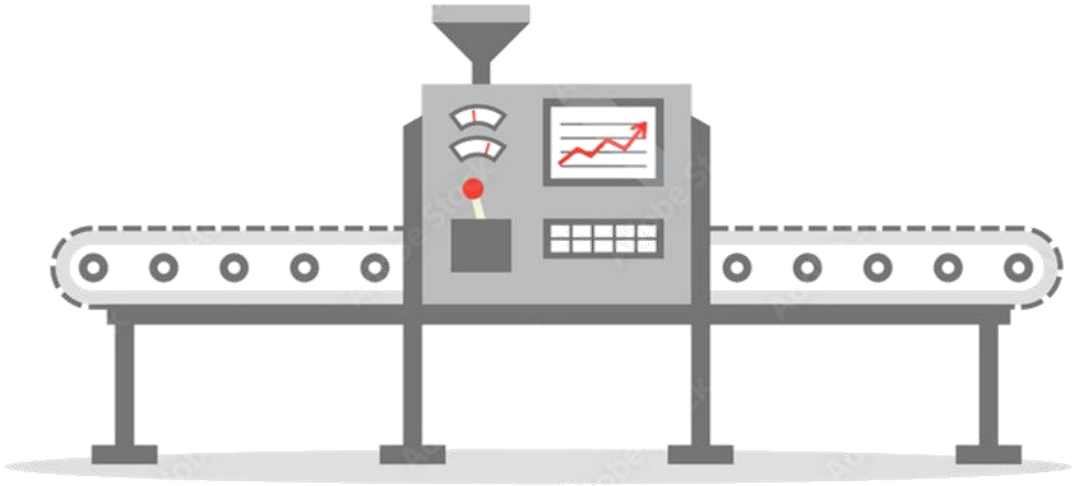
The Product in Development (PID) Control Theory:



How Product Development Processes Can be Modeled and Optimized as Engineering Control Systems

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Agenda

- Context for Topic
- System Goals and Everyday Examples
- Control system simplified model and two key elements
- 3 System Control Levers
- 3 System Responses
- 3 Key Takeaways
- Concluding comments
- Questions and Answers

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Context for Topic:

28 years and counting

14 years leading at the director level**

Academic Research	*Product Research*	*Product Development*	Manufacturing Floor
7 years	7 years	10 years	4 years

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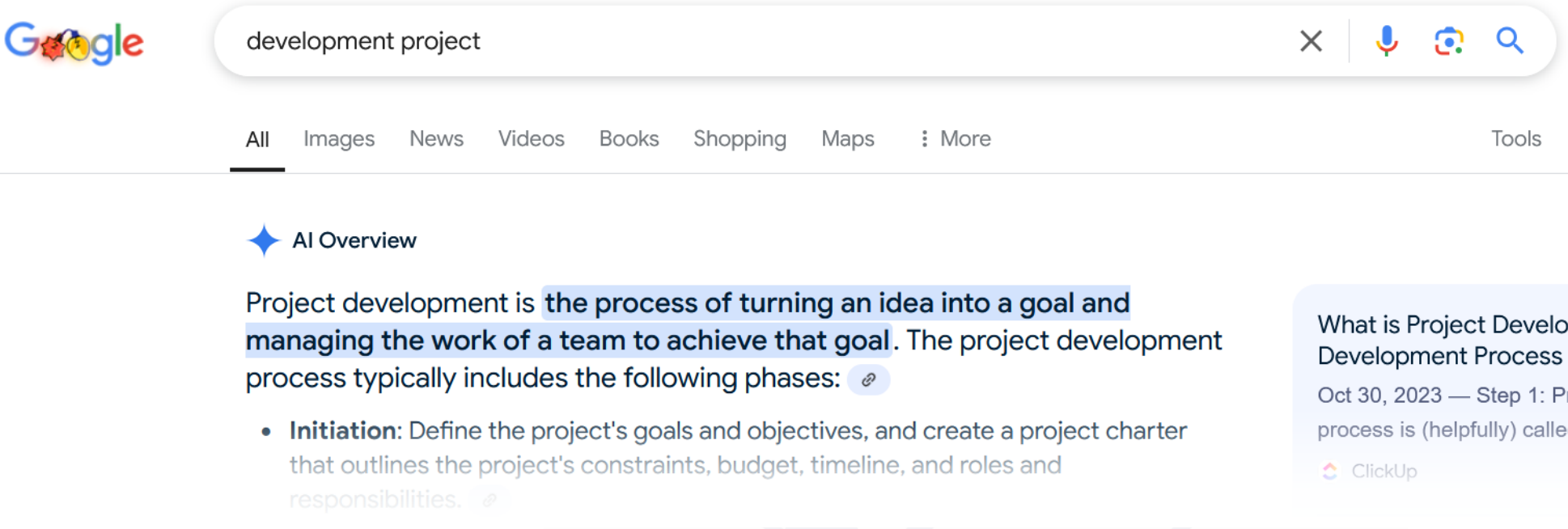
The Goal:


development project
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Project development is the process of turning an idea into a goal and managing the work of a team to achieve that goal. The project development process typically includes the following phases:
Initiation: Define the project's goals and objectives, and create a project charter that outlines the project's constraints, budget, timeline, and roles and responsibilities.
What is Project Development? Improve Your Development Process
Oct 30, 2023 — Step 1: Project initiation The first step in the process is (helpfully) called initiation. This is where you get…
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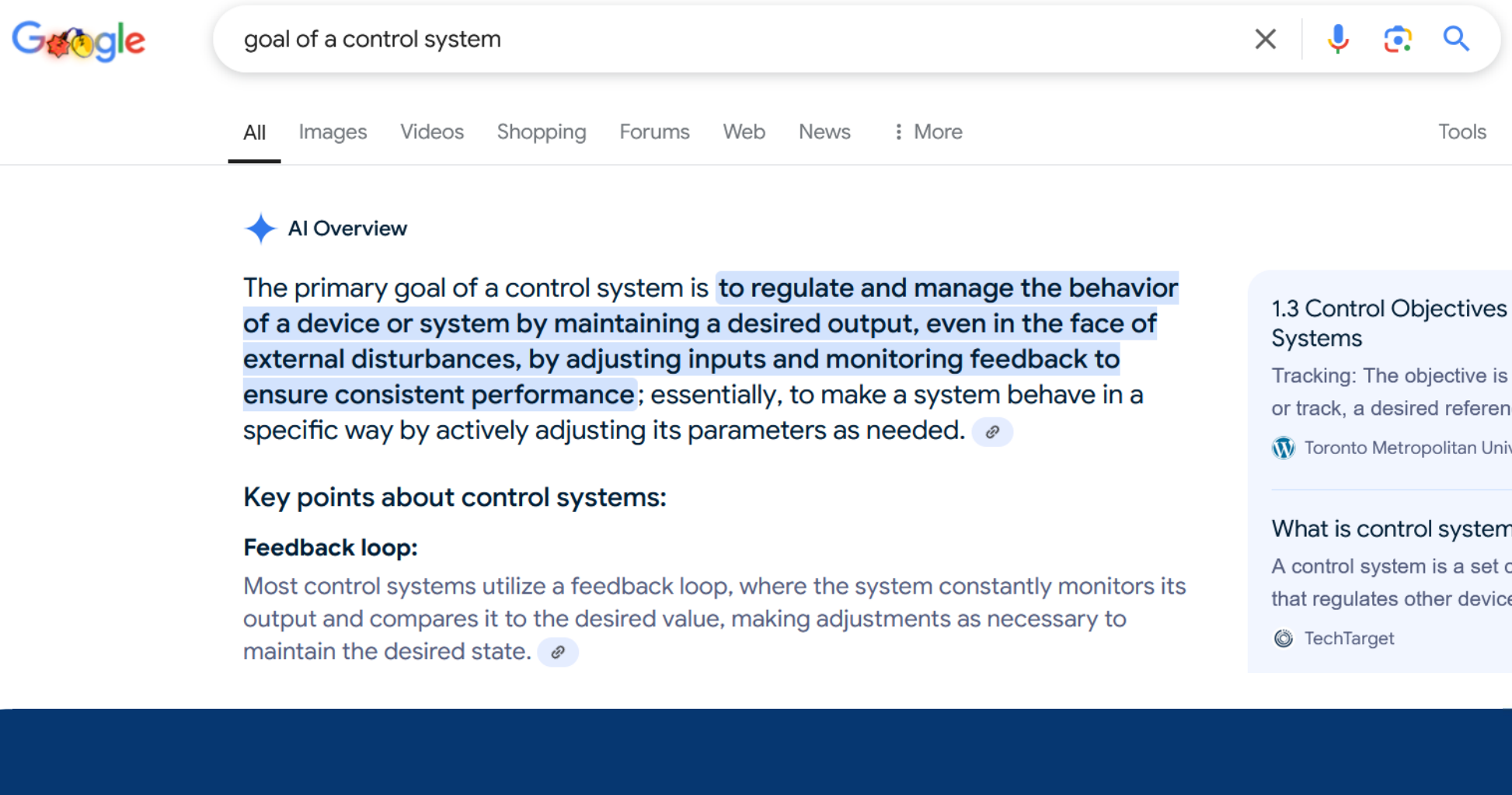
The Goal: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goal of a control system
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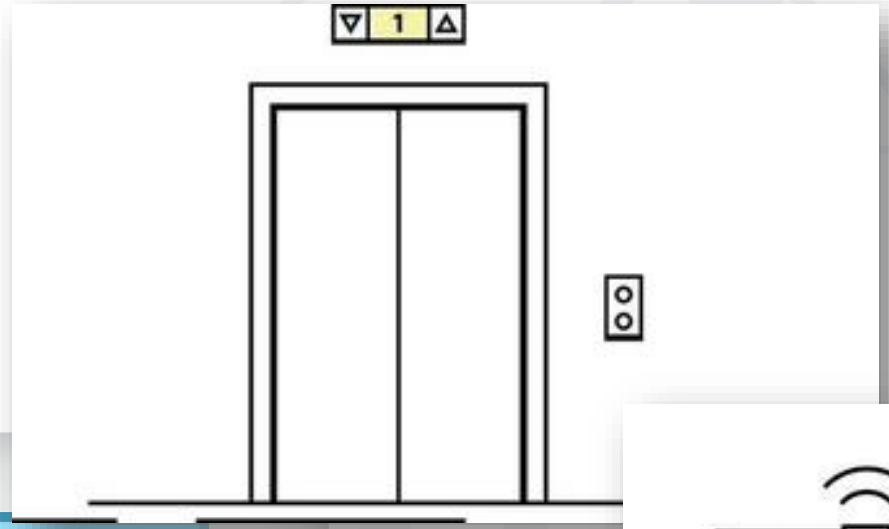
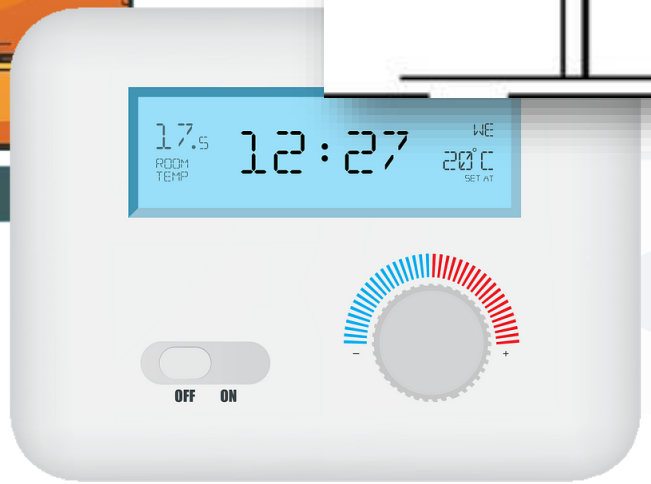
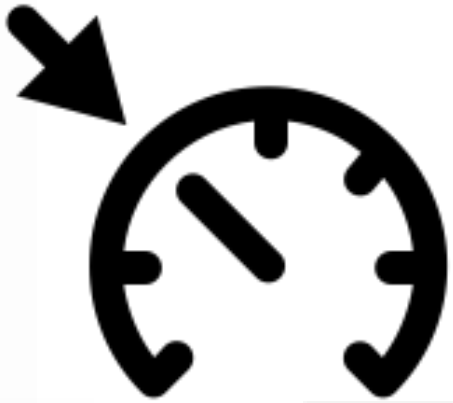
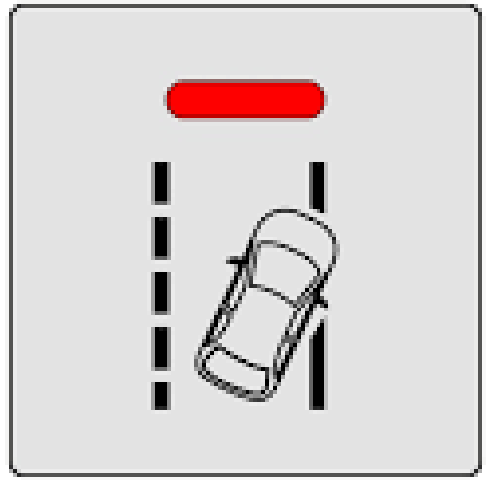
The primary goal of a control system is to regulate and manage the behavior of a device or system by maintaining a desired output, even in the face of external disturbances, by adjusting inputs and monitoring feedback to ensure consistent performance; essentially, to make a system behave in a specific way by actively adjusting its parameters as needed.
Key points about control systems:
Feedback loop:
Most control systems utilize a feedback loop, where the system constantly monitors its output and compares it to the desired value, making adjustments as necessary to maintain the desired state.
1.3 Control Objectives – Introduction to Control Systems
Tracking: The objective is to force the process output to follow, or track, a desired reference signal. We will concentrate on…
Toronto Metropolitan University Pressbooks
What is control system? | Definition from TechTarget
A control system is a set of mechanical or electronic devices that regulates other devices or systems by way of control loo…
TechTarget

Everyday Control System Examples









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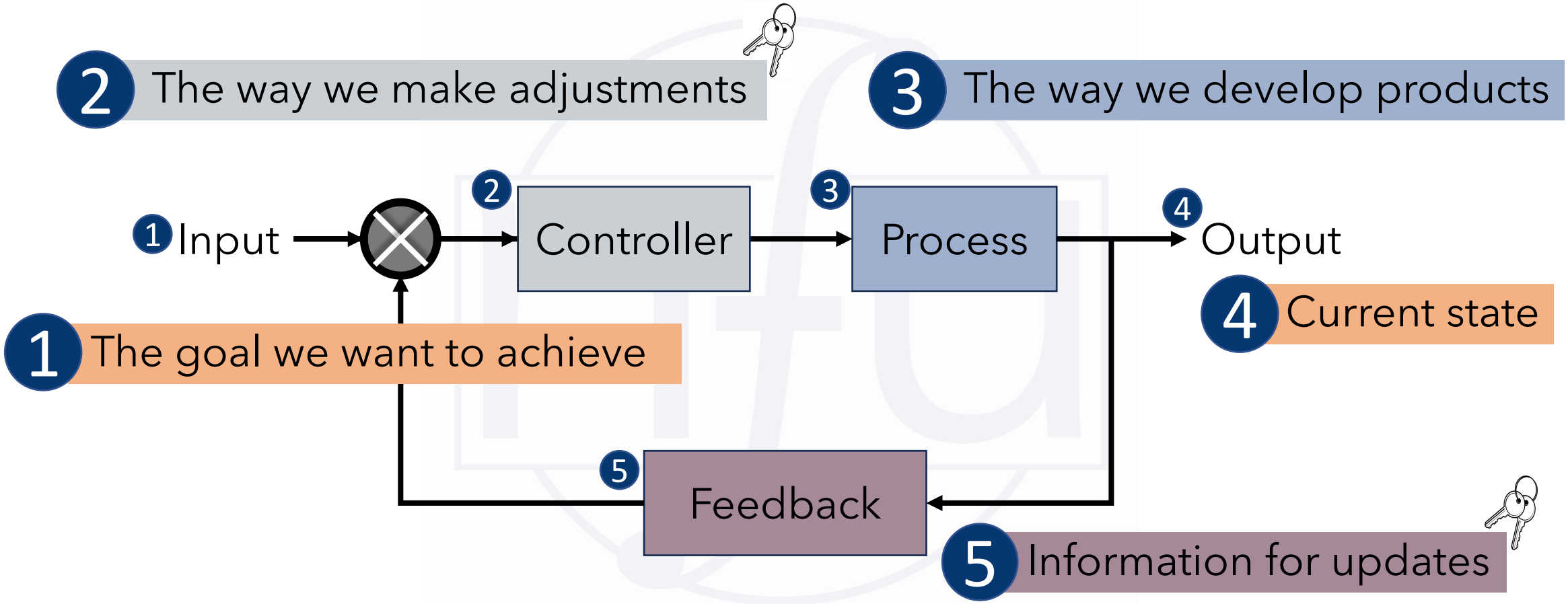
Control System Simplified Model



Purpose of a Control System: Make the output match the input

Controls: Key #1 – Feedback

- Provides context on:
  - Current effort remaining to arrive at goal
  - The effectiveness of any previous process changes
- Creates the opportunity for pivot points
- Type / frequency greatly affects over-all agility and effectivity of the system

Example of normal use:
Doing a lessons learned at the end of a project

Which is like:
Performing system validations to see if you got the right parts from the vendor

If you can't measure it, you can't manage it.
- Peter Drucker

Controls: Key #2 – the Controller

- This is the brain of the system
  - The controller modifies the effect of the process
  - Drives the process to deliver the desired target
  - Decides when the output and the target match

The Mathematical Model uses 3 levers to accomplish its purpose

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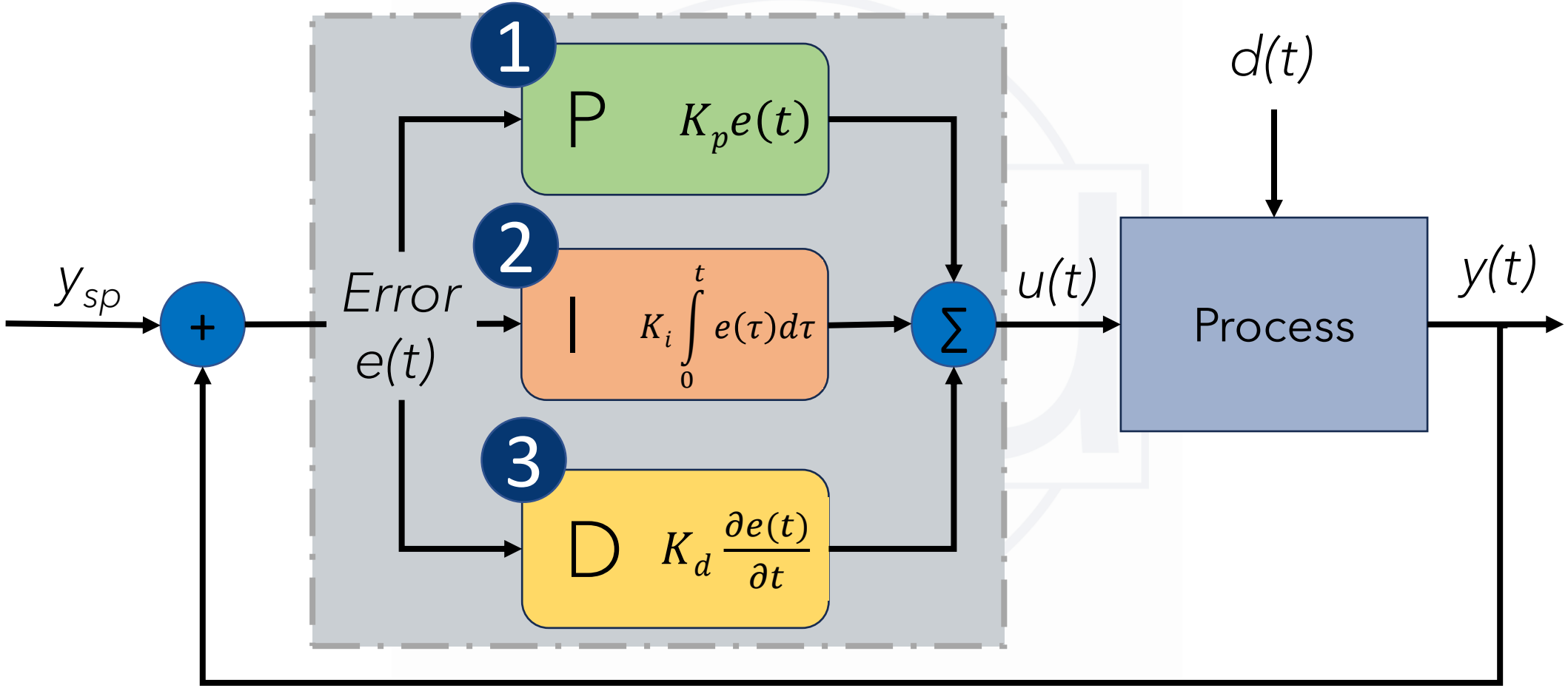
3 Systems Levers (Mathematically)



The *Coolest* Implementation (Using Math)

Controls: 3 Levers – the Crossover

Mathematical Levers

1 P $K_p e(t)$

2 I $K_i \int_0^t e(\tau)d\tau$

3 D $K_d \frac{\partial e(t)}{\partial t}$

Proportional term

– affects immediate controller actions

Team size and resources

Integral term

– helps retain steady-state conditions

Documentation

Differential term

– changes speed of responses

Ability to make Decisions

Product Development Levers

1 P 

2 I 

3 D 

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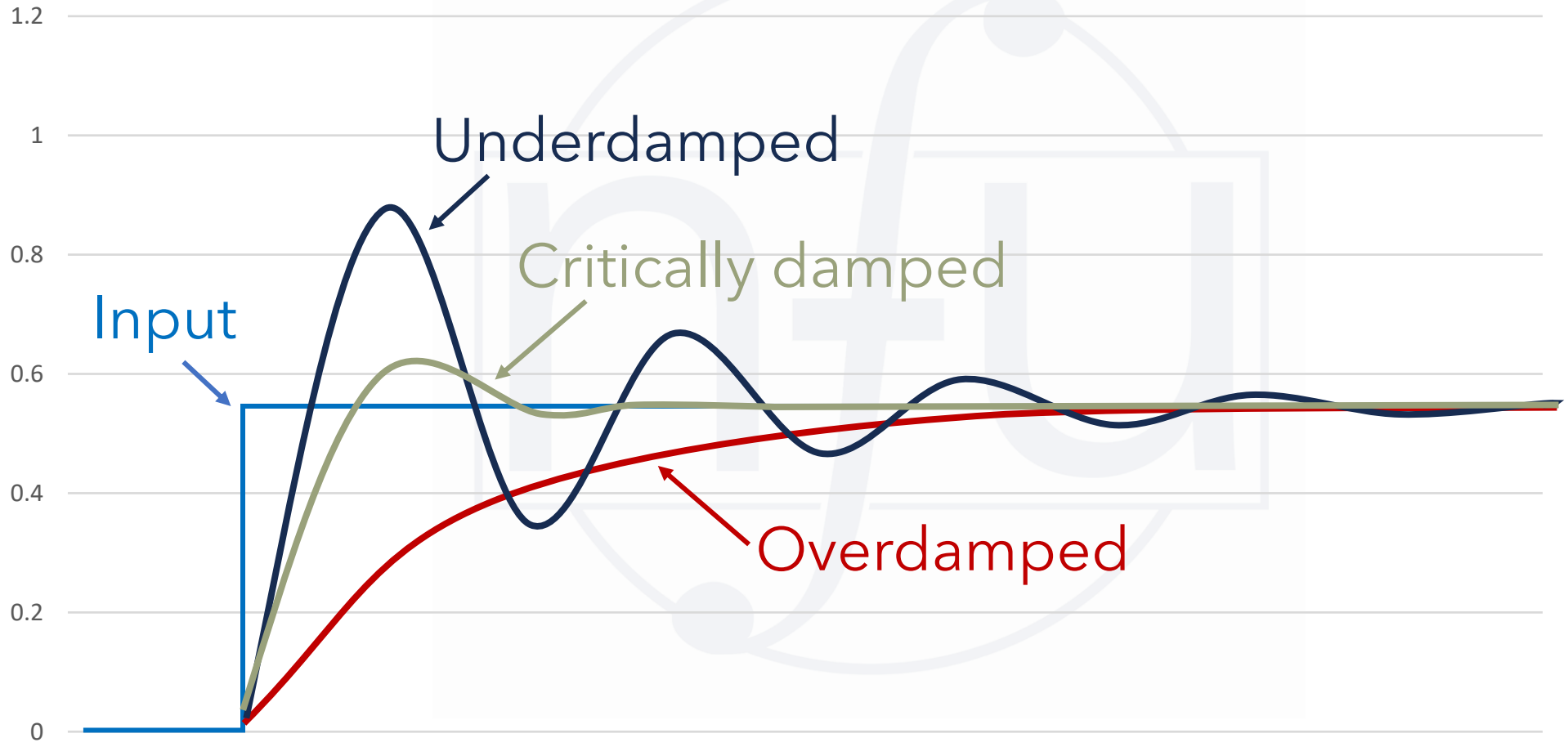
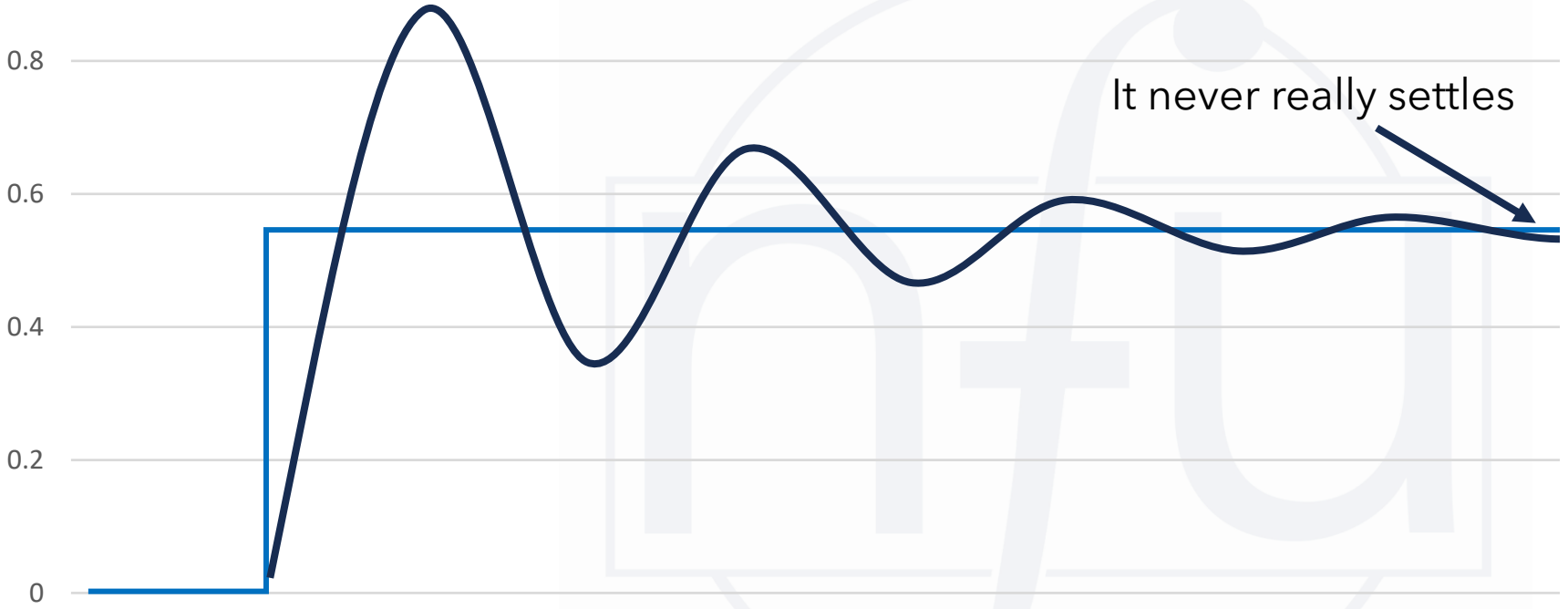
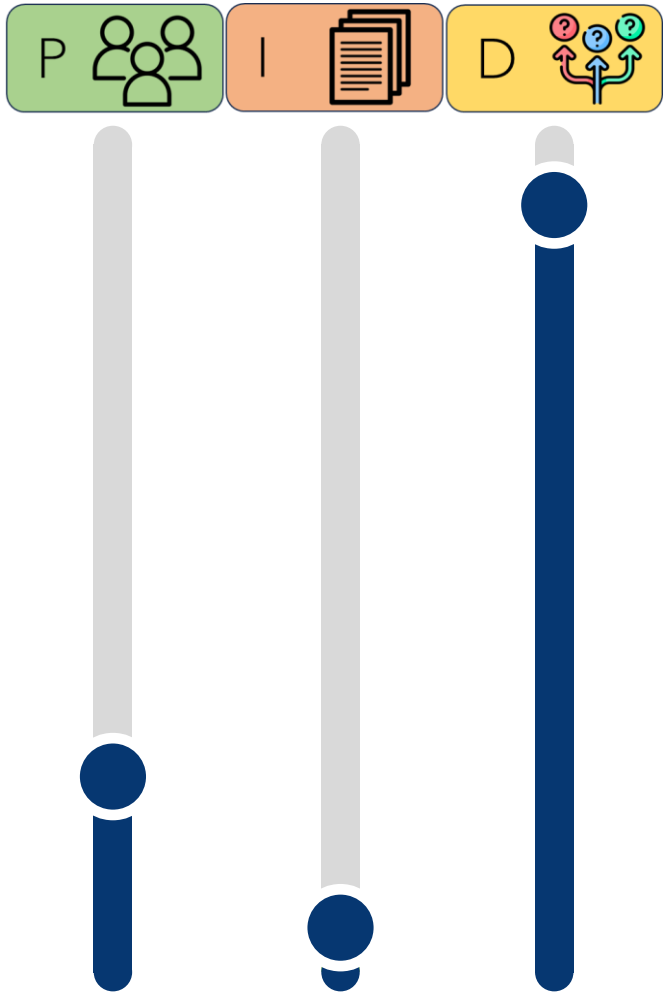
3 System Responses



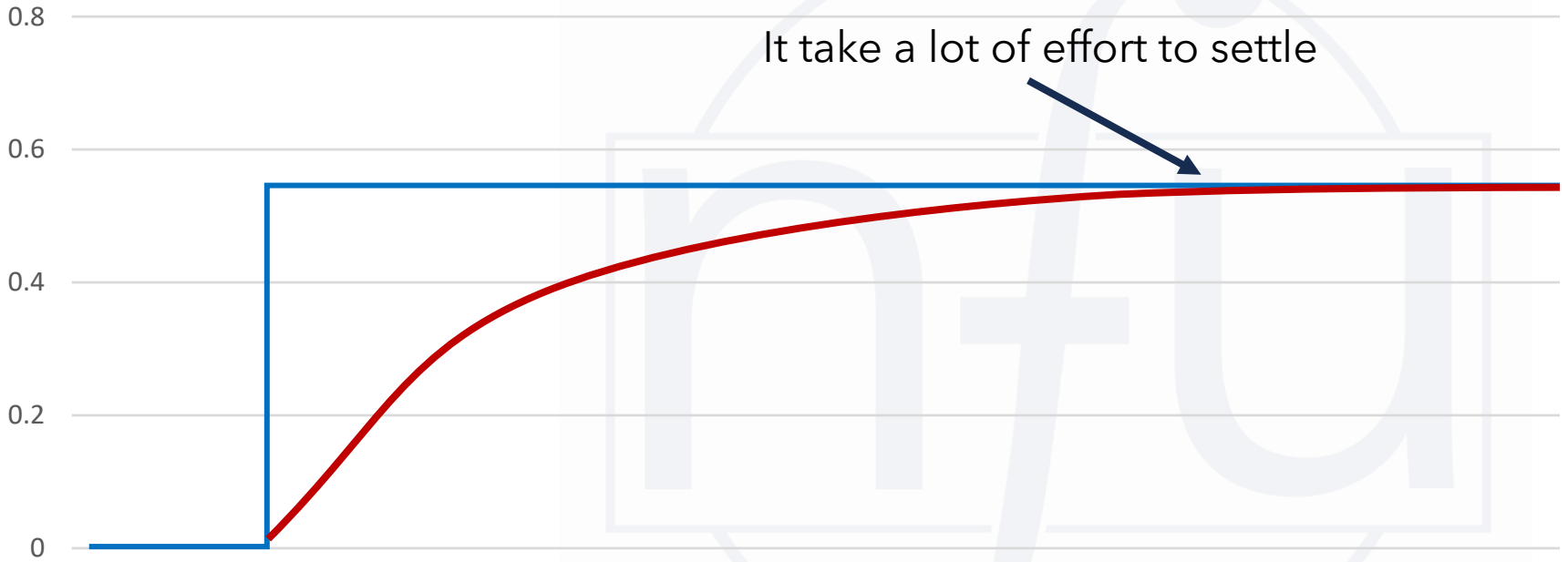
System Response 1: Underdamped

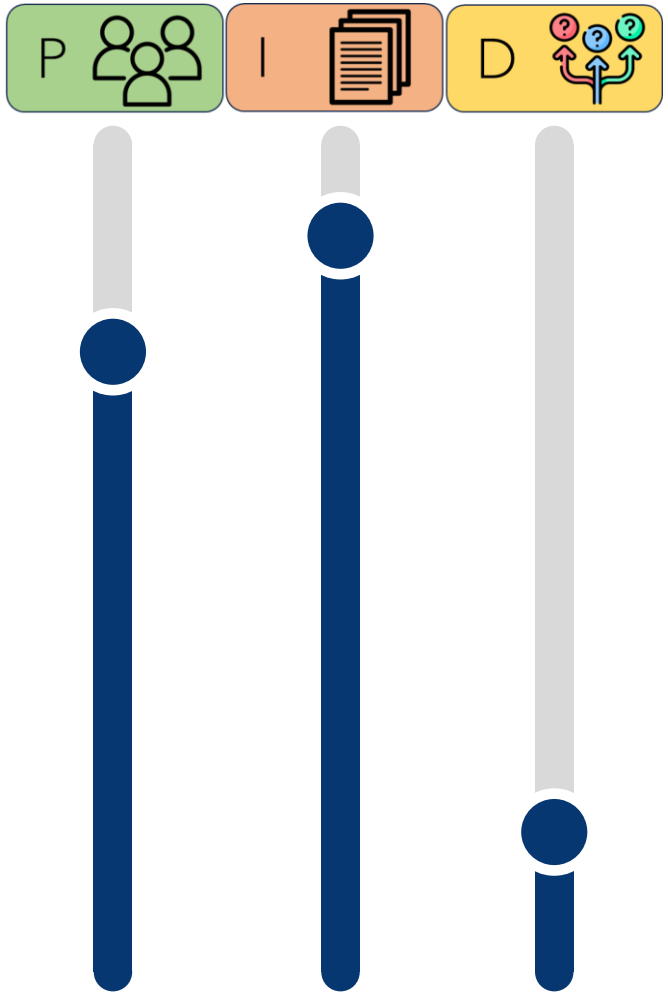




- Execute, execute, execute with “Entrepreneurial spirit”
- Nothing seems to ever get finished (or documented)
- Transfer to production only works when engineering comes too

System Response 2: Overdamped





- Slow to show progress / reluctant to change
- A lot of communications to get to a decision
- A lot of documentation to change / update / review / approve

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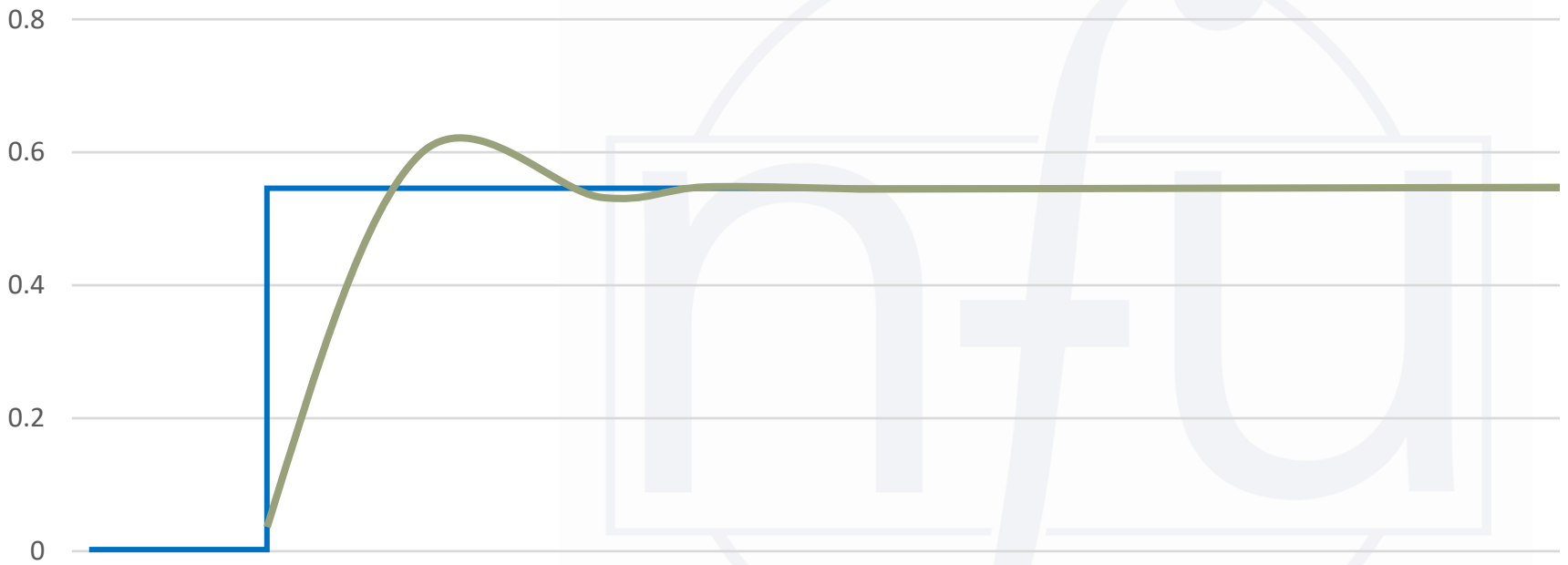
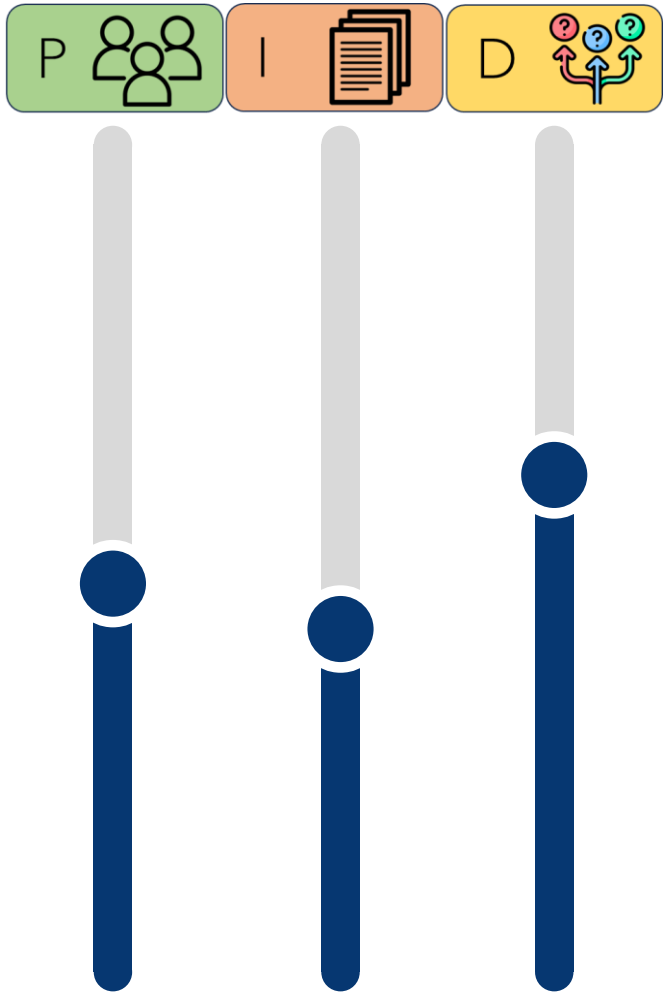
System Response 3: Critically Damped





- Fast early response
- Quickly home in on target
- Most efficient use of resources

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3 Lever Controls Summary

Keys to People and Resource Lever

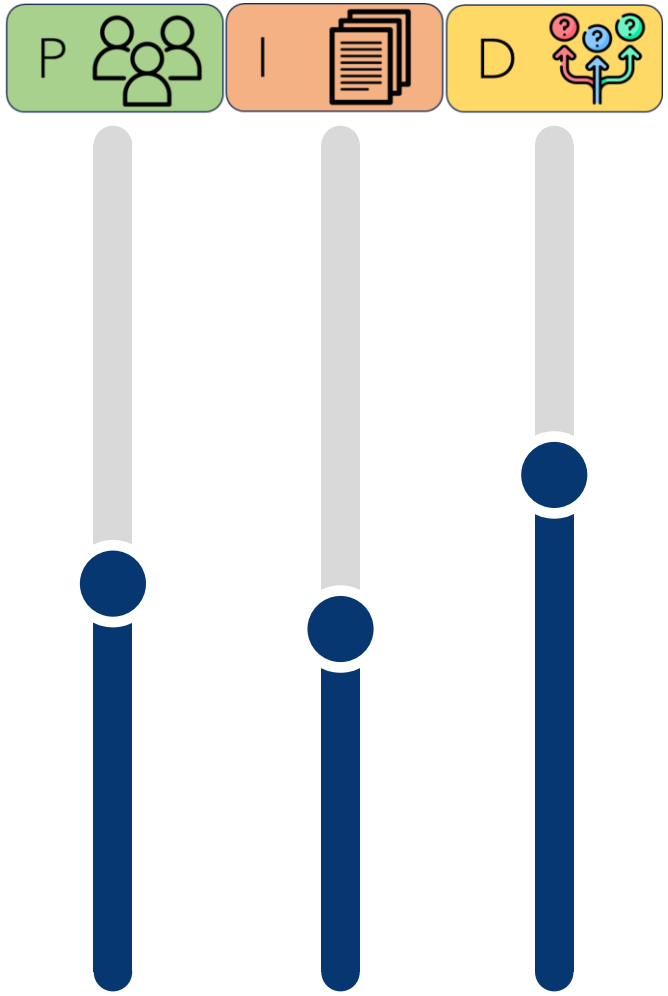
- Know *who* is needed to run your process
- Have well defined roles and responsibilities
- *Tools are not processes*

Keys to Integration Lever

- Projects with incremental changes
- Small batch size principles

Keys to Decision Lever

- Risk-based product development
- Deliver short projects and incorporate market learnings



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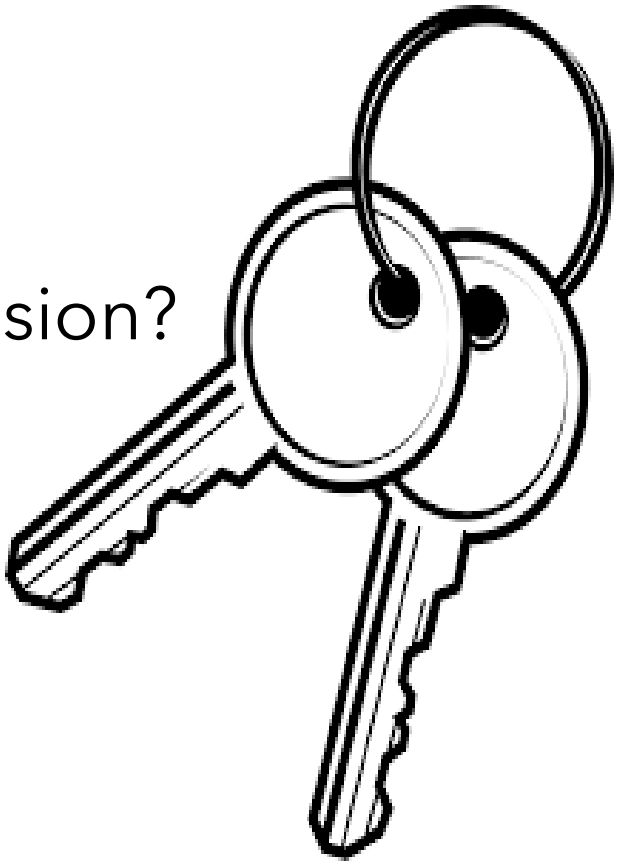
Key Take Away 1: Things that Slow

- Communications and waiting for responses
- Consensus building and meetings
  - How many people does it take to make a decision?
- Documentation
  - Writing / Reviewing
  - Approving



- What happens if you do too much? Too little?
- How does your process function?

Key Take Away 2: Things that Accelerate

- Prototyping / Bench testing early in the process
- Roles and responsibilities
  - know who is going to make the decision(s)
- Get to justifiable decision points quickly with enough information to make good decisions
  - Document the why's
- What happens if the process allows too many people to make too many decisions? Or too quickly?

Key Take Away 3: Keep the critical

Remember good information leads to good decisions

1. Adjust the process to the scope of the project so that
   - Resources
   - Documentation
   - Decisions

   Are all right sized to the team

2. 

3. How often are you looking at the process metrics?

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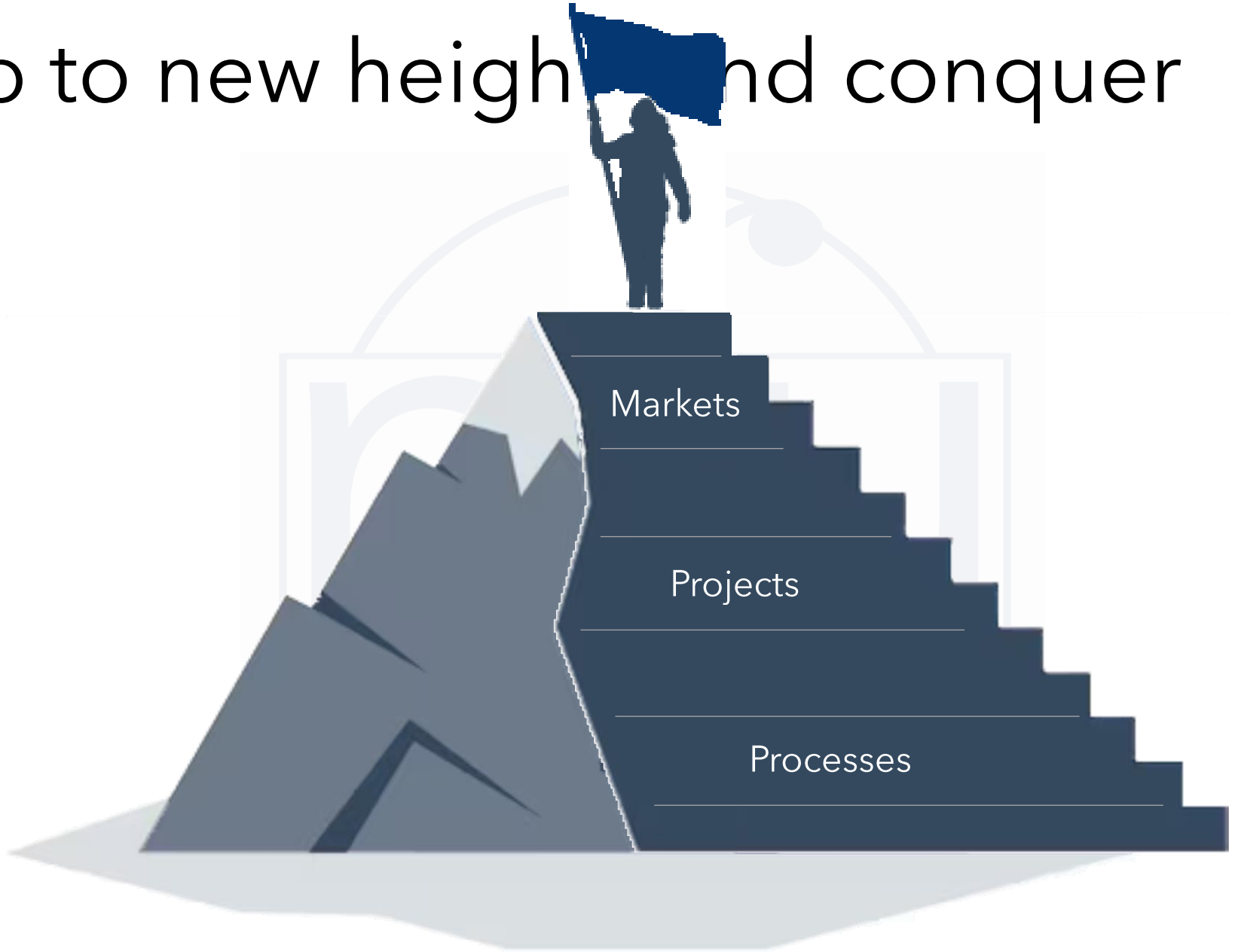
Climb to new heigh nd conquer



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Let's Talk Controls

Booth #4097

LEAD *People*, MANAGE *Processes*, CHANGE *Lives*

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