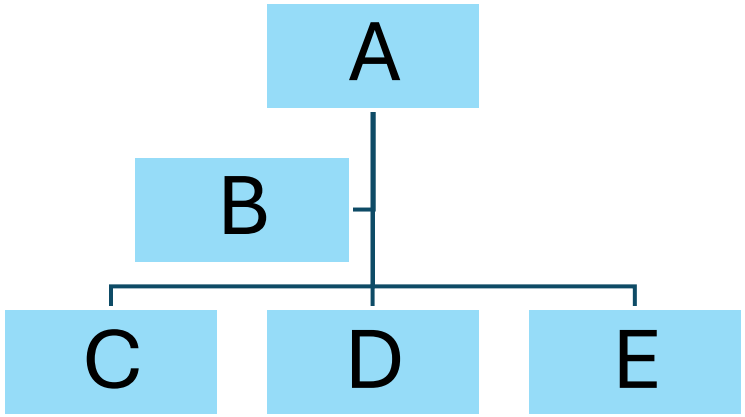
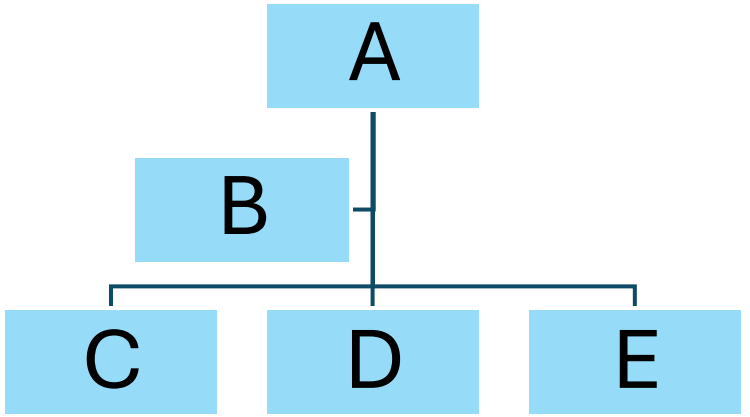
my Generic Organization

A Basic Template



Notes developed / compilied by: David Gould

Systems science concepts applied to a generic organization.



Purpose

The purpose of this slide show is to provide a description of a generic social organization from a systems science perspective, starting from definitions to inputs-throughputs-outputs to constructing a database for the organization.

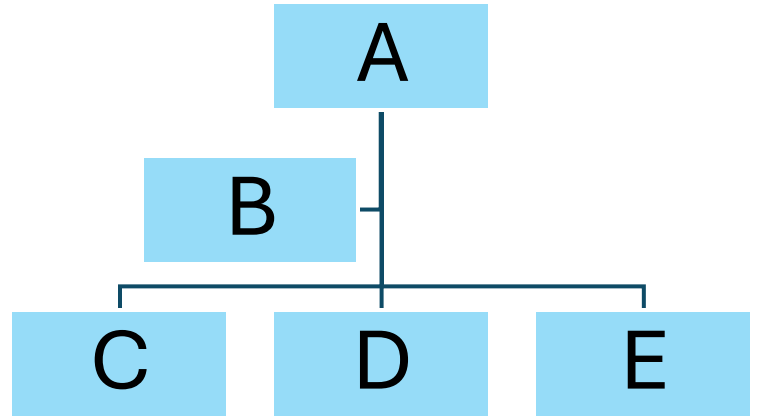
The organization could be any social organization: a family, small business, nonprofit, town, small city, a community, ...

Critical Things to Know About an Organization

- Where is it coming from? (History)
- Where is it? (Present day)
- Where does its leadership want to go? (Future)

These slides primarily address the second point about the present. The future is touched on in the slide on Organizational Statements, specifically vision, mission, and goals.

Contents



Definitions

System (Organization)

- An organization is a system
- A set of elements and their relations that exhibit behavior.
- Elements may be agents, components, or subsystems.
- Agents create and / or execute algorithms expressing systems behavior
- Components are part of a system, but not a complete subsystem
- Subsystems are complete systems as part of a larger system
- Algorithms are recipes (step by step instructions) that describe behavior

System (Organization)

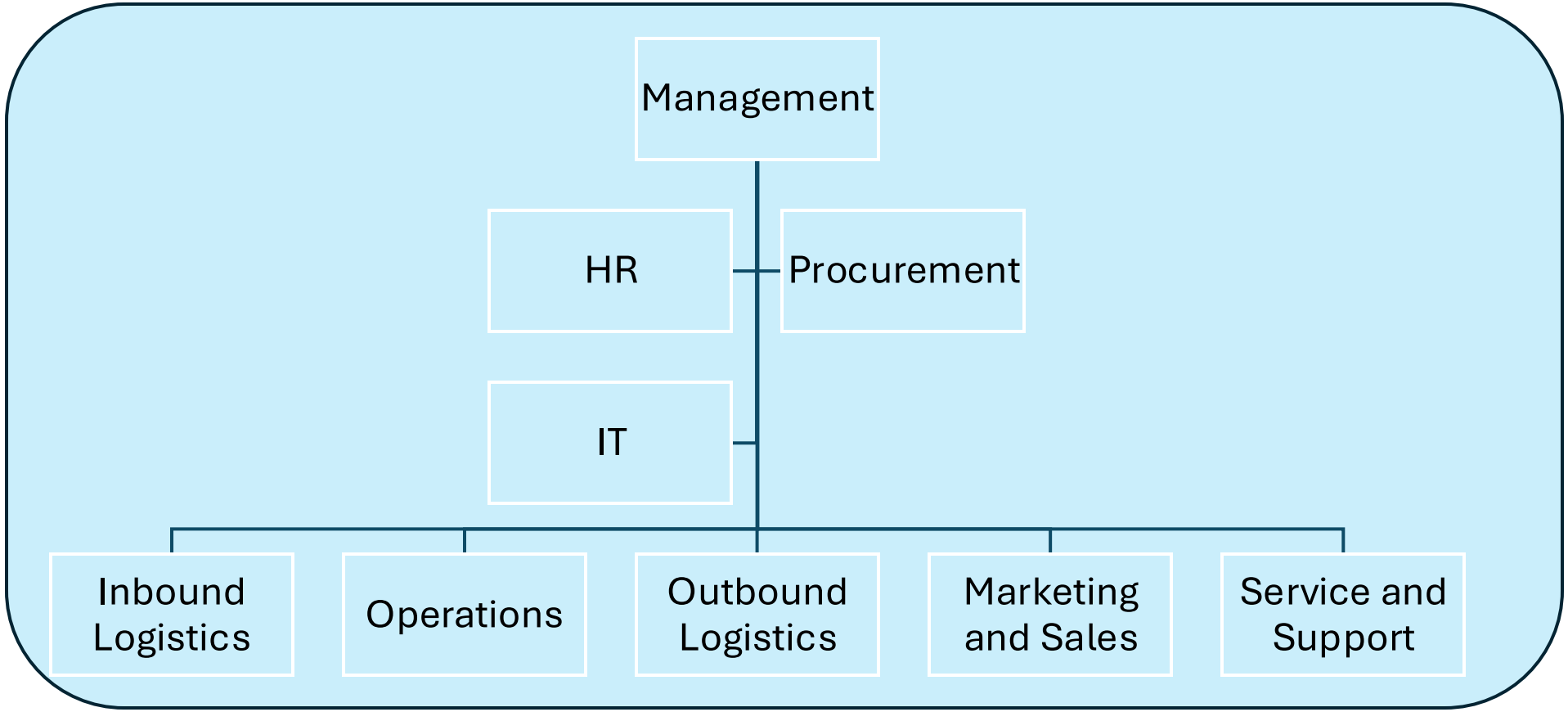
- Relations are a set of ordered pairs that define the interconnections, interactions, or dependencies among the elements. Examples:
  - S = {Bob, Alice}, with a relation R on S, {(Bob, Alice) | Bob reports to Alice}
  - S = {DeptX, DeptY} with a relation R on S, {(DeptX, DeptY) | DeptX and DeptY are co-equal}
- Behavior of elements is expressed in terms of algorithms or rules that (a) transform external inputs to internal throughputs to external outputs or (b) that modify internal operations; that is the system itself changes or adapts.

my Generic Organization

my Generic Organization

- my Generic Organization contains several elements
  - Subsystems include management / leadership, HR, procurement, IT, inbound logistics, operations, outbound logistics, sales and marketing, and service and support. Other, more, or fewer subsystems may exist. See visual below.
  - Algorithms for managing the system, HR, procurement, inbound logistics, operations, outbound logistics, sales and service and such describe behaviors. (adapted from Porter)
  - Its boundary (a component) is the separation space between it and the physical environment, competition, economic / financial, government, technology, and other social organizations.
  - Other components include stocks of resources required for operations.
  - Agents include owners / investors, managers, and staff
  - The structure is the network that describes the organization such as tree structure.
  - Interfaces include I/O portals for the transfer of materials, energy, messages, and agents.

my Generic Organization



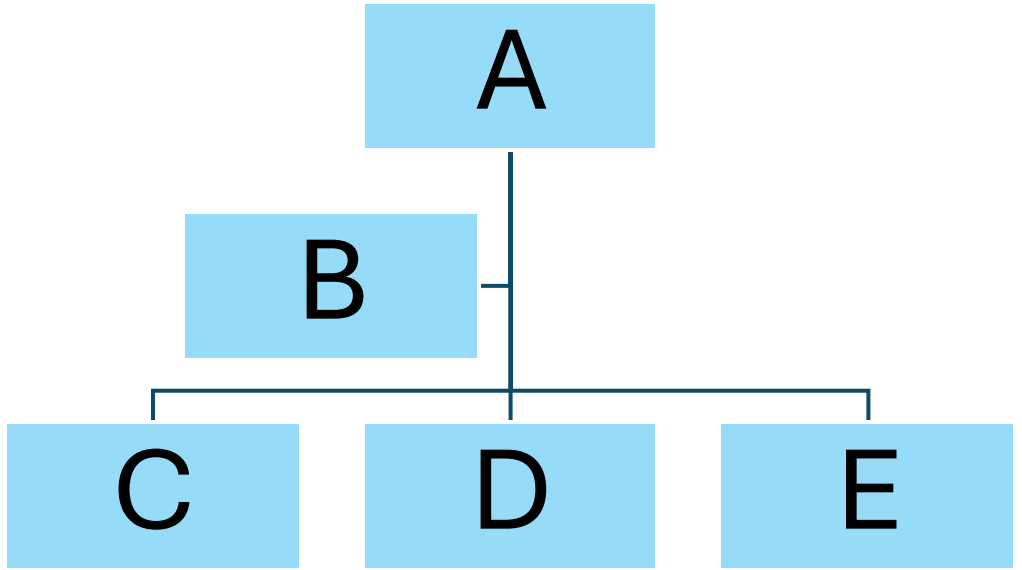
Adapted from Michael Porter

Subsystems are Management, HR, IT, ...

Organizational Statements

- Vision
  - A short description of where the organization is going
- Mission Statement (includes)
  - The primary product(s) / service(s)?
  - The primary market
  - The principal technology for production / delivery
- SMART Goals
  - Specific
  - Measurable
  - Achievable
  - Realistic
  - Time-Bounded
- Objectives
  - Justify and Rationalize

my Generic Organization Chart



my Generic Organization

(with applied principles adapted from Mobus (2022))

Systems may be composed of subsystems

- my Generic Organization is functionally decomposed into subsystems X, Y, Z

Systems exhibit behavior; that is, they are nonstationary

- my Generic Organization is in an expansionary phase

Systems have a history

- my Generic Organization was founded 10 years ago and is still in the same location.

Systems are bounded

- my Generic Organization has only one location in a mid-sized city.

Systems are dynamic

- At times, my Generic Organization is stable, other times, growing, and sometimes shrinking. Currently, my Generic Organization is in an expansionary or growth phase.

Systems interact with other systems

- my Generic Organization interacts with suppliers and customers, government agencies

my Generic Organization

(with applied principles adapted from Mobus (2022))

Systems process information (some may process material or energy)

- my Generic Organization processes required MEM for operations

Systems are composed of networks

- Internal networks among operational agents as well as external networks among suppliers, customers, …

Systems regulate themselves through negative feedback

- my Generic Organization requires maintenance in terms of the number of agents, types of products sold, financial stability

Systems develop; systems evolve

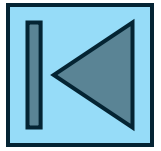
- Development / evolution in response to environmental conditions

Systems have a life cycle (origin or startup, growth, mature, decline)

- Founded X years ago and in the growth stage

Systems will collapse at some point and die

- Not there yet



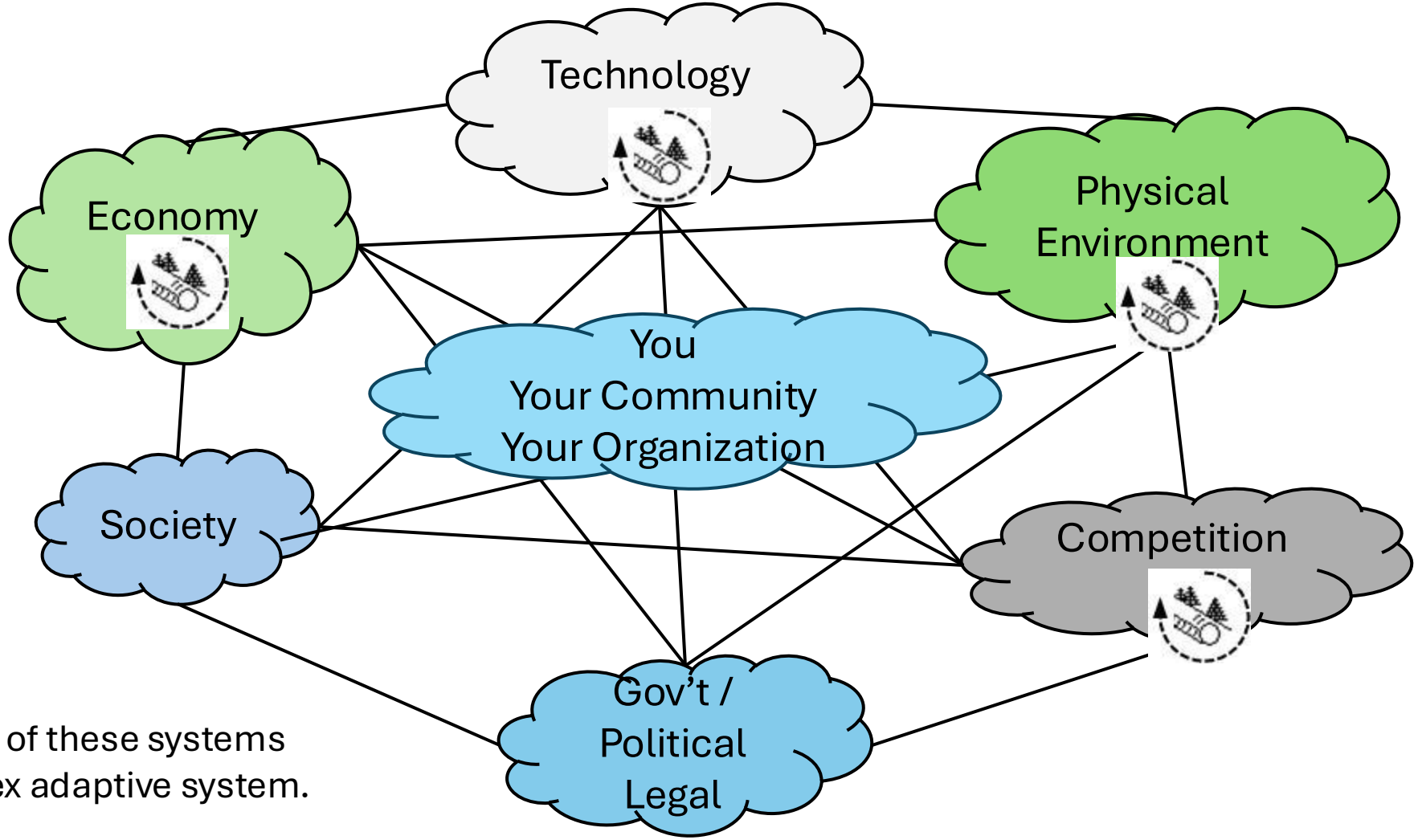
Environment

External Environment

- The external environment consists of the broader social / demographic, political, economic, technological, and competitive factors that the organization cannot control but must respond to.
- The external environment provides inputs (material, energy, and messages) to the organization and receives (material, energy, and messages) from it.
- Organizations continuously scan its environment to understand threats, opportunities, and risks to make informed decisions to mitigate and / or adapt to changes to survive.

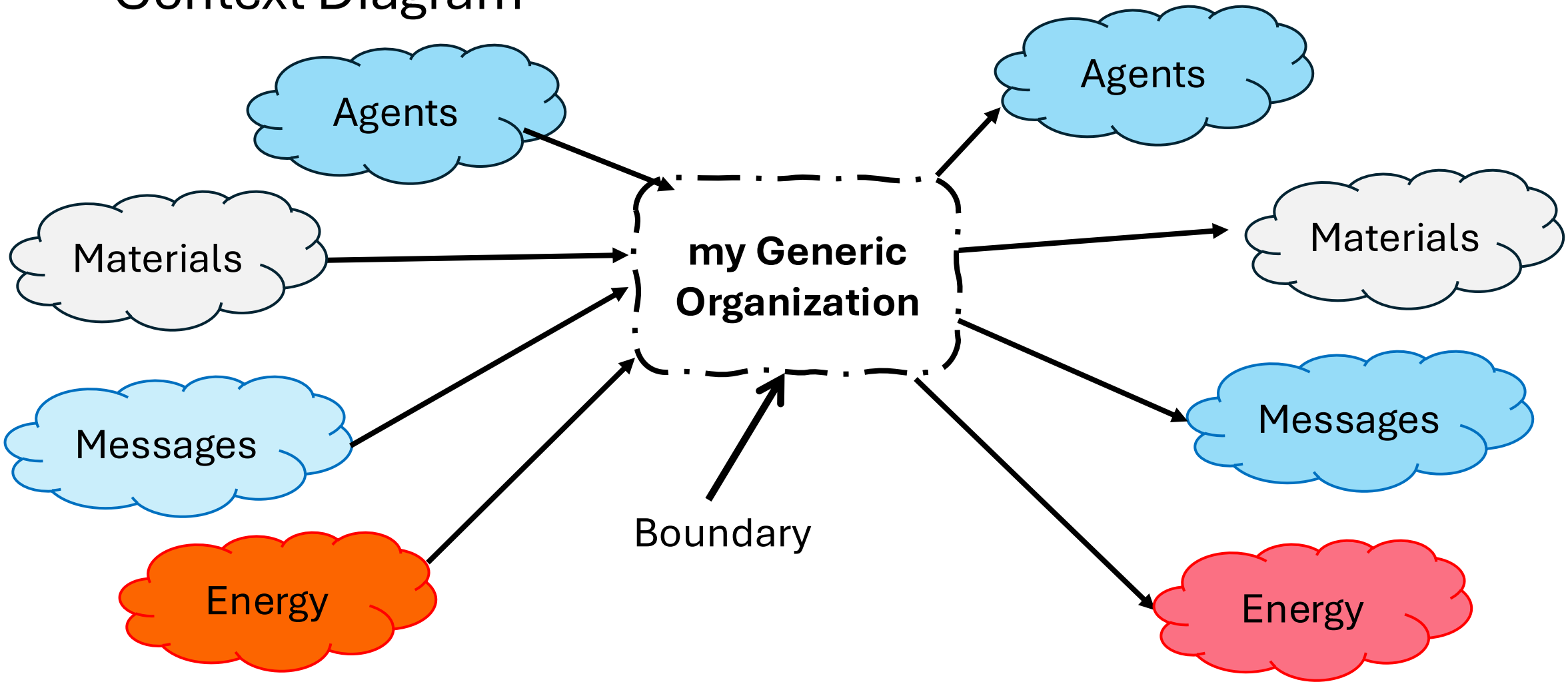
The Environment (for Social Organizations)

A complex network

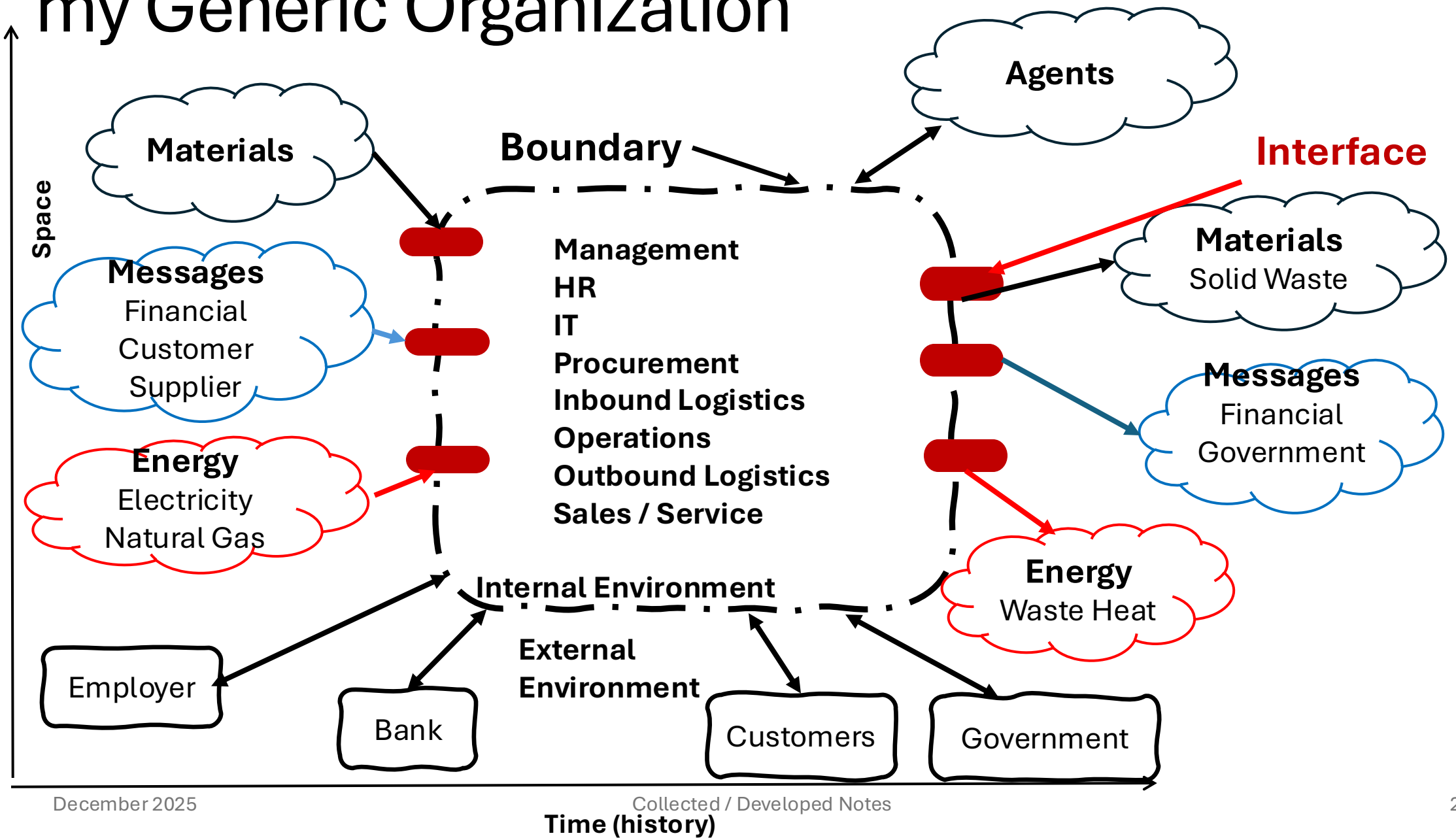


Note: Each of these systems is a complex adaptive system.

my Generic Organization
Context Diagram



my Generic Organization



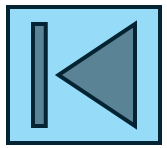
Boundaries

Boundaries

- Organizational boundaries are permeable for input / output functions (e.g., organizations are open systems).
- Boundaries may be breached at times or tip. Examples:
  - An organization may become overextended financially and tip into bankruptcy.
  - An organization can merge with another organization and become something else.
- A physical location is one type of boundary, but boundaries can also be social (hierarchy), cultural (shared values), psychological (employee preferences), demographic (age, religion, ideology, sex,…), economic (financial), ….

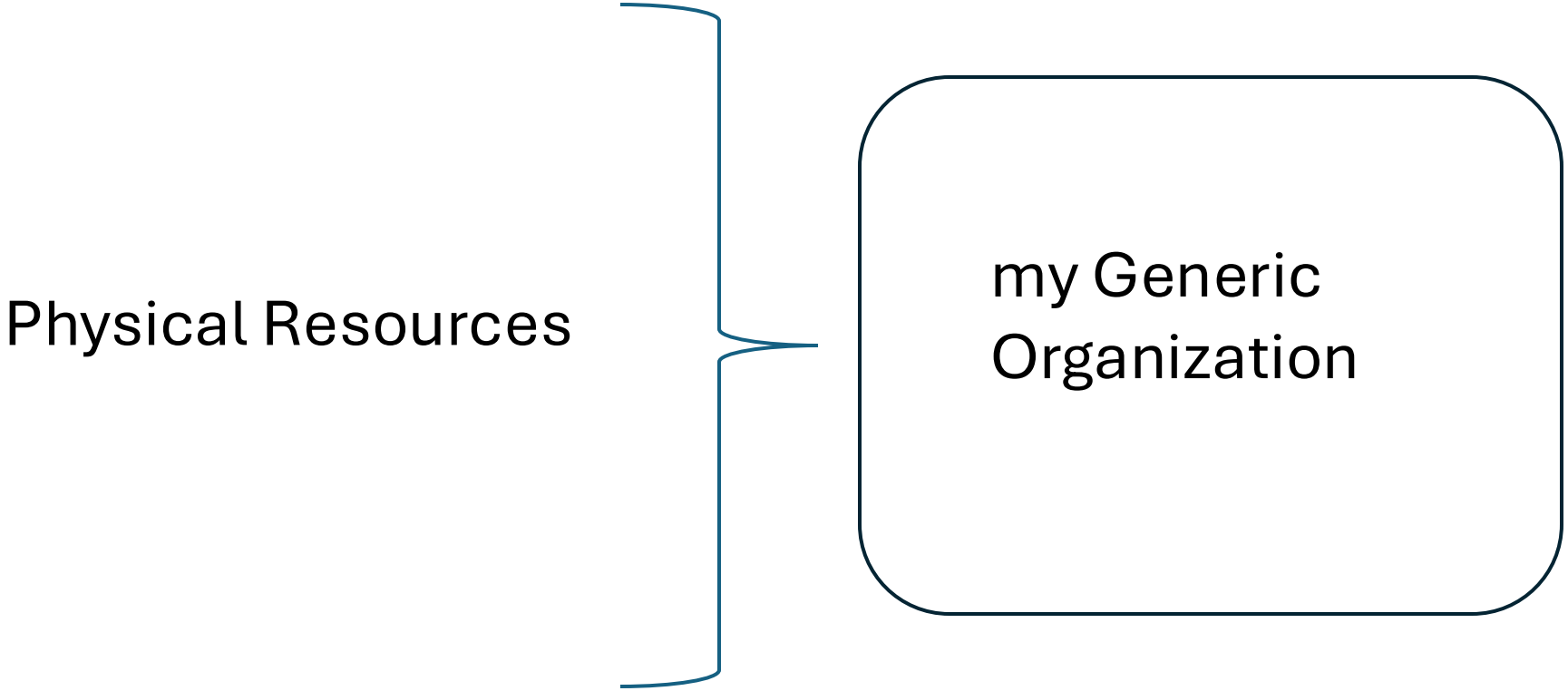
Types of Boundaries

- Environmental
- Economic
- Technological
- Competitive
- Governmental /Legal / Military
- Social / Demographic



Inputs

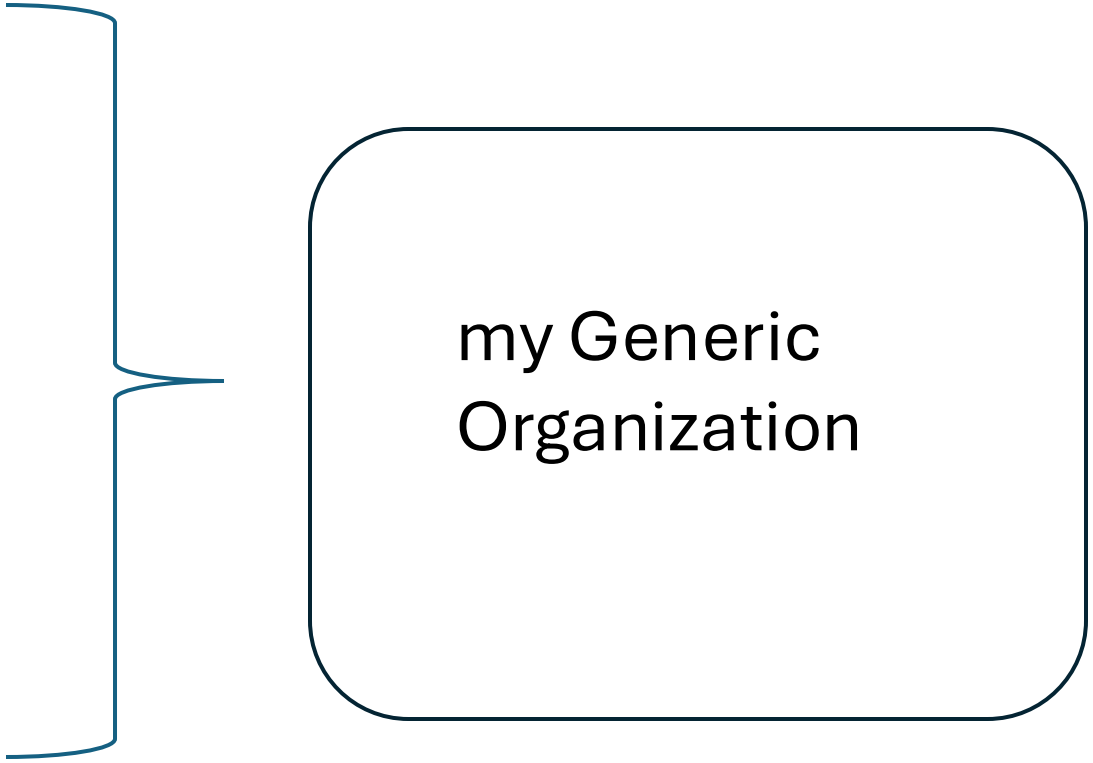
Input Materials



Add properties such as frequency, volume, cost, regulations, policies,

Input Energy

- Electricity
- Natural Gas
- Sunlight



Add properties such as frequency, volume, cost, regulations, policies,

Input Messages

- Commercial
- Customers
- Financial
- Government
- Insurance
- Suppliers

Add properties such as frequence, volume, cost, regulations, policies,

Input Agents

- Consultants
- Customers
- Employees
- Government agents
- Suppliers

Add properties such as frequence, volume, cost, regulations, policies,

Throughputs

Porter's Value Chain

Inside my Generic Organization

Macro-processes leading to an organizations value.

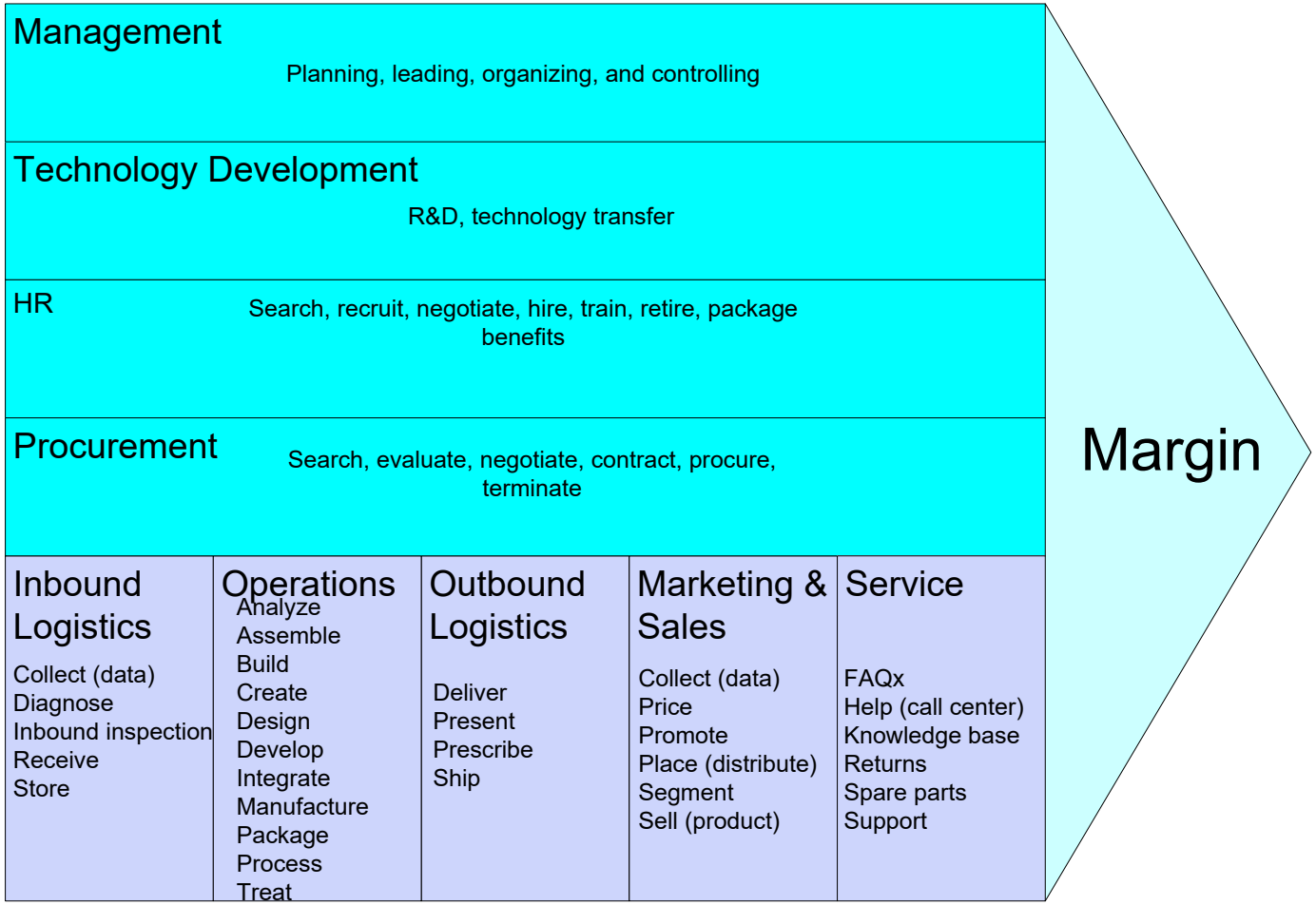
Each of these macro-processes can be deconstructed into several subprocesses.

Example: Management can be deconstructed into subprocesses planning, leading, organizing, and controlling.

Other or even different subprocesses could be included.

Each of these subprocesses / activities could be described via algorithms

Generic Value Chain



Throughputs

- Throughput includes the internal subsystems / processes that convert inputs to outputs; that is, the tasks or activities performed by the organization.
- Subsystems are processes and contain the algorithms or recipes that take inputs (material, energy, messages) and turn them into outputs or new (material, energy, messages).

Throughput

- Systems **input-throughput-output** material, energy, and messages
- Capacity is the maximum sustainable flow rate. In periods of heavy congestion, throughput is equal to capacity.
- Sometimes referred to as the flow rate
- For example:
  - A company may process or manufacture 100 units per month.
  - A university may graduate 250 PhDs per year
  - A software company may sell 50 apps per month
  - A router may process 1 million packets per second

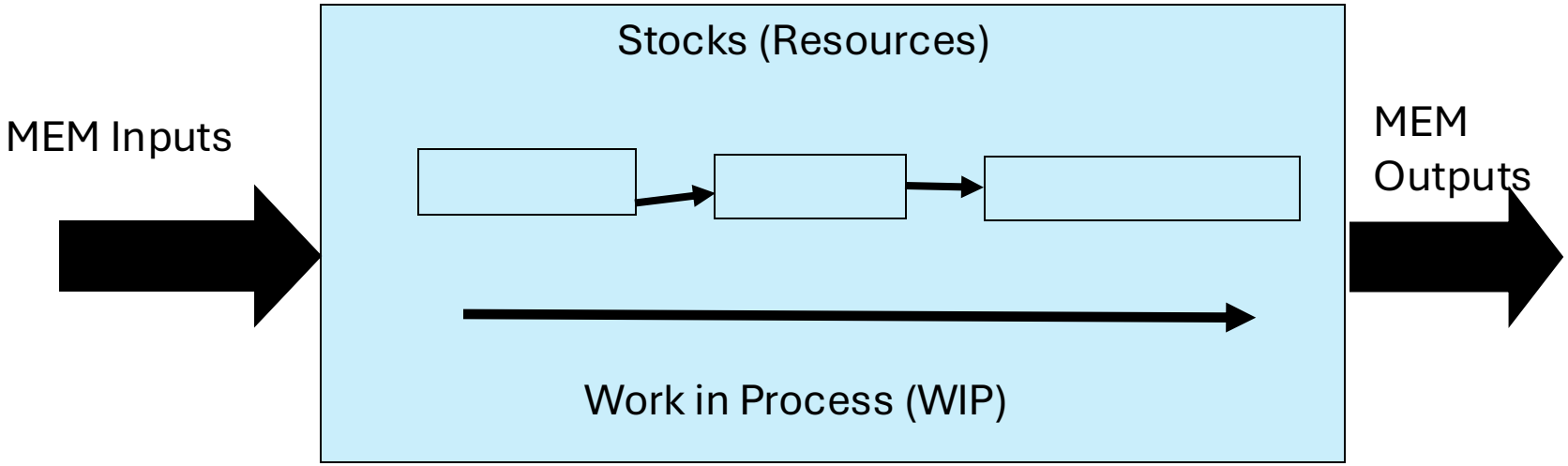
Throughput

Cycle Time

- Cycle Time is defined in terms of Capacity.
- Examples:
  - Cycle time = 1/Capacity
  - If Capacity = 10 units /hour, then Cycle Time = 1/10 hour or 6 minutes.
- Throughput is typically less than Capacity given a maximum rate is not sustainable.

Throughput

Any Production System (Processing MEM)



Input = Output [– defects] (1st Law of Factory Physics)

Idle time - % of time a resource is not working

Throughput – the average number of processed MEM units per unit of time

Lead time –time needed to process a component of MEM

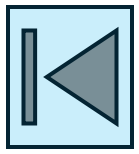
Throughput

Little's Law

Little's Law:
WIP = (Throughput) x (Lead Time)

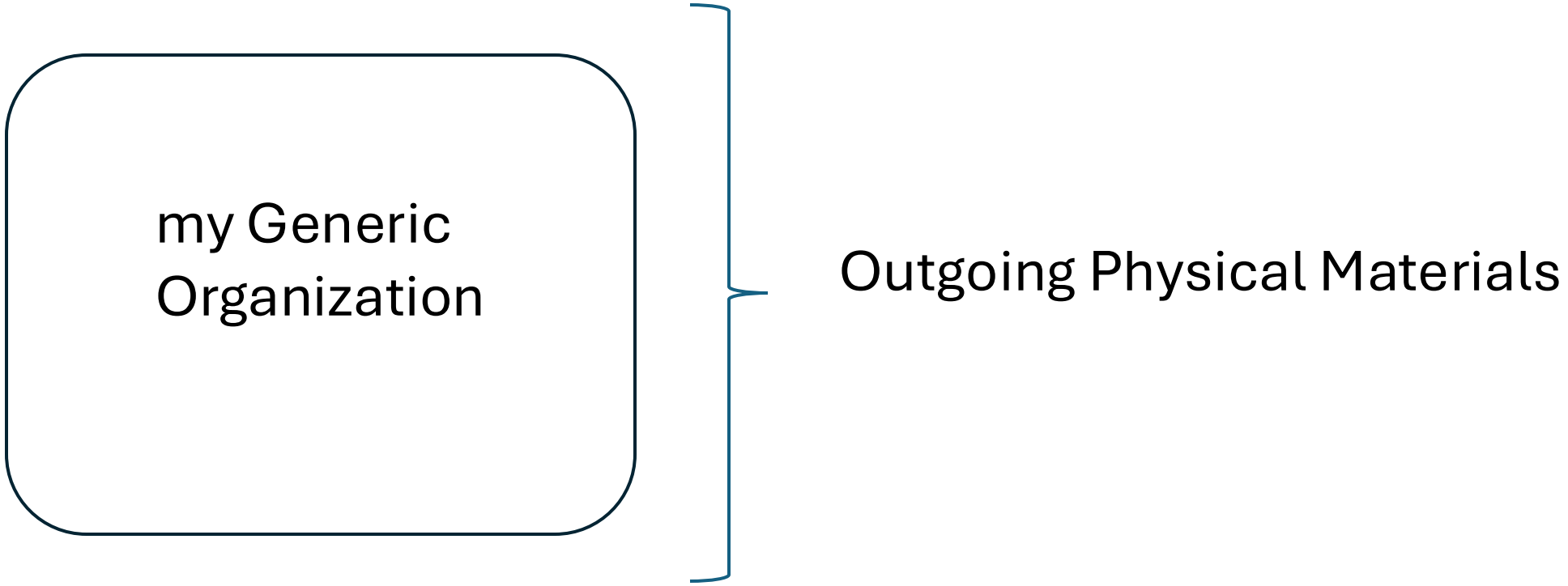
- Little's Law is a fundamental law of system dynamics
- Gives good results for a variety of scenarios
- *Throughput* (Units/time).

Example: A facility can produce 250 units / month, and the average lead time is 3 months. According to Little's law the average WIP = 250 x 3 = 750 units.



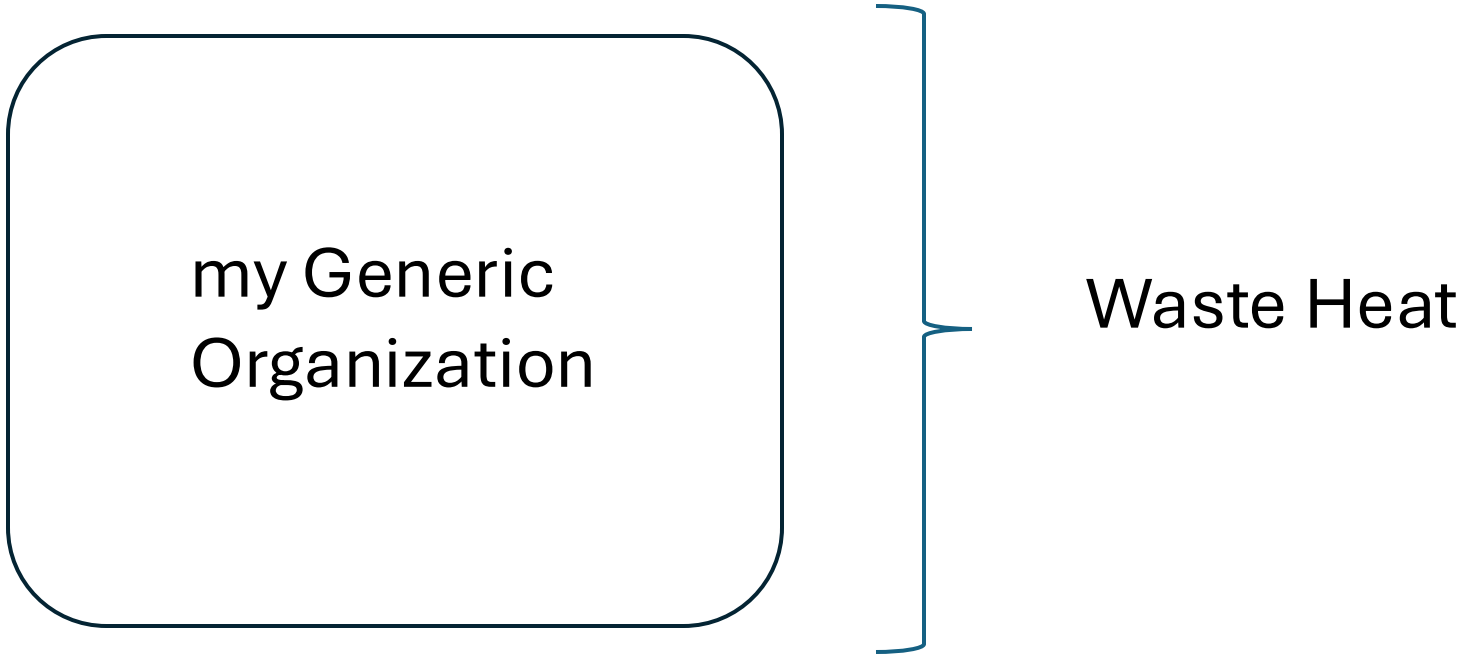
Outputs

Output Materials



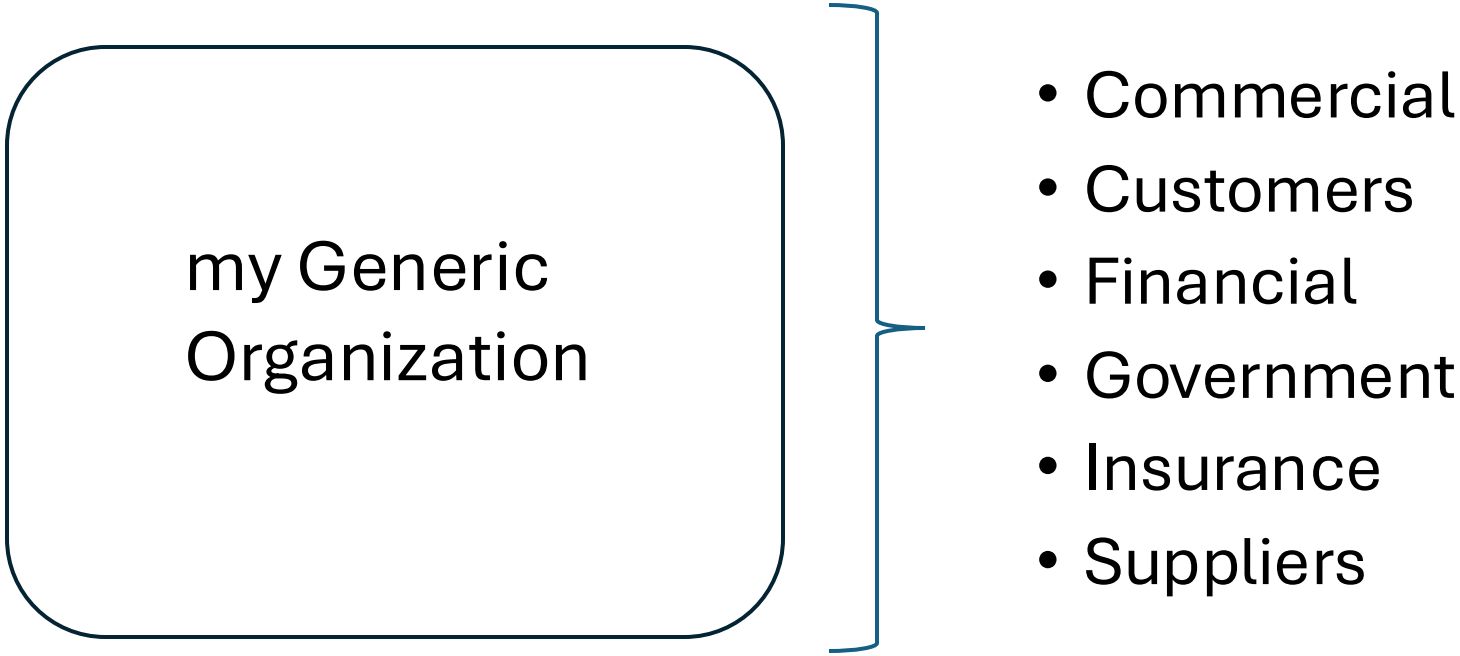
Add properties such as frequency, volume, cost, regulations, policies,

Output Energy



Add properties such as frequency, volume, cost, regulations, policies,

Output Messages

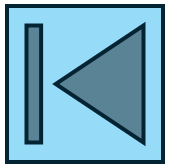


Add properties such as frequency, volume, cost, regulations, policies,

Output Agents

my Generic Organization

- Consultants
- Customers
- Employees
- Government Agents
- Suppliers



Add properties such as frequency, volume, cost, regulations, policies,

Algorithms

Algorithms

Definitions

- Algorithms in simple terms are recipes.
  - Algorithms are as Berlinski (2000) noted, “a finite procedure, written in a fixed symbolic vocabulary, governed by precise instructions, moving in discrete steps 1,2,3, ..., whose execution requires no insight, cleverness, intuition, or perspicuity, and that sooner or later comes to an end.”
- Algorithms are a set of instructions to process input **data** to solve a problem or complete a task.

Algorithms

Relaxed Definition

- Generalizing by relaxing the conditions that algorithms are just about **data** and precision and more like a recipe for processing **material** or **energy** gives:
  - **An algorithm is a set of steps to process input MEM to output MEM or in simple terms, to do something**.
- Data and information are messages.

That is, an algorithm is a set of steps, $A = \{s_1, s_2, \ldots s_n\}$ that transform input MEM to output MEM.

Algorithms

- Each of the nine subsystems making up the generic organization contain at least one algorithm defining the action(s) of the subsystem.
- These nine subsystems are only one instance of the structure of a social system.
- Other, more, or fewer subsystems may exist and at different time.
- These algorithms may or may not exist in software, but some are and likely more could be.

Algorithms

- Management
  - Planning, Leading, Organizing, Controlling, Finance among others
- Human Resources
  - Recruiting, Promotions, Retirements, Firing, Education among others
- Procurement
  - Buying, Returning among others
- Information Technology
  - Software Development, Security, Software Acquisition, Implementation among others.

Algorithms

- Inbound Logistics
  - Storage, Retrieval among others
- Operations
  - Product / Service Development among others
- Outbound Logistics
  - Storage, Retrieval among others
- Marketing and Sales
  - Planning, Sales among others
- Service and Support
  - Delivery, Installation, Repairs, Returns among others

Algorithms

- Productivity is a function of the capability of people to work, the maturity or intelligence of the algorithms / processes, and the capability of the technology employed.
  - Capability of people includes native talent; education / training; ability to work in teams; reading, writing, and communication skills; and content expertise among other.
  - Maturity of algorithms is about how efficient they are designed to complete tasks.
  - Technology employed is about the capability of the technology to a task.
- The success of an organization is directly related to the leadership and management of the inputs-throughputs-outputs.

Source: SEICMMI

Algorithms

Processes can be described in one or more algorithms.

An example from a wine bar:

Customer Service

1. Begin
2. Take Wine Bar customer's order
3. Search for bottle of wine in cabinet (stored FIFO)
4. Pour a glass of wine
5. Serve to customer
6. Receive payment from customer
7. Is wine bottle empty?
8. If yes, toss into trash
9. If no, return wine bottle to wine cabinet
10. Customer requests another glass of wine?
11. Yes, go to step 3
12. No. Close

Algorithms

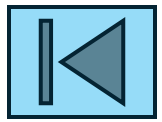
Example: Maintenance (Negative Feedback)

- Maintain cash reserves
- Maintain employee count
- Repair or replace failing components or subsystems
- Replenish stock
- ……..

Algorithms

Example: Growth (Positive Feedback)

- Bank accounts with compound interest
- Expansion of existing organization
- Franchising
- Opening new wine bars
- See the Alchemy of Growth
  - Sell more to existing customers
  - Enter new markets
  - Develop new products
  - Develop new delivery approaches
  - Expand geographically

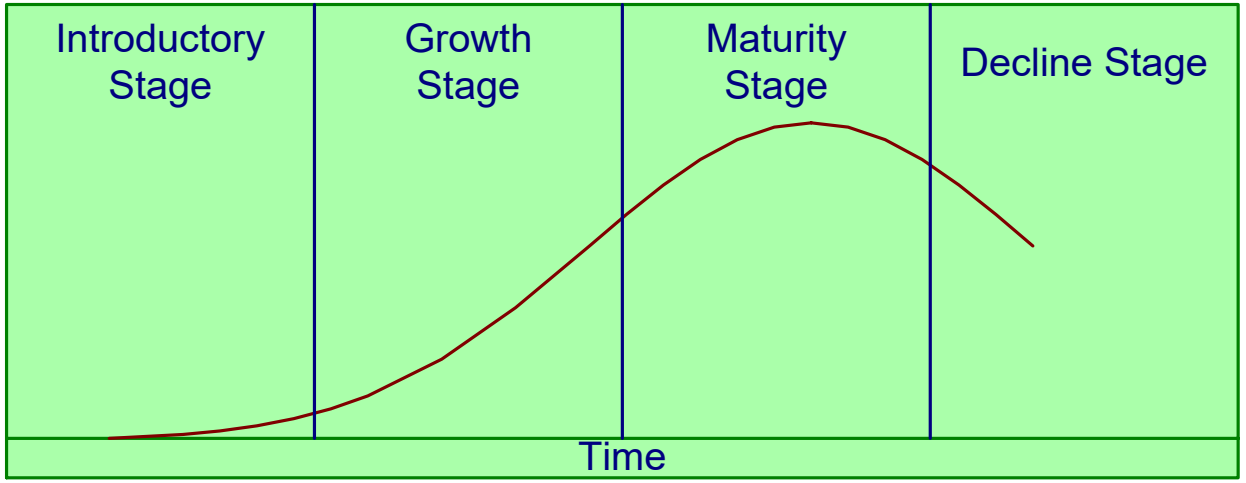


Organizational Dynamics

This section includes some typical dynamical patterns in organizations.

Life Cycle Change

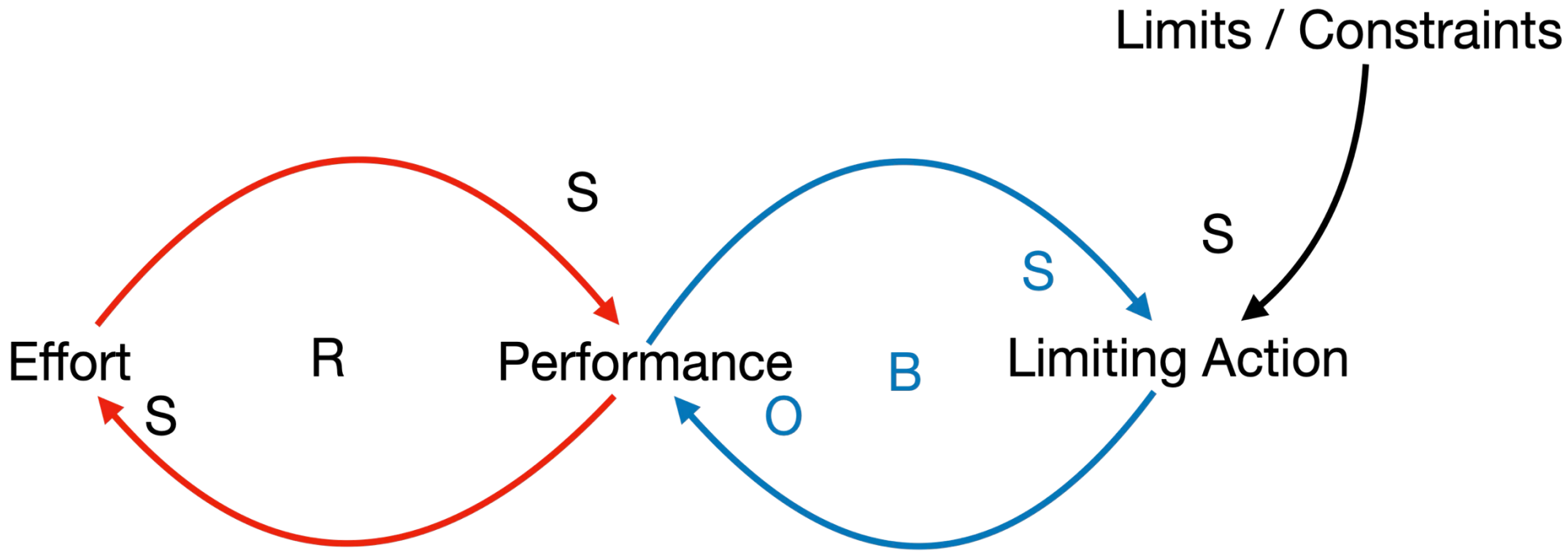
Life cycle change is focused on stages of growth, organizational maturity, and organizational decline.



Source: Adrianna Kezar, “Understanding and Facilitating Organizational Change in the 21st Century”

Limits to Success Archetype

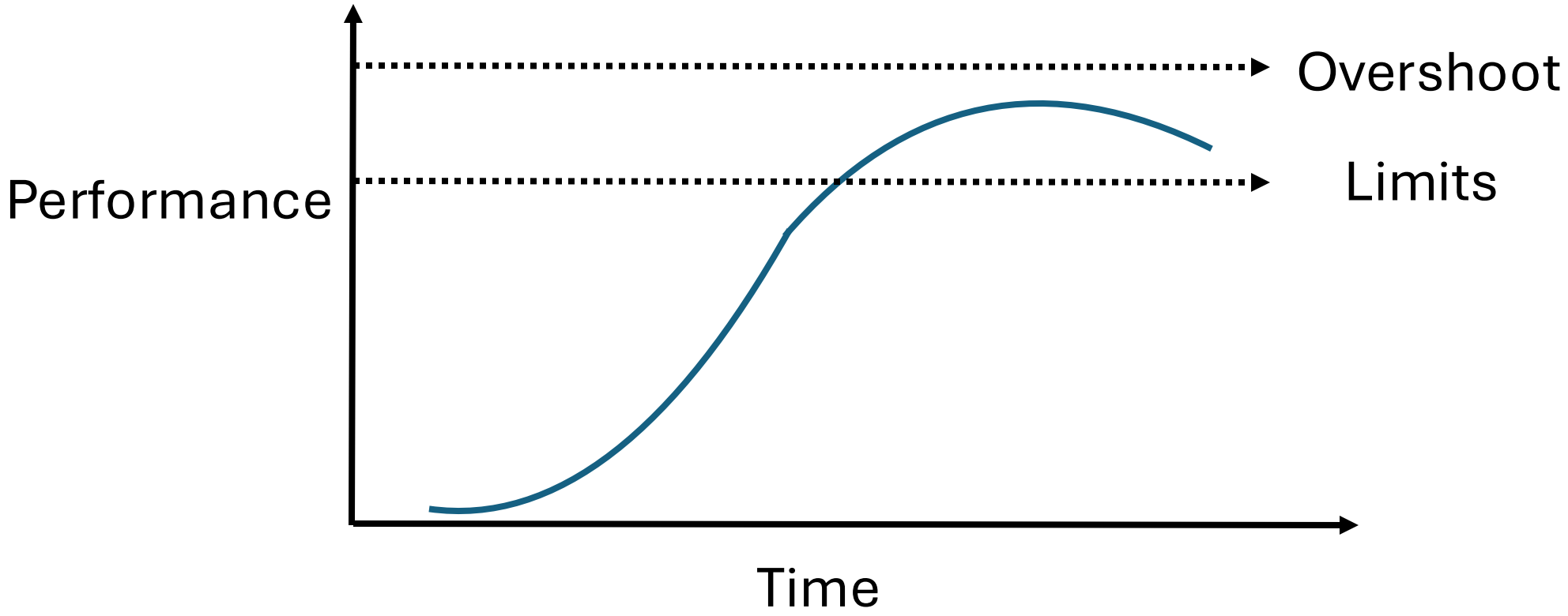
Structure



Adapted from: Senge, P. (2006). *The fifth discipline*. Doubleday.
All causal loop diagrams created in Apple Keynote.

Limits to Success

Behavior Over Time



Adapted from: Braun, W. (2002). *The systems archetypes*.
https://www.albany.edu/faculty/gpr/PAD724/724WebArticles/sys_archetypes.pdf

Limits to Success

Applications

- Performance
  - Cities
  - Companies
  - Countries
  - Education Level Attainment
  - Financial Success
  - Sales / Marketing
  - Sports

Limits to Success

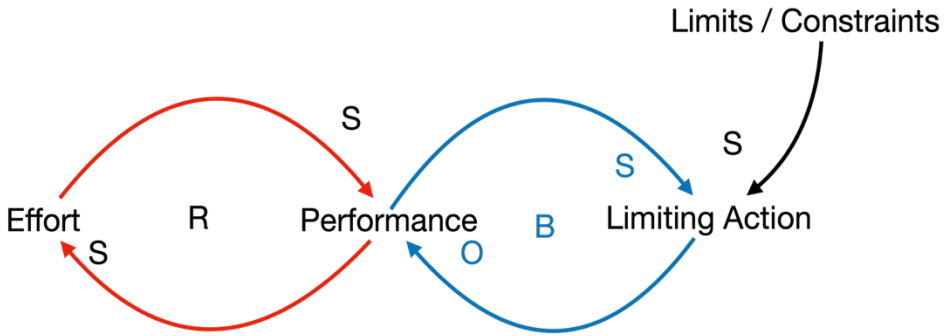
Examples

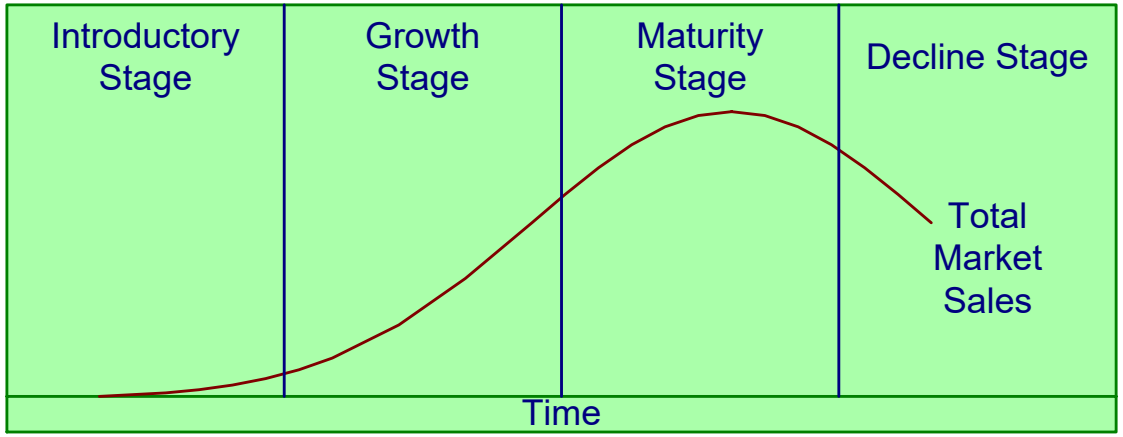
- The Product Life Cycle curve in marketing / sales
- Limits to the improvement of anything
  - Athleticism
  - Education
  - Products
  - Services
  - Skills

Limits to Success

Product Life Cycle Model or Pattern

- The product life cycle model (plan, do, check, act) is a special case of the more general limits to growth pattern or archetype. See below for the behavior over time.
- This is the behavior pattern for **marginal returns**. Early returns are productive, then over time become diminishing returns, and then potentially negative returns.





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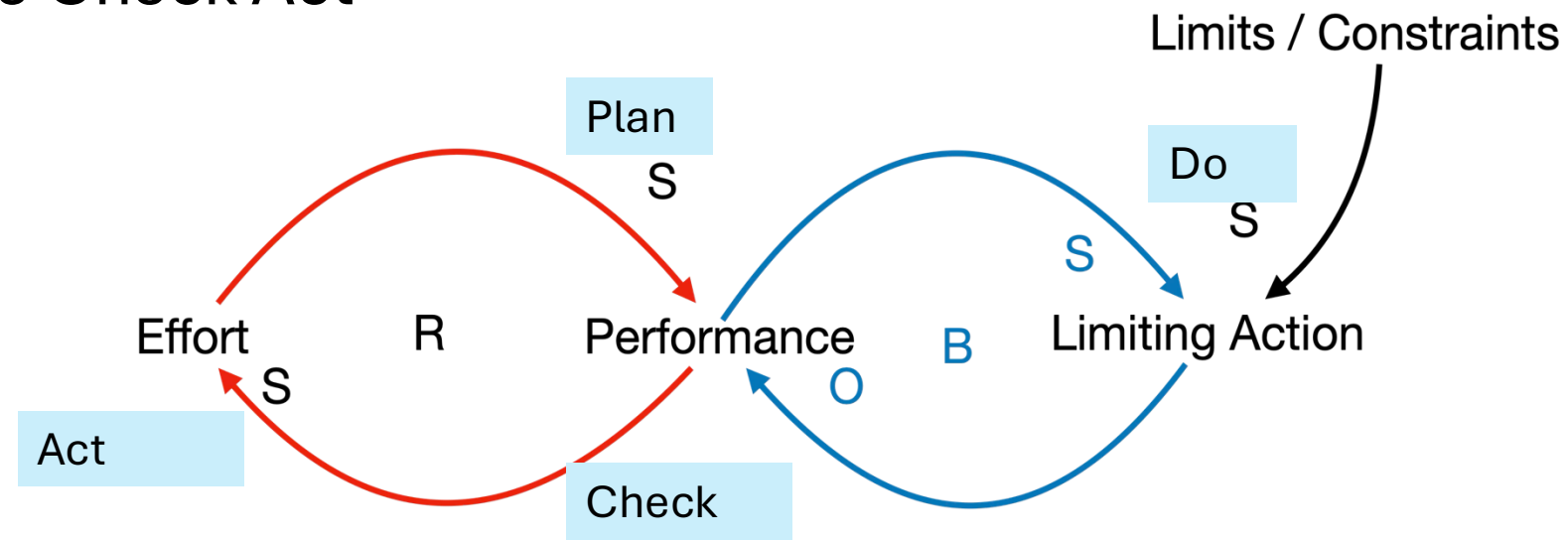
All causal loop diagrams created in Apple Keynote.

Limits to Success

Plan Do Check Act



There are limits to improvement such as the laws of physics, chemistry, biology, investment capital, time, mental models, and interest.

Improvements may start slow, speed up, slow to stop, oscillate about a line, or even decline as limits to improvements are reached

Adapted from: Senge, P. (2006). *The fifth discipline*. Doubleday.
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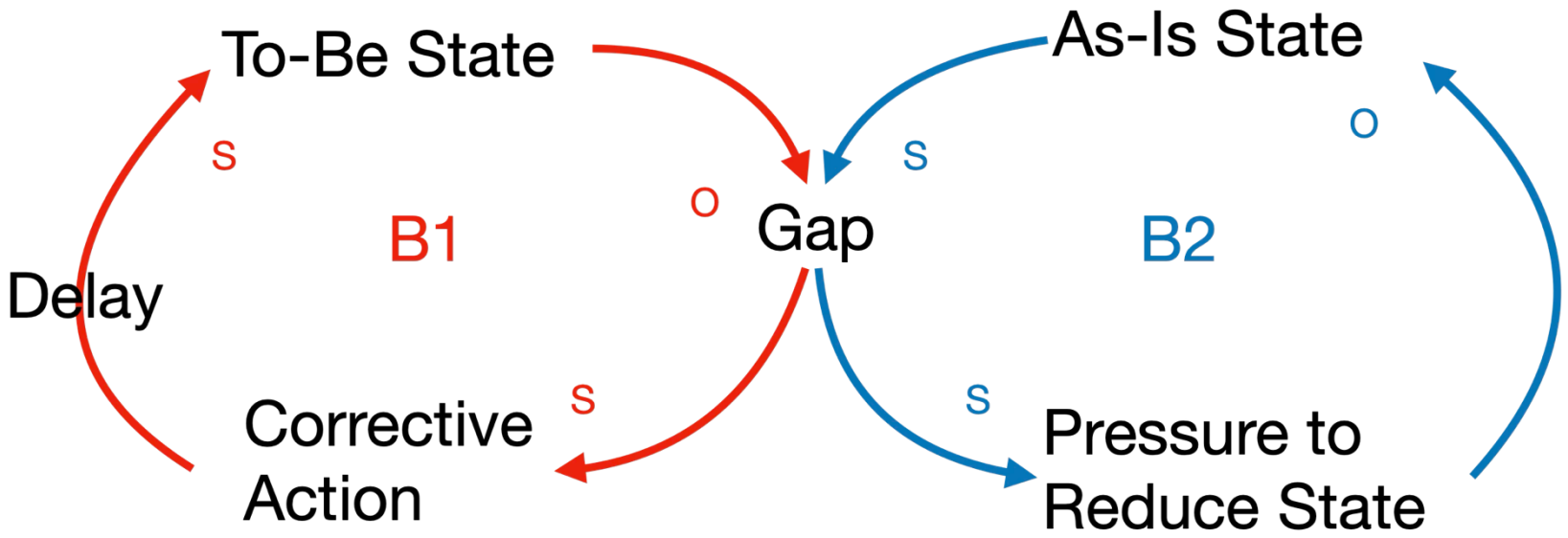
Drifting (Eroding) Goals Archetype

Structure



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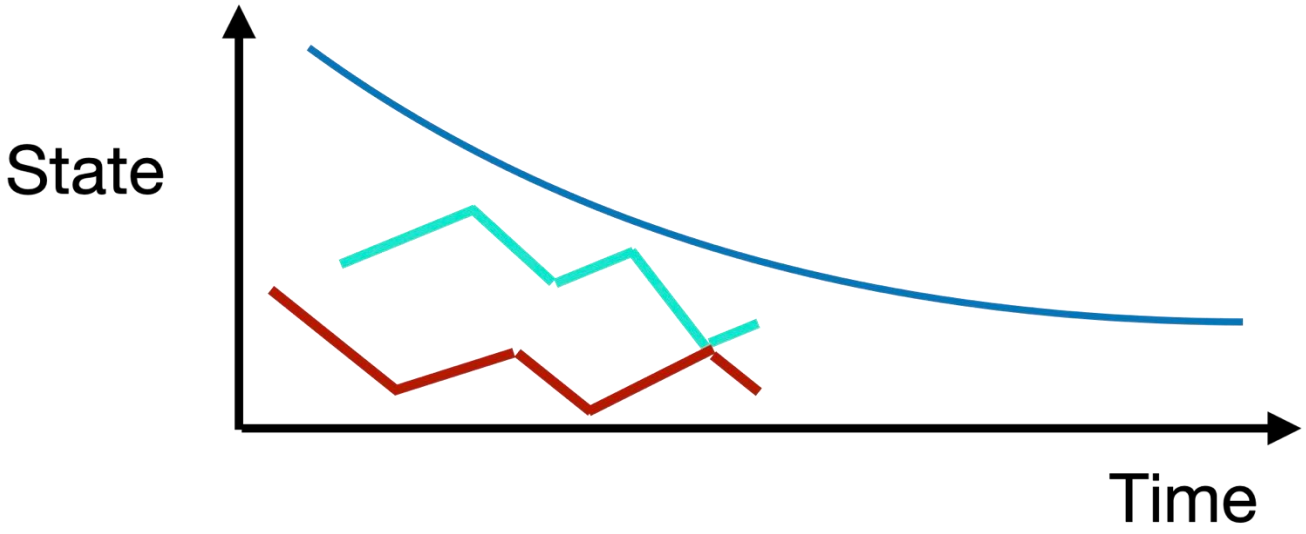
Drifting Goals

Behavior Over Time



To Be State

As Is State

Gap

Adapted from: Braun, W. (2002). *The systems archetypes*. https://www.albany.edu/faculty/gpr/PAD724/724WebArticles/sys_archetypes.pdf

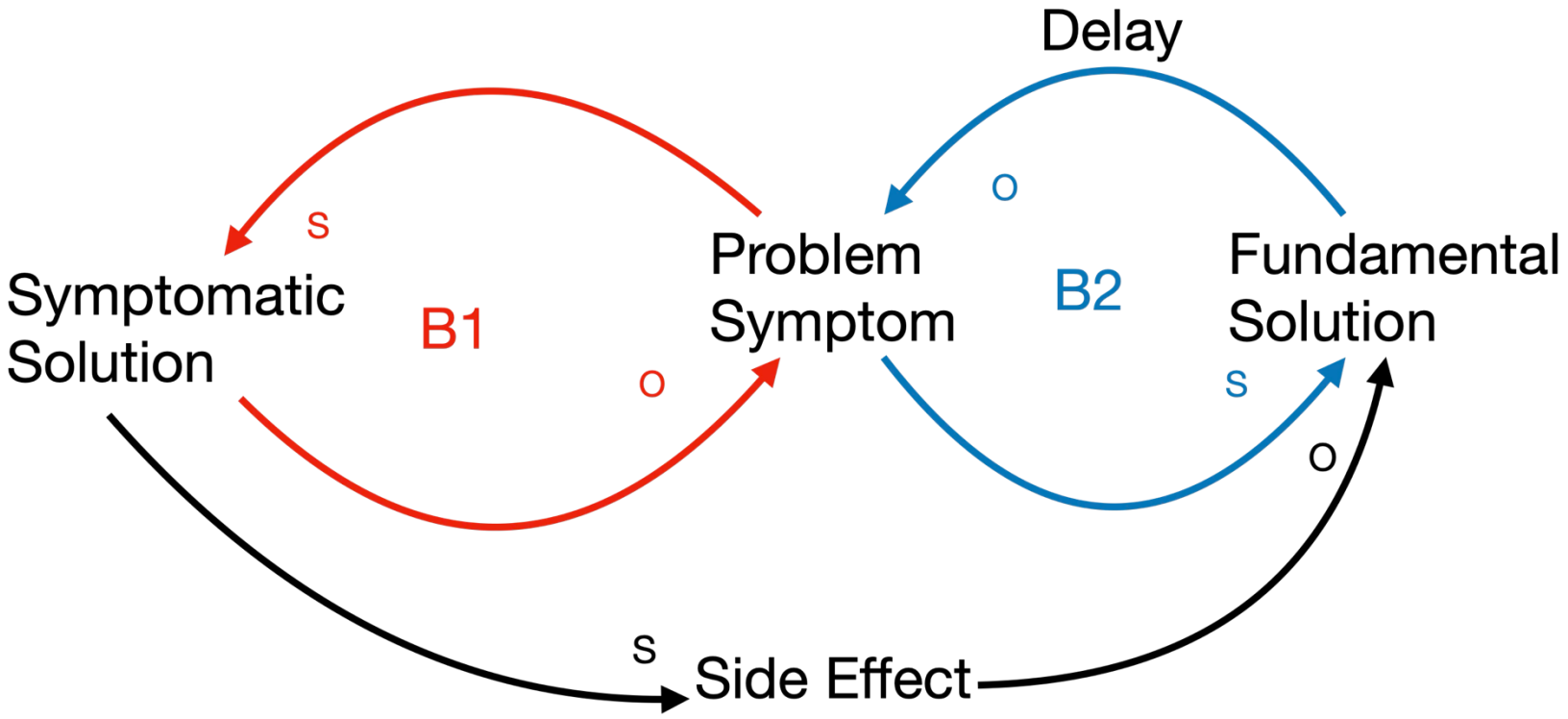
Drifting Goals

Applications / Examples

- Deficits
  - Increasing budget deficit limits
- Lowering expectations
  - Reducing personal expectations in life
  - Reducing expectations of others
- Lowering quality
  - Reducing the quality of ingredients in a product
  - Reducing the quality of a product or service
  - Reducing the quality of education

Shifting the Burden Archetype

Structure



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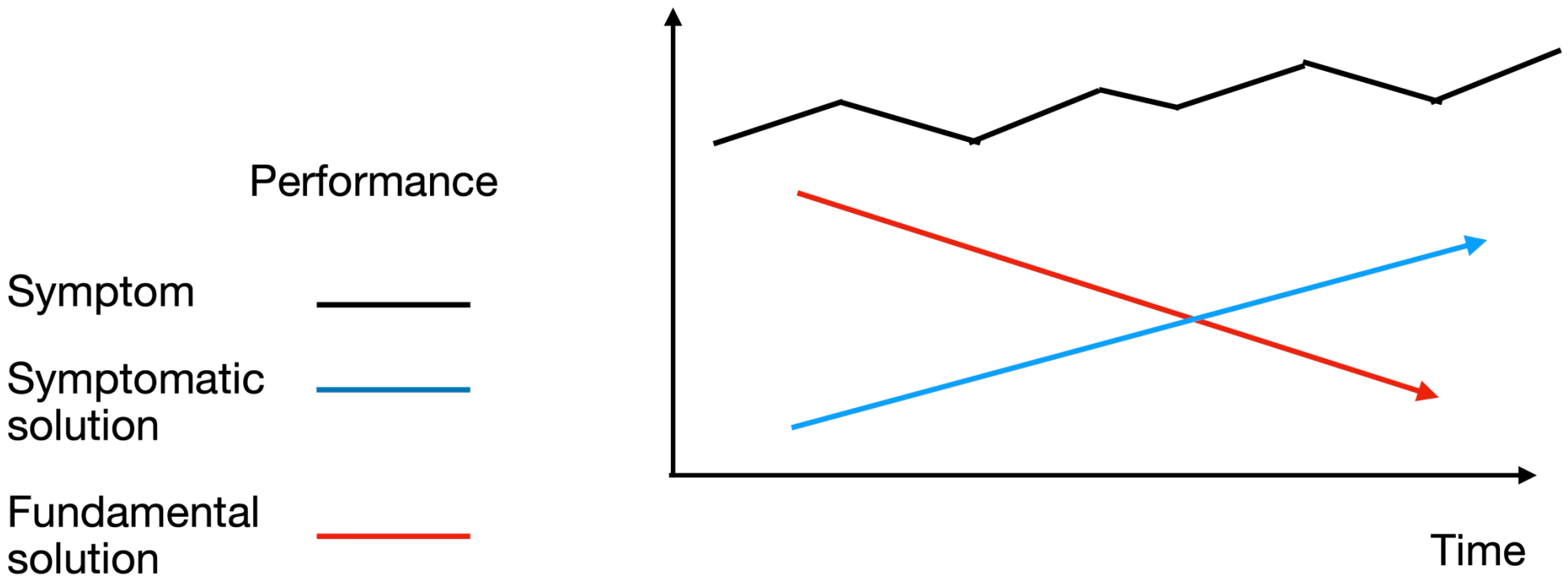
Shifting the Burden

Behavior Over Time



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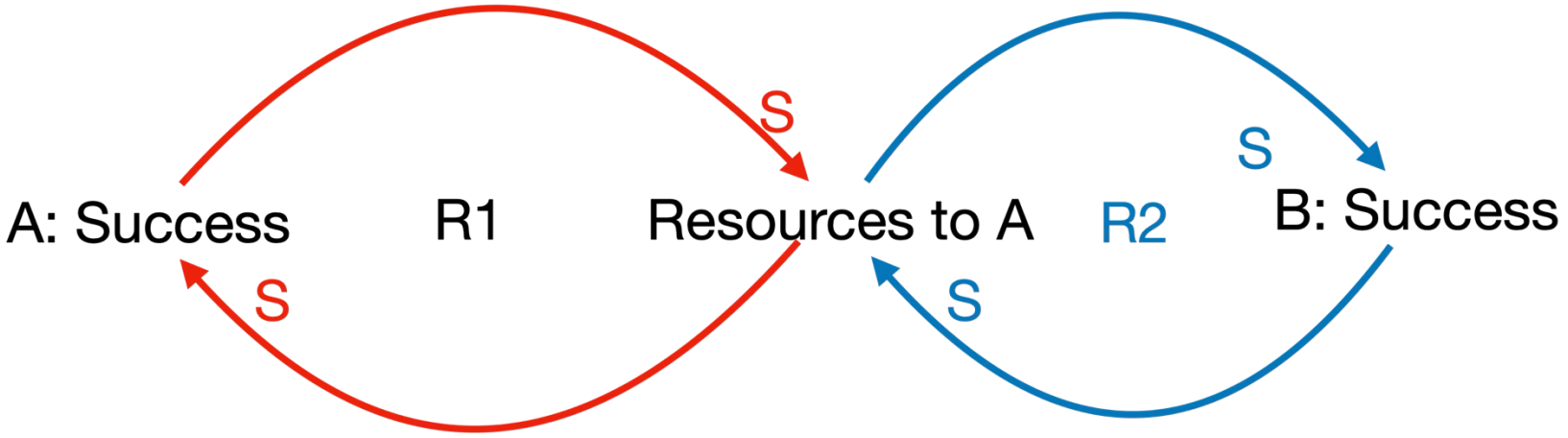
Shifting the Burden

Applications / Examples

- Outsourcing
  - Outsourcing competencies rather than building your own
- Retaining consultants
  - Instead of developing internal talent
- Borrowing money
  - To cover deficit spending
- Self medication
  - Instead of seeking medical professional advice

Success to the Successful Archetype

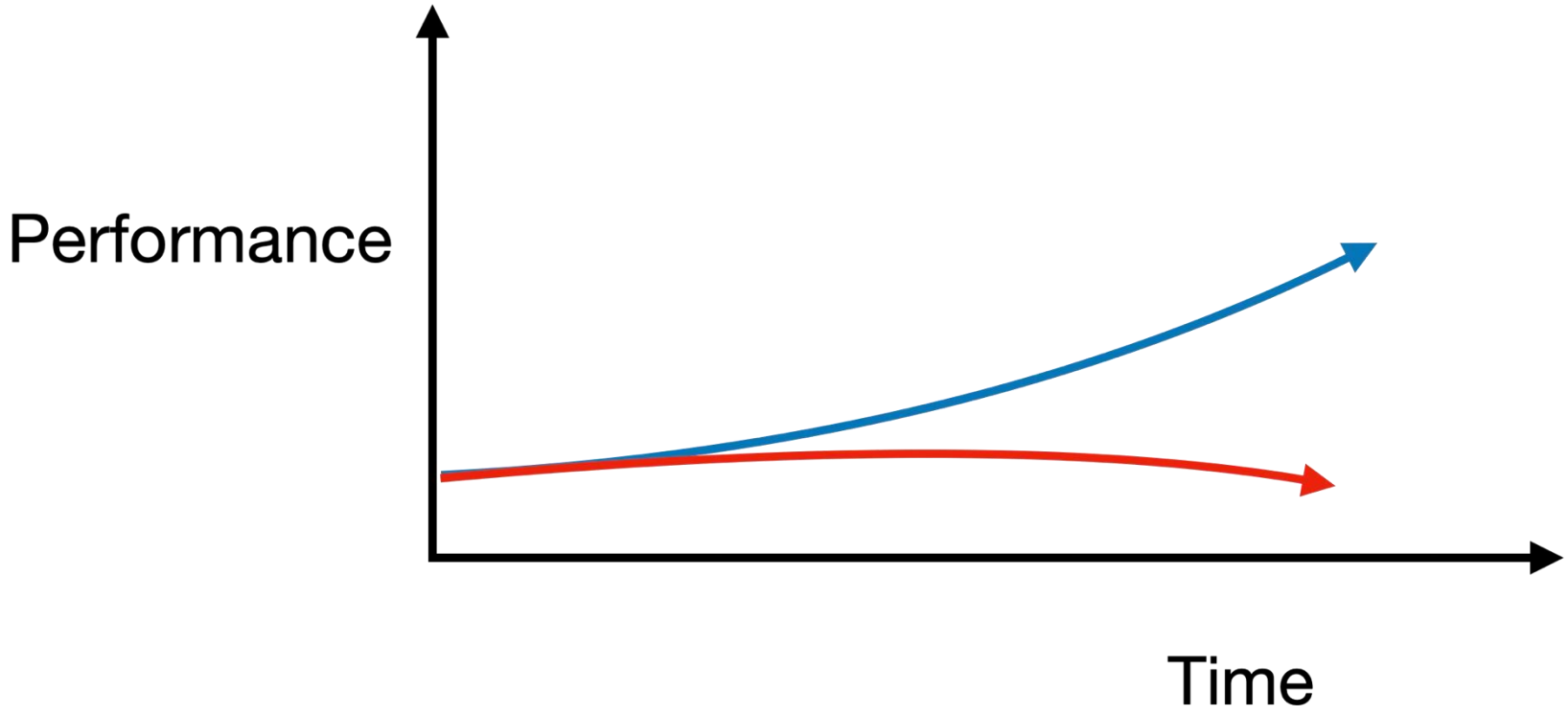
Structure



Adapted from: Senge, P. (2006). *The fifth discipline*. Doubleday.
All causal loop diagrams created in Apple Keynote.

Success to the Successful

Behavior Over Time



my Generic Organization Dynamics (Behavior)

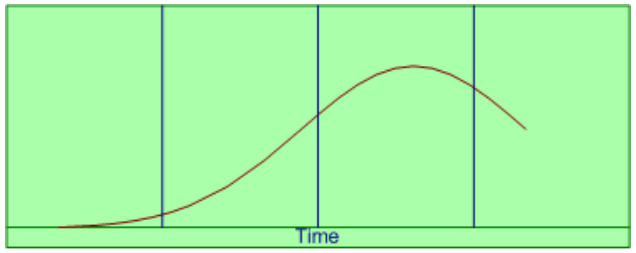
- Positive Feedback (Growth)
- Negative Feedback (Maintenance)
- Oscillating growth and collapse / shrinking
- Merge
- Spinoff
- Limits to Success (Sigmoid)
- Escalation (war, conflict)
- Eroding goals
- Evolution
- Tragedy of the Commons
- Growth and Underinvestment
- Success to the Successful
- Evolutionary Development

Evolution

- Social organizations such as a business, government, military, or nonprofit are NOT sustainable.
- Instead, because they are complex adaptive systems, they evolve over time.

Limits to Success (Sigmoid)

- Driven by demand and / or available resources
- Starts slow, growth rate improves, growth rate slows and may decline given a decline in demand and or available resources.
- Example: A new product is developed, customers buy it, customers recommend it to others who buy it, saturation occurs, and sales slow and potentially decline.
- See sigmoid curve shape below



Data Base

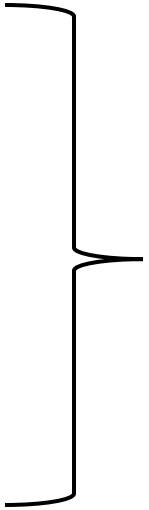
Flows and Stocks

Flows and stocks of material, energy, and messages (MEM) can be described in terms of their properties or attributes and stored in a database for subsequent processing.

my Generic Organization

Database Possibilities

- Input flows
- Throughput flows
- Stocks
- Output flows
- Models
- …



Can be described in tabular format and added to a database for processing

Material Flow

Flow from Supplier to my Generic Organization

Primary Key	Name	Supplier	Customer	Frequency	Size	Cost	When
	What	Who	Who	When			When

Material Flow

Flow from Customer to my Generic Organization

Primary Key	Name	Supplier	Customer	Frequency	Size	Cost	When
	What	Who	Who	When			When

Energy Flow

Flow from Supplier to my Generic Organization

Primary Key	Name	Supplier	Customer	Frequency	Size	Cost	Timing
	What	Who	Who	When			When

Message Flow

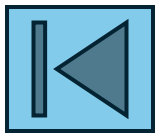
Message Flow from Supplier to my Generic Organization

Primary Key	Name	Supplier	Customer	Frequency	Size	Cost	Timing
	What	Who	Who	When			When

Message Flow

Message Flow from my Generic Organization to Supplier

Primary Key	Name	Supplier	Customer	Frequency	Size	Cost	Timing
	What	Who	Who	When			When



Improvements

Improvements Using Meadows Leverage Points
Tips From Gemini

- To improve the operations of a small organization, apply Meadows' leverage points, focusing on three key areas: **rules of the system**, **structure of the system**, and the **mindset or paradigm** that underpins it.
- By targeting these leverage points, more can be achieved with significant and lasting change than by simply tweaking minor operational details.

Meadow's Leverage Points

Places to Intervene in a System in Increasing Order of Effectiveness

- Item 1 is the most effective on up to item 12, which is the least effective.
- Example: Item 2, consider:
  - Shift from a Transactional to a Relational Mindset
  - Shift from a Scarcity to an Abundance Mindset
  - Embrace a Learning and Adaptable Paradigm
- Respond to each in turn and then see what makes the most sense to execute and in what order and time.

Meadow's Leverage Points

Places to Intervene in a System in Increasing Order of Effectiveness

12. Constants, parameters, numbers (such as subsidies, taxes, standards)

11. The sizes of buffers and other stabilizing stocks, relative to their flows.

10. The structure of material stocks and flows (such as transport networks, population age structures)

9. The lengths of delays, relative to the rate of system change

Meadow's Leverage Points

Places to Intervene in a System in Increasing Order of Effectiveness

8. The strength of negative feedback loops, relative to the impacts they are trying to correct against
7. The gain around driving positive feedback loops
6. The structure of information flows (who does and does not have access to what kinds of information)
5. The rules of the system (such as incentives, punishments, constraints)

Meadow’s Leverage Points

Places to Intervene in a System in Increasing Order of Effectiveness

4. The power to add, change, evolve, or self-organize system structure

3. The goals of the system

2. The mindset or paradigm out of which the system—its goals, structure, rules, delays, parameters—arises

1. The power to transcend paradigms

my Generic Organization

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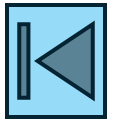

Thank you!