Best Practices for Building a Rack-Based Test System

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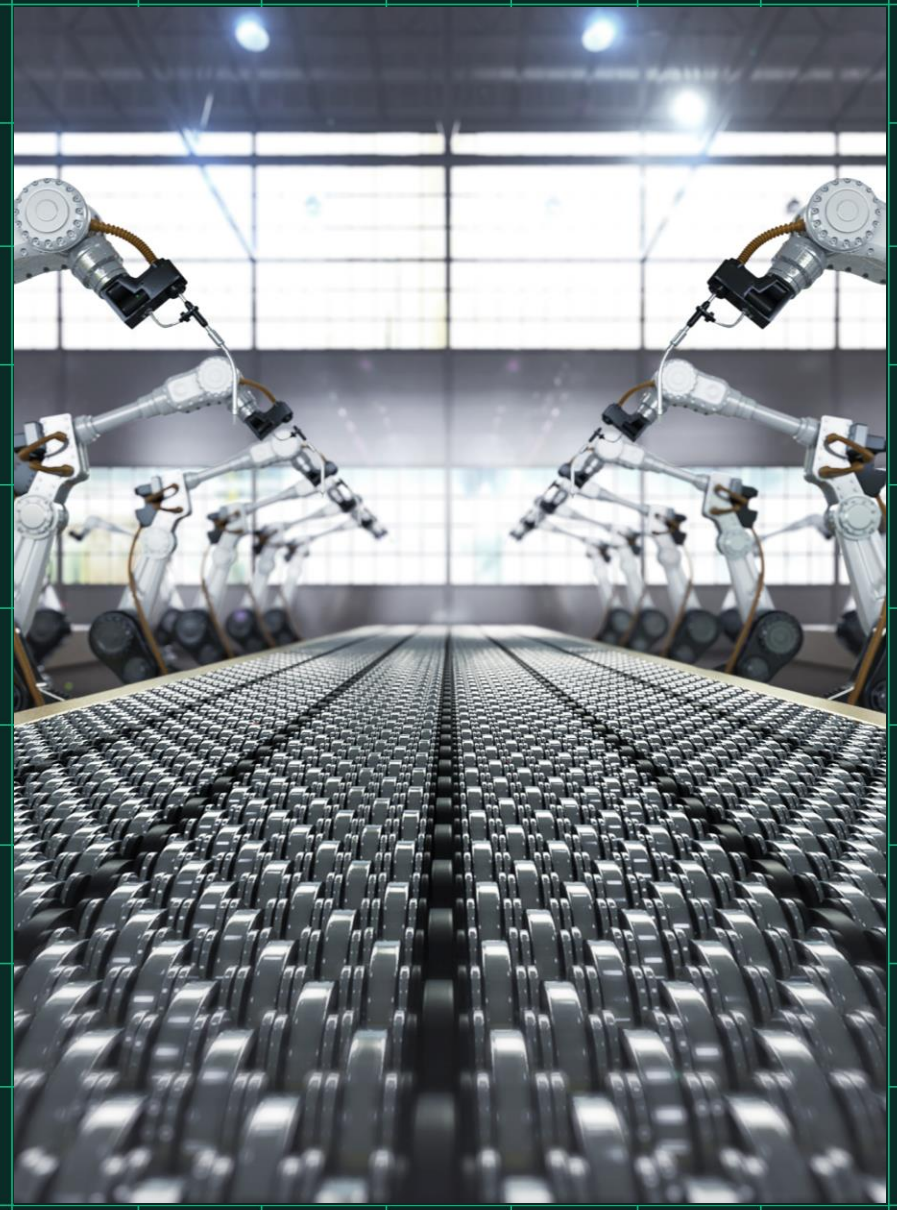
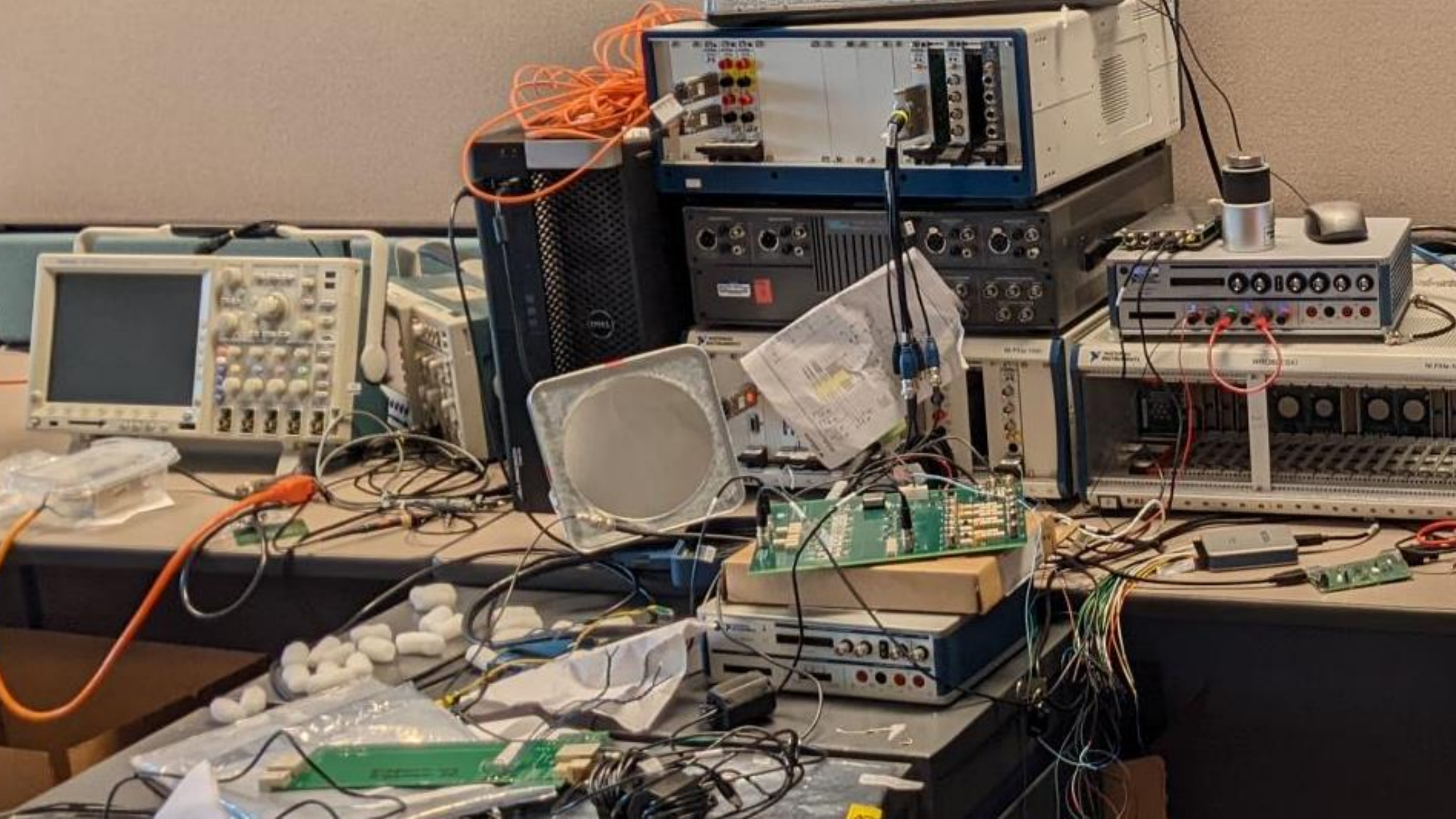


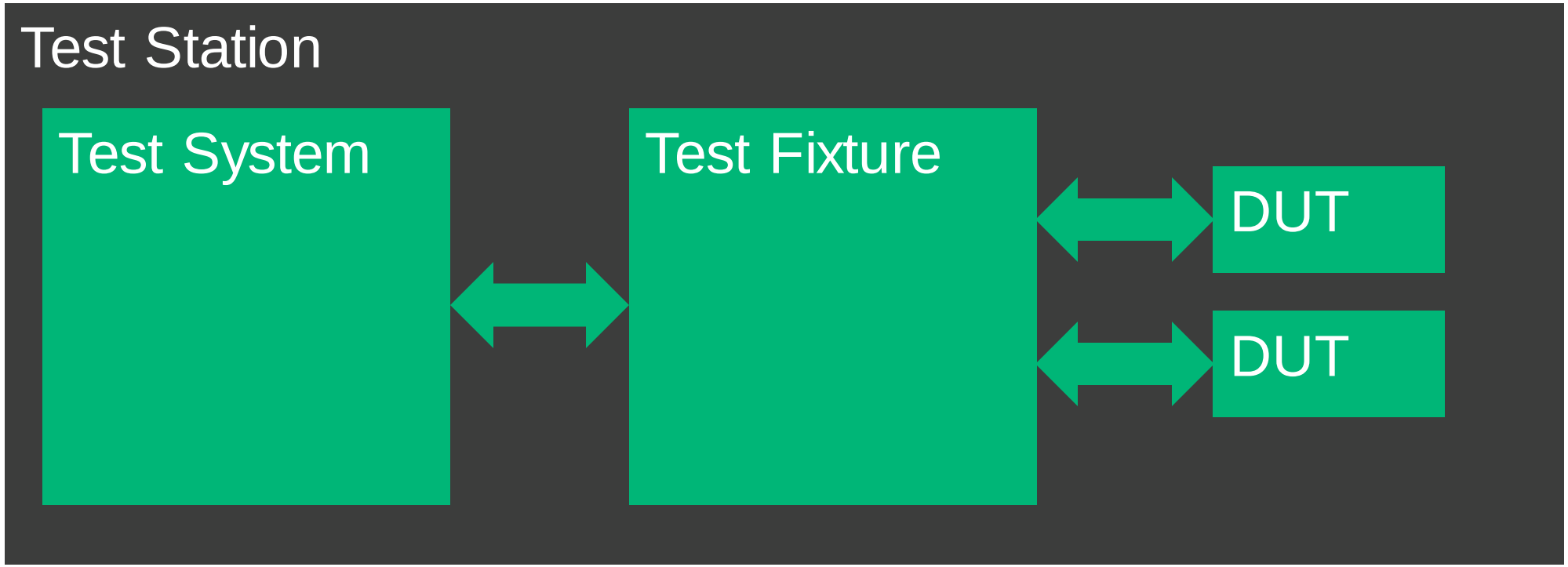


What is a Test System?

A **system** *is an arrangement of parts or elements that together exhibit behavior or meaning that the individual constituents do not.*

An **engineered system** *is a system designed or adapted to interact with an anticipated operational environment to achieve one or more intended purposes while complying with applicable constraints.*

https://www.incose.org, accessed May 5, 2022



What is a Rack?

Rack. *An open structure for mounting electrical or electronic equipment.*

Cabinet. *A freestanding and self-supporting enclosure for housing electrical and/or electronic equipment. It is usually fitted with doors and/or side panels, which may or may not be removable.*

EIA-301-D

In this presentation, we'll use the term **rack** to refer to a freestanding and self-supporting structure for mounting test equipment, regardless of whether it's an open structure or an enclosure, and regardless of conformance to EIA-310-D.

Value of a Rack Based System

- Simplified asset management
- Footprint
- Simplified operator interface
- Simplified connectivity

- Any others?

Selected Best Practices for Any Test System Design

Know Your Requirements

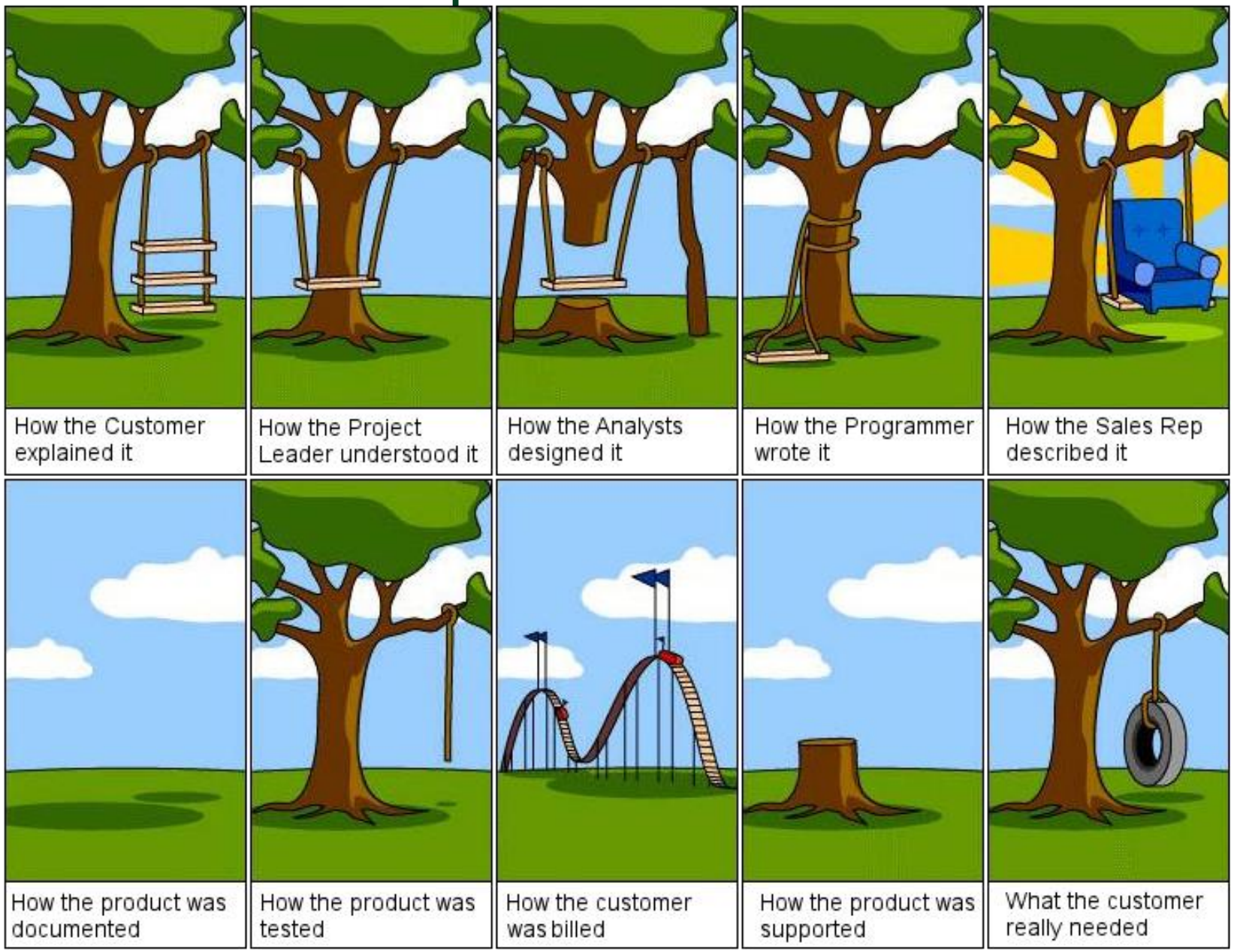
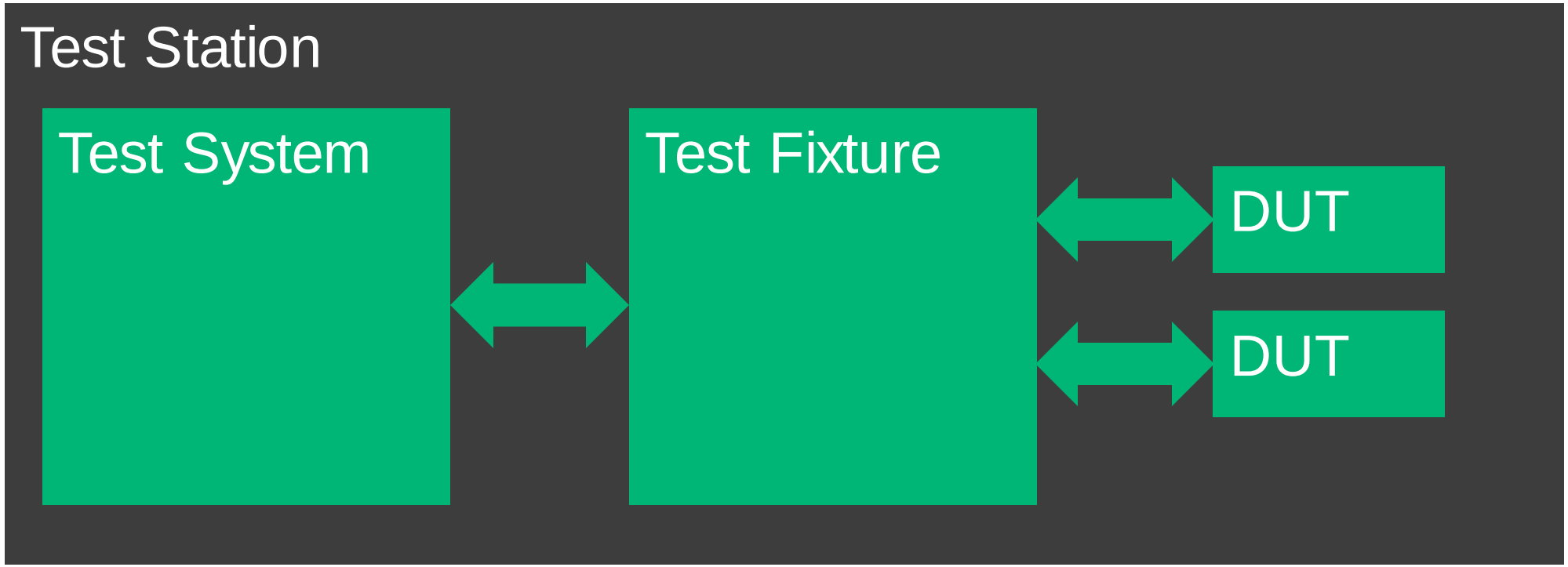
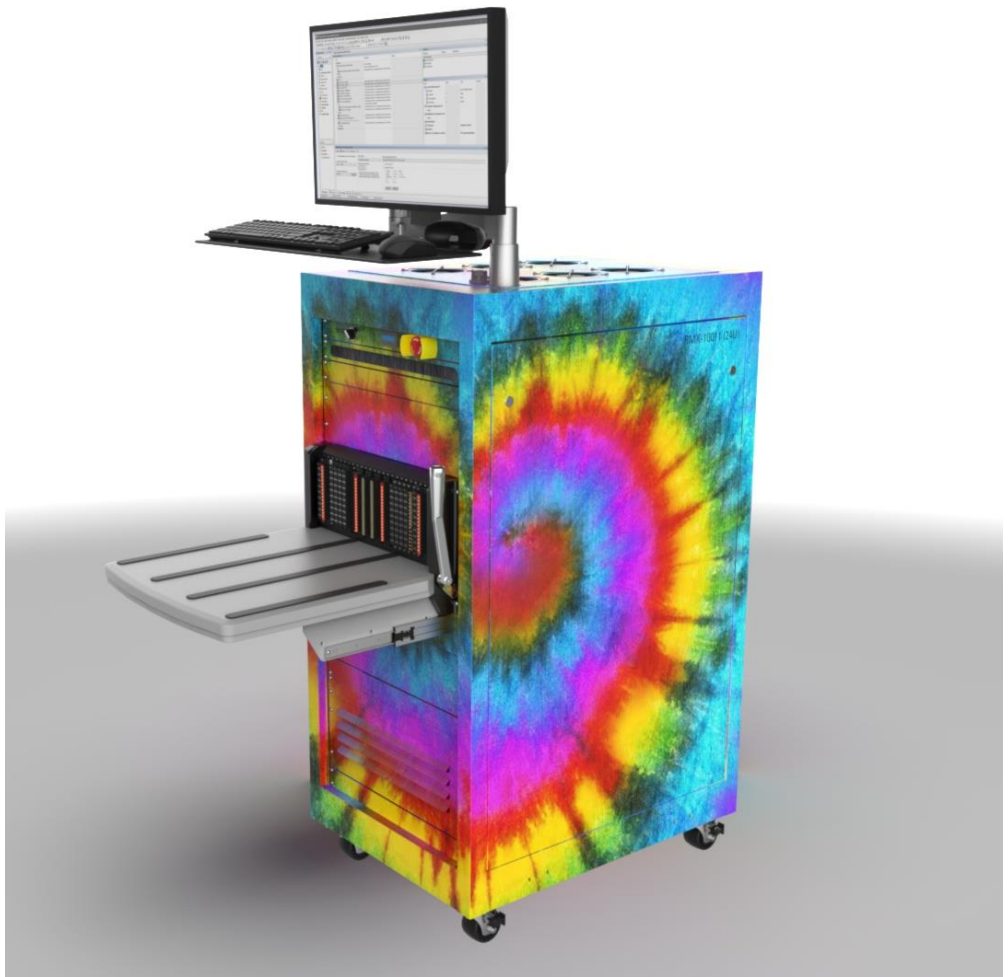


Image source: https://www.pngwing.com/en/free-png-dufzl

Understand the Context



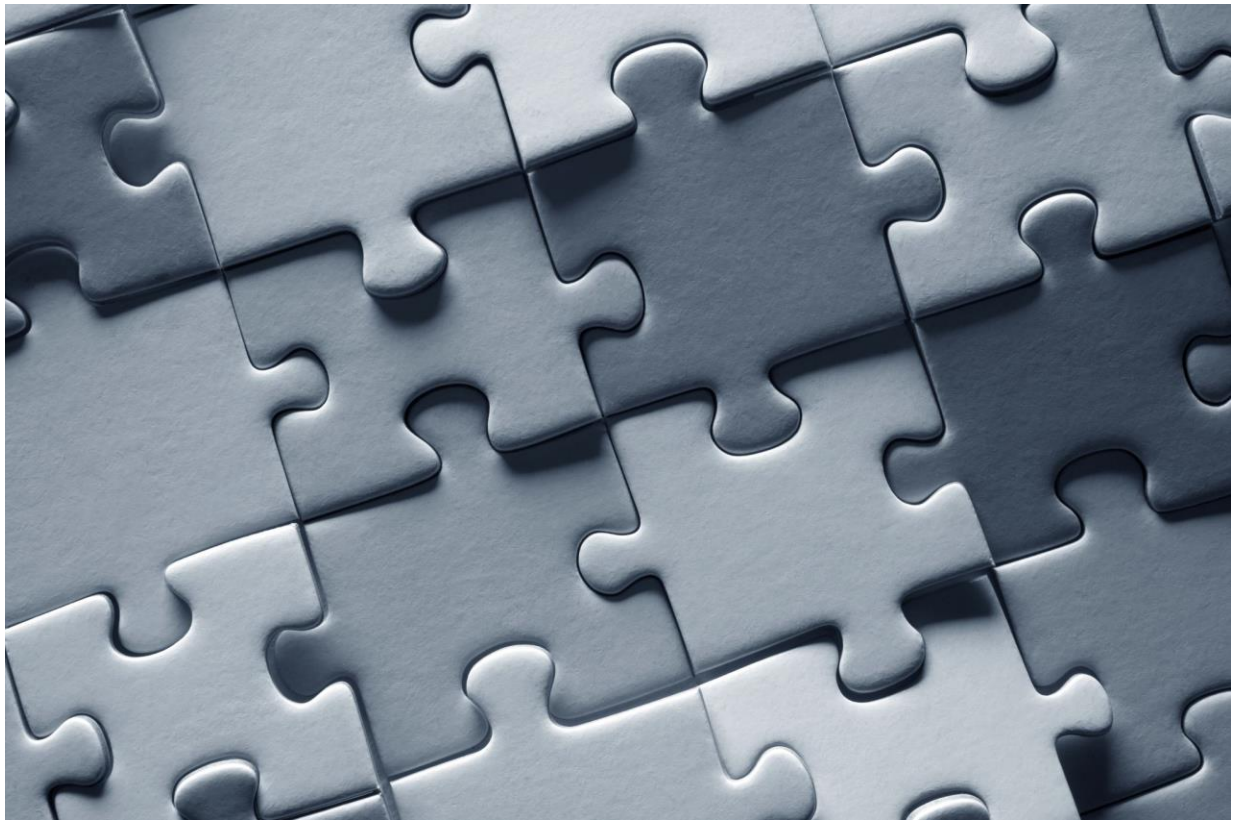
Know Your Constraints



How do you know that you are done?

Additional Considerations

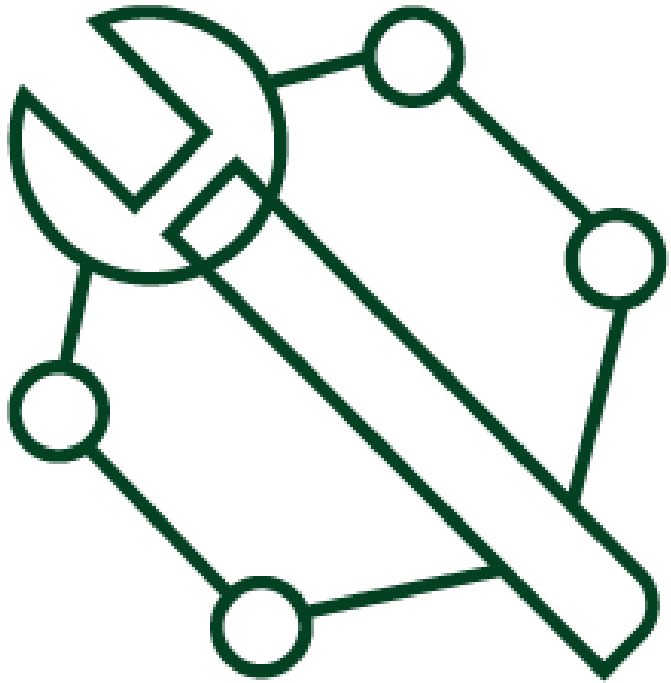
1. Component selection
2. Software considerations
3. System documentation
4. Manufacturing test plan
5. Bring-up plan
6. Repair plan
7. Preventative maintenance plan
8. Calibration plan
9. Operator training



Anything else?

More Software: System Maintenance Software

- Are the right components present at the right locations?
- Are the components working?
- What's the calibration status?
- …



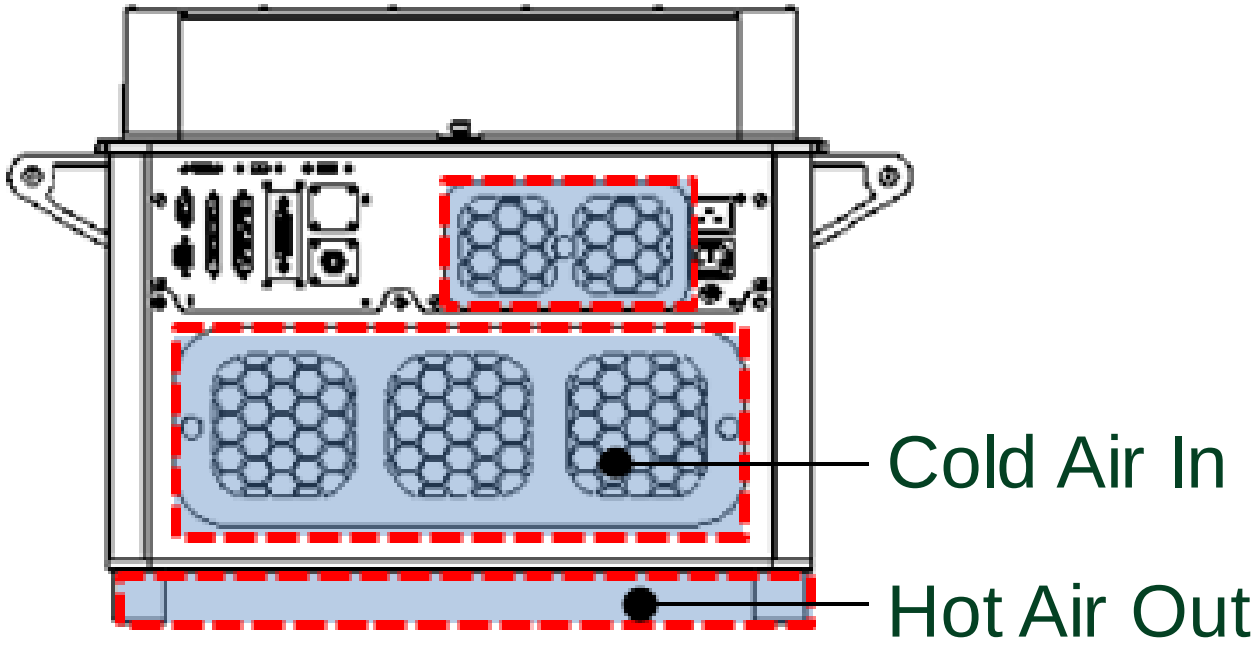
Field Diagnostic Test (of the Test System)

When the test station goes down, test system is the prime suspect

Staff for Success

- Program Manager
- Overall Technical Lead
- Domain Experts
- Test Engineers
- Electrical Engineers
- Software Engineers
- Technical Writers
- …
- Mechanical Engineers

Minor Rack Modification or: How I Learned to Stop Worrying and Love Mechanical Engineers



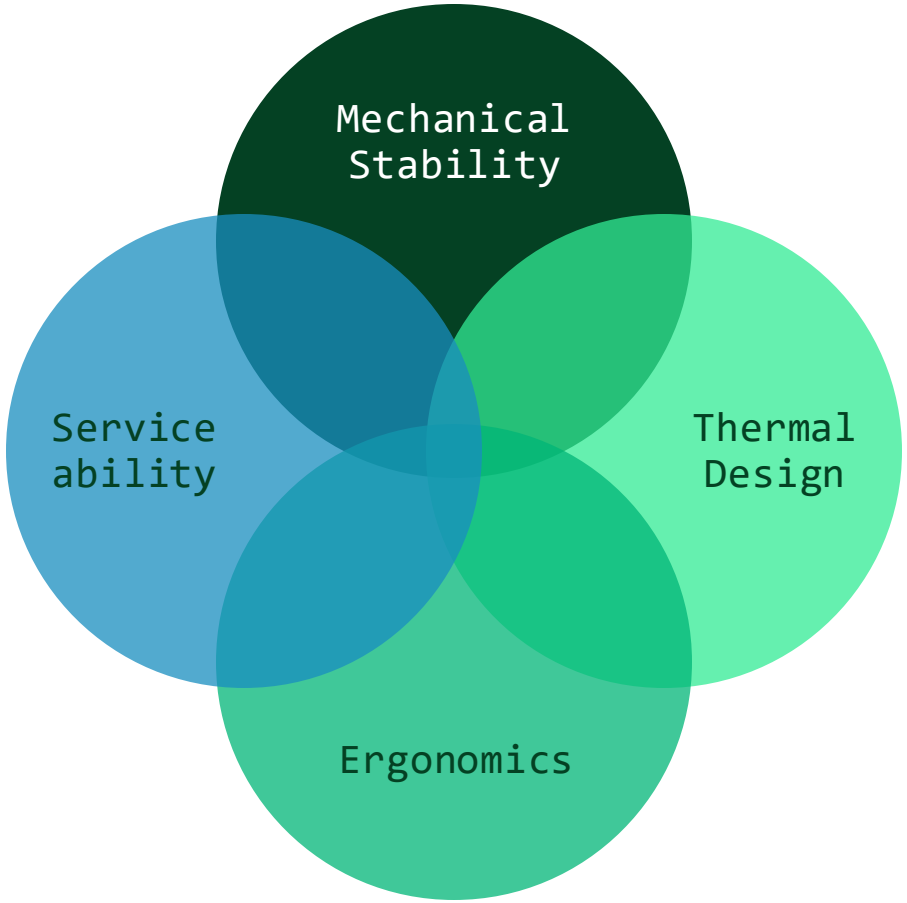
My homework:

1. Increase bottom clearance from 1.5 inches to 2 inches on three sides
2. Prevent air flow on the remaining side

Minor Rack Modification or: How I Learned to Stop Worrying and Love Mechanical Engineers

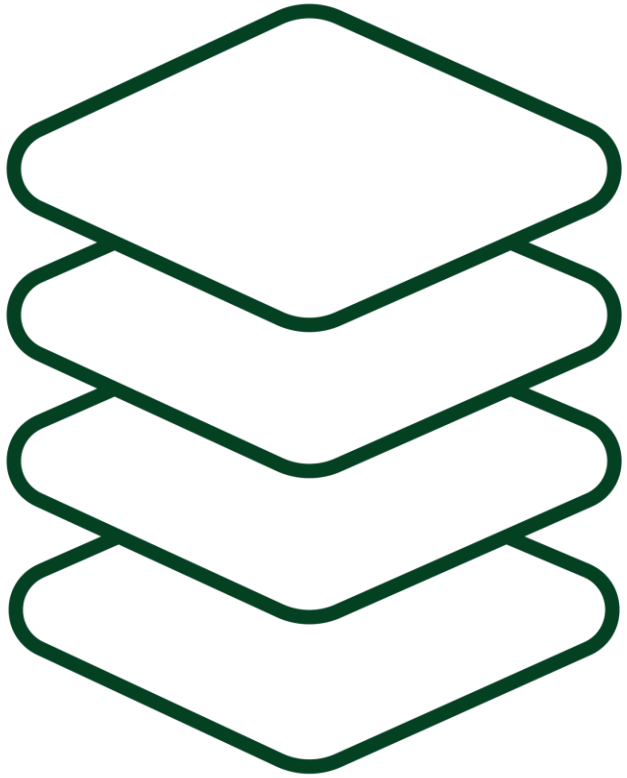
Selected Considerations for Rack-Based Test System Design

Featured Topics



System Level Considerations

- **Design**
  - Equipment Density
  - Rack Geometry & Total Footprint
  - Connection to DUT
  - User Interface
  - IO interface
  - Power Budget
  - Serviceability
  - Thermal Performance
  - Further Integration
- **Deployment**
  - Acoustic requirements
  - Environmental
  - Power Source
  - Thermal Dissipation
  - Access (internal & external)
  - Footprint



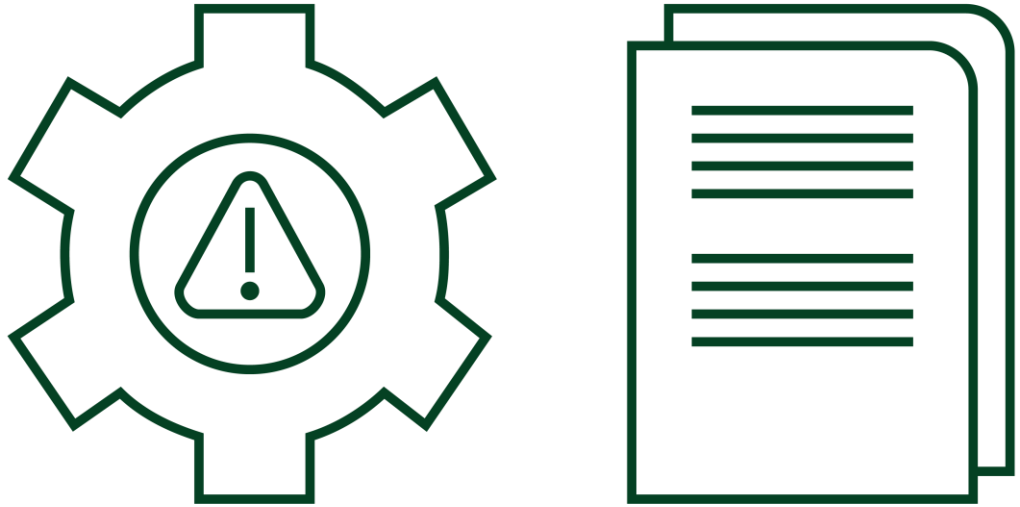
Equipment Level Considerations

- Rack Mounting, Installation, and Serviceability
- Thermal Requirements
- Airflow
- Interconnect
- Cable routing
- Installation
- Equipment Density
- Rack Geometry
- Power Requirements
- Function

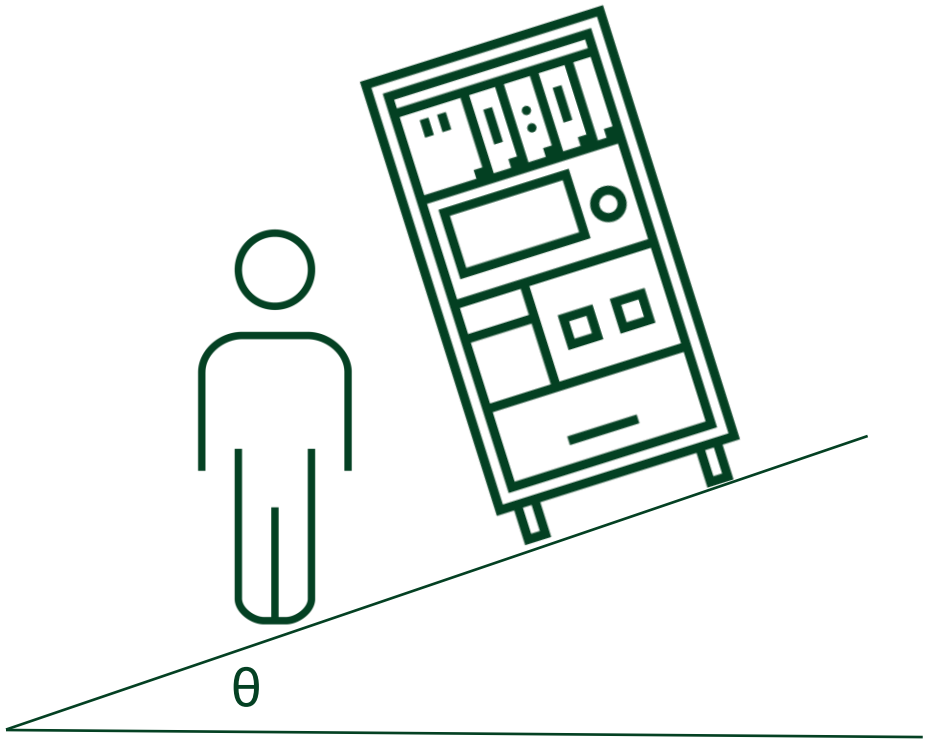
Mechanical Stability

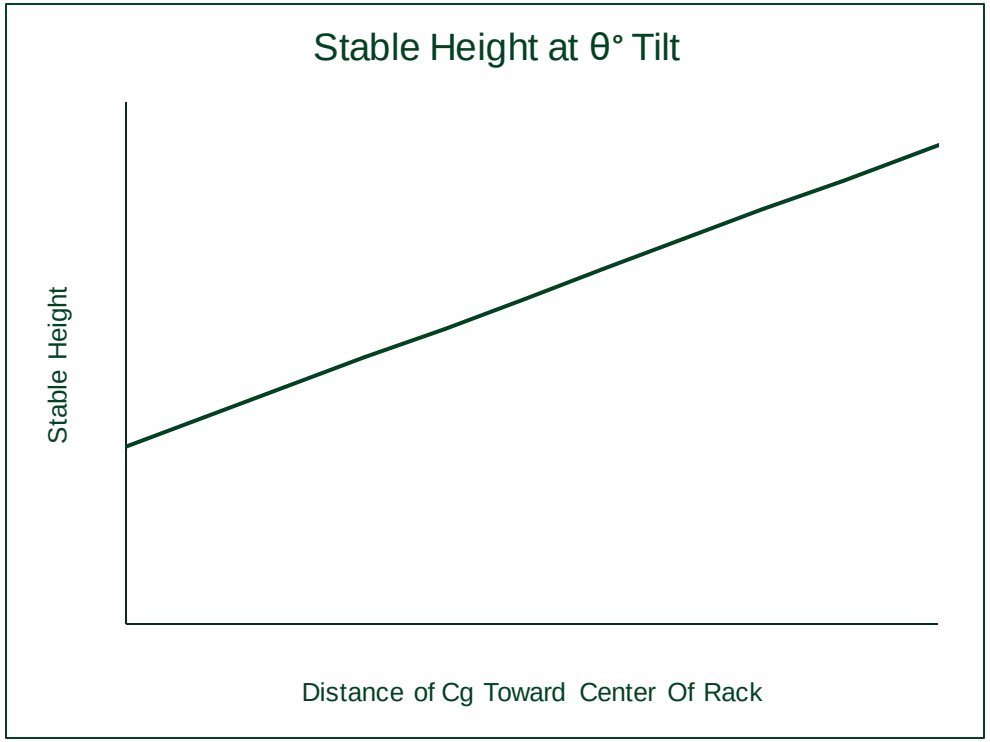
Specification Impact

- Depending on where your test system is deployed, there may be explicit requirements about how good it is at staying standing up.
- What specifications govern your test system?

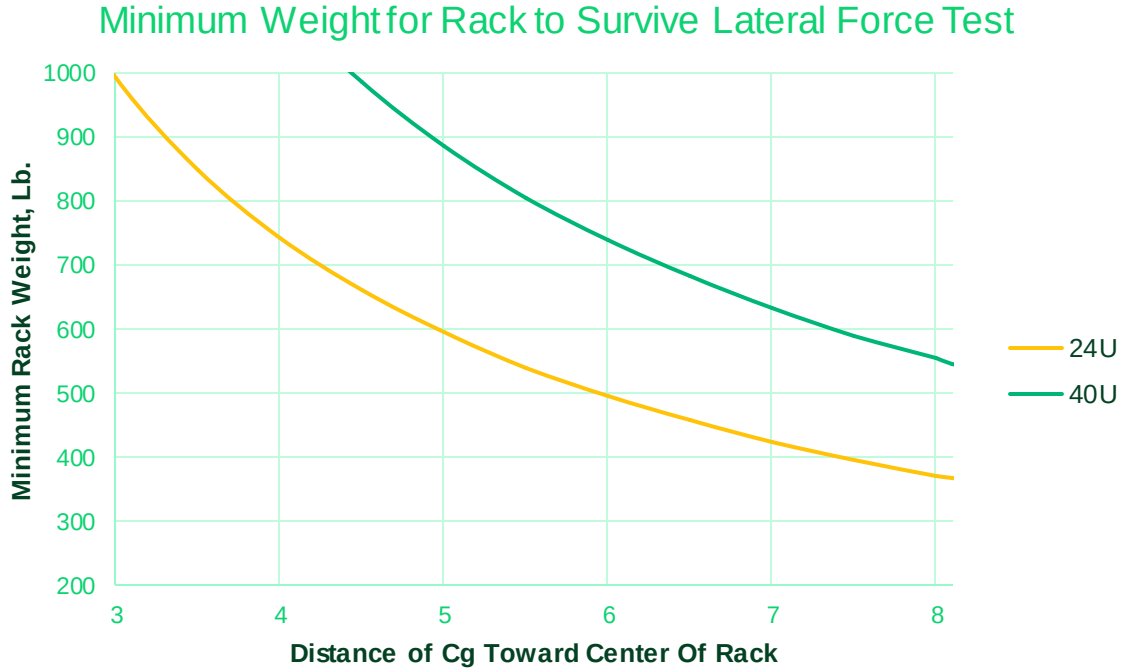


System Tilting





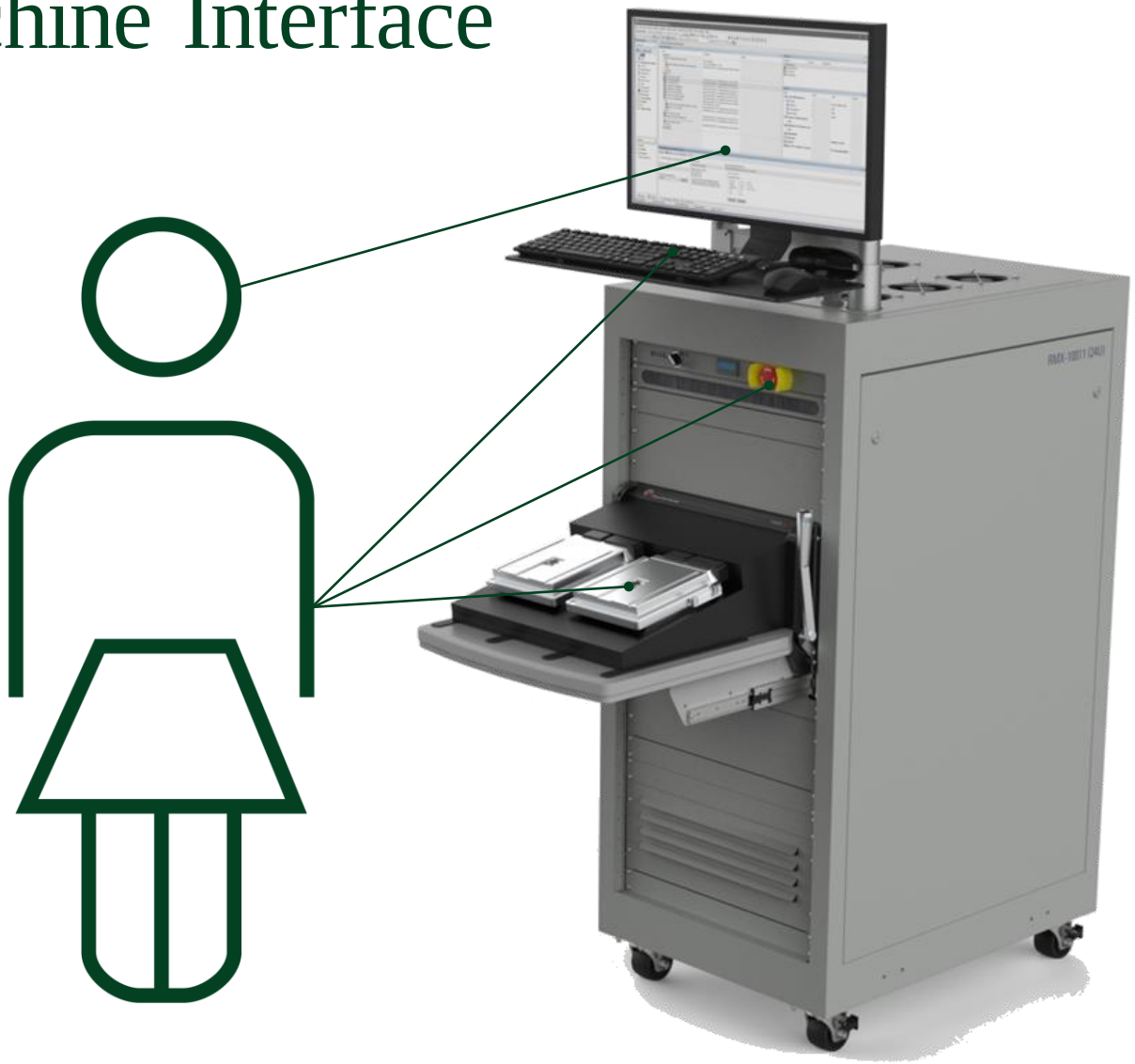
System Tipping



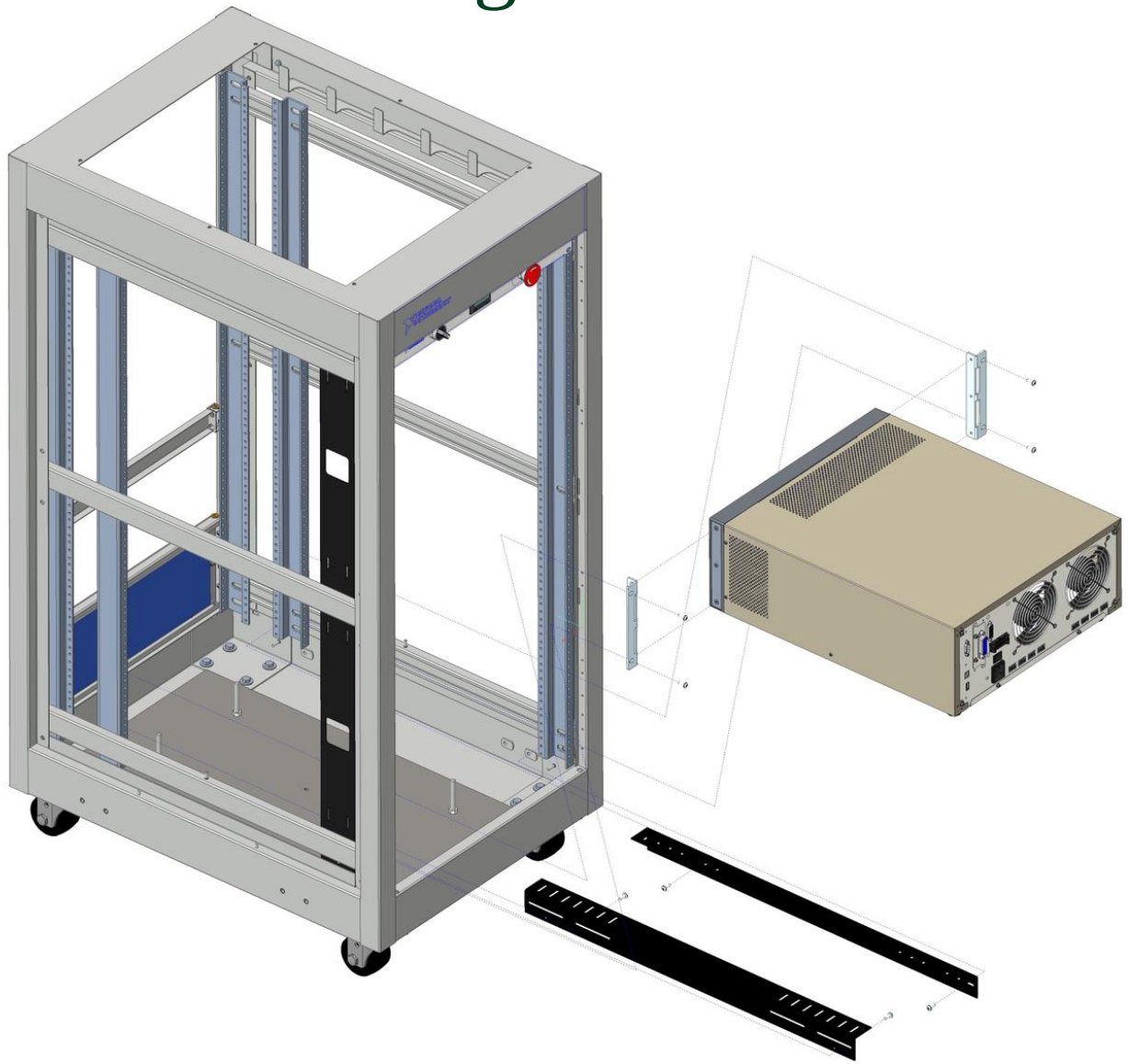
Serviceability

Ergonomics

Human Machine Interface (HMI)



Design For Manufacturing

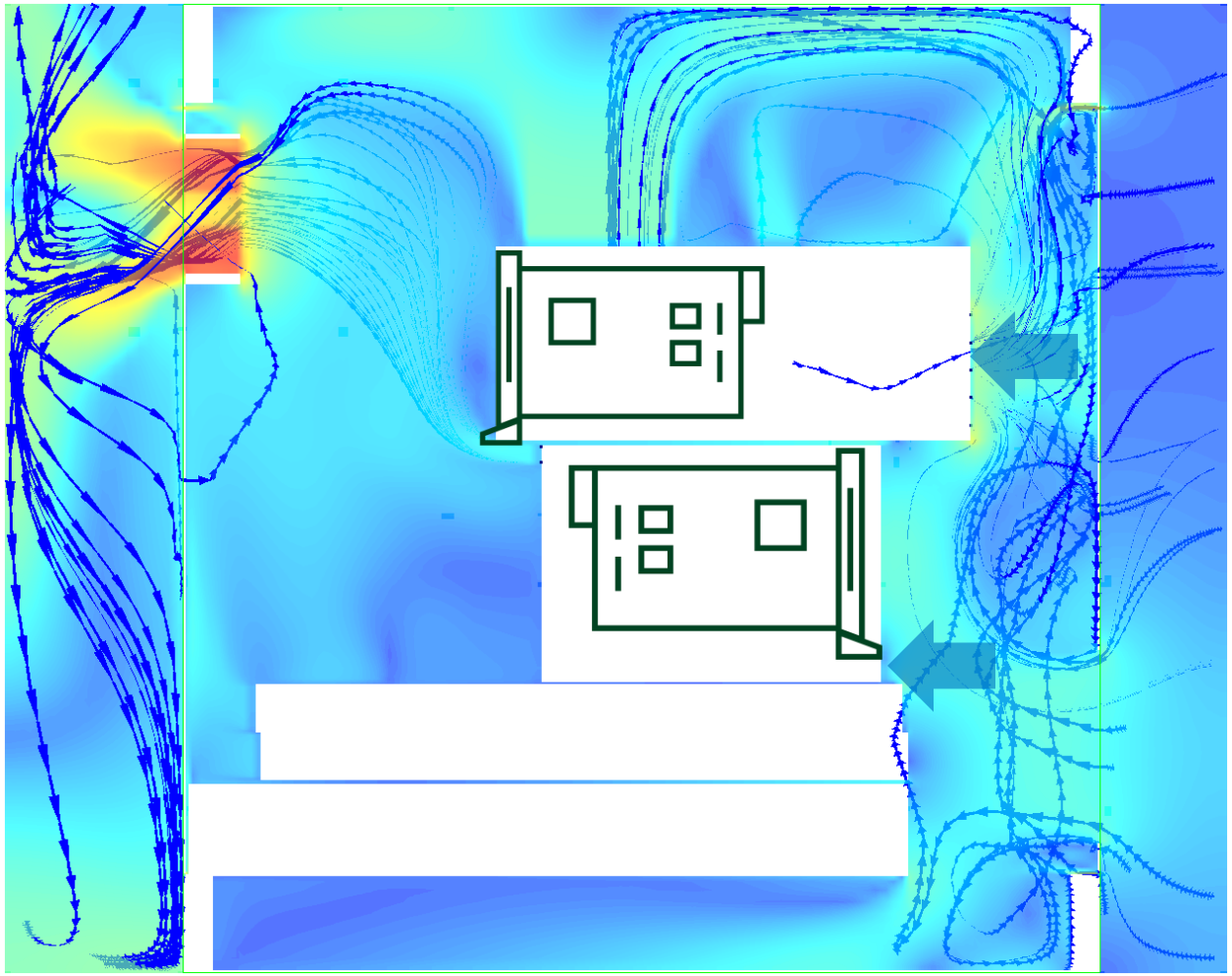


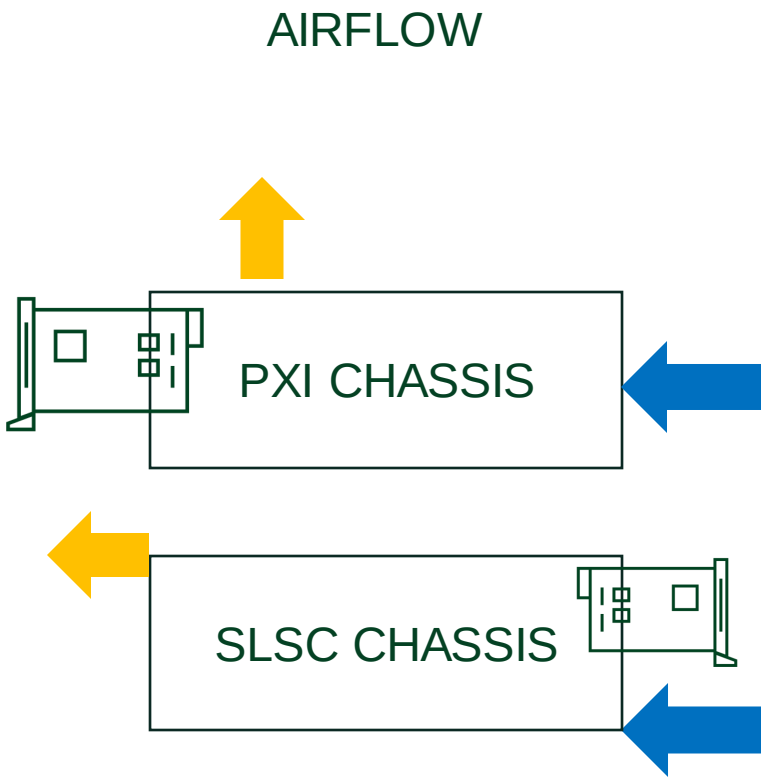
Thermal Considerations

When to consider?

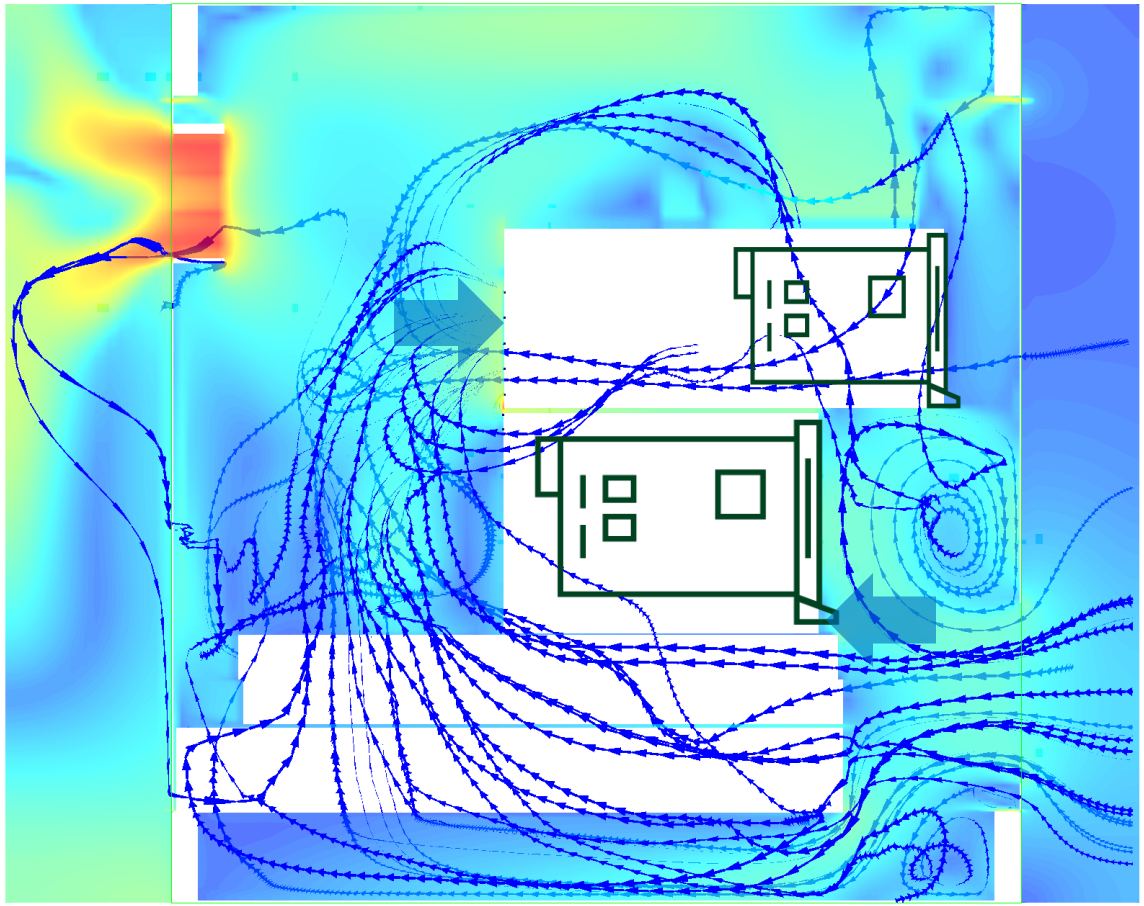
Serviceability

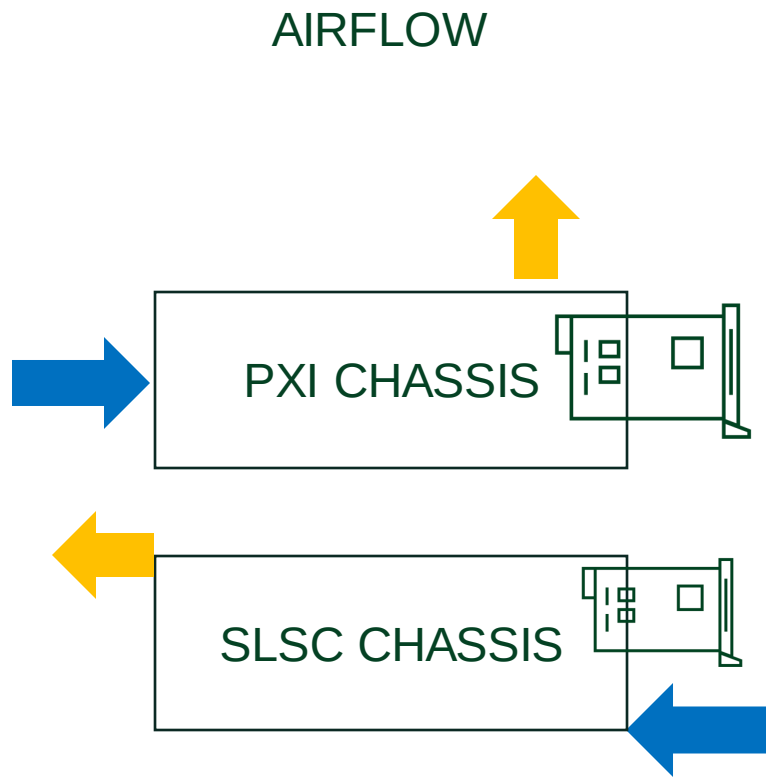
Airflow and Thermals Vs…



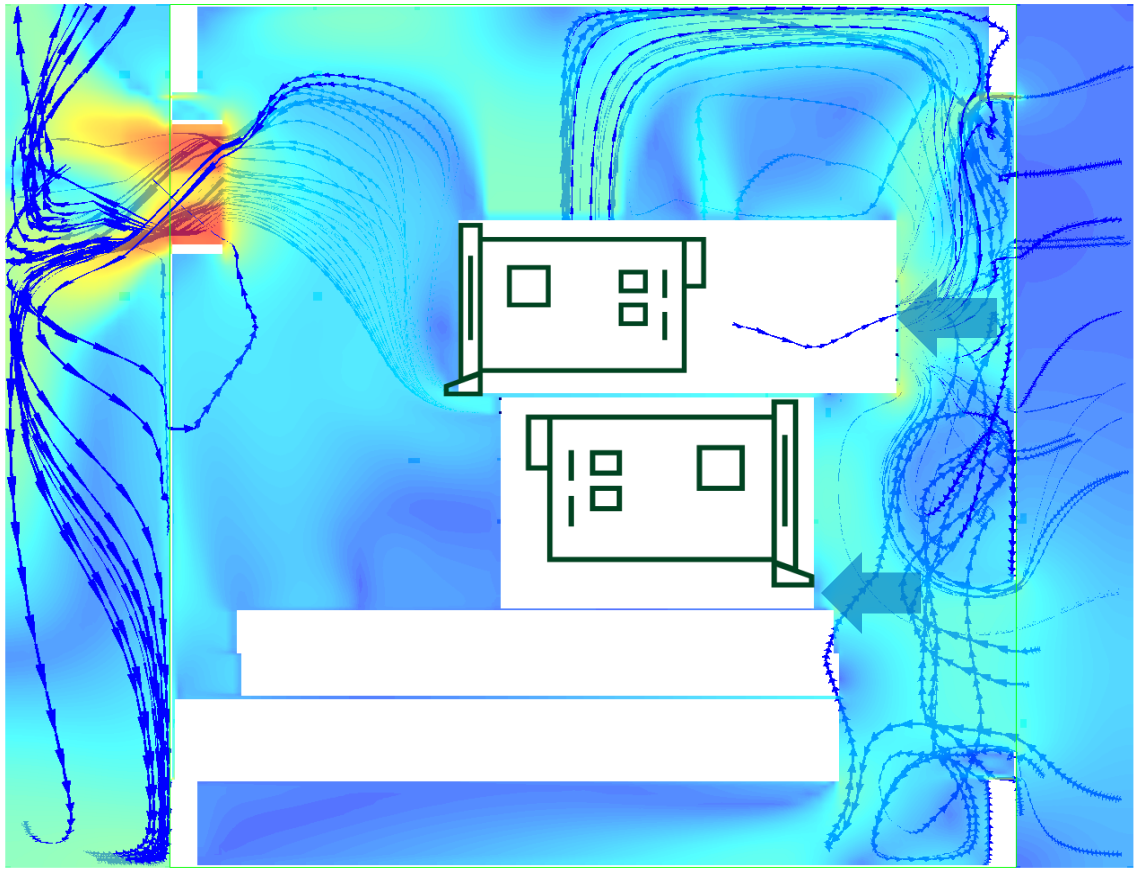


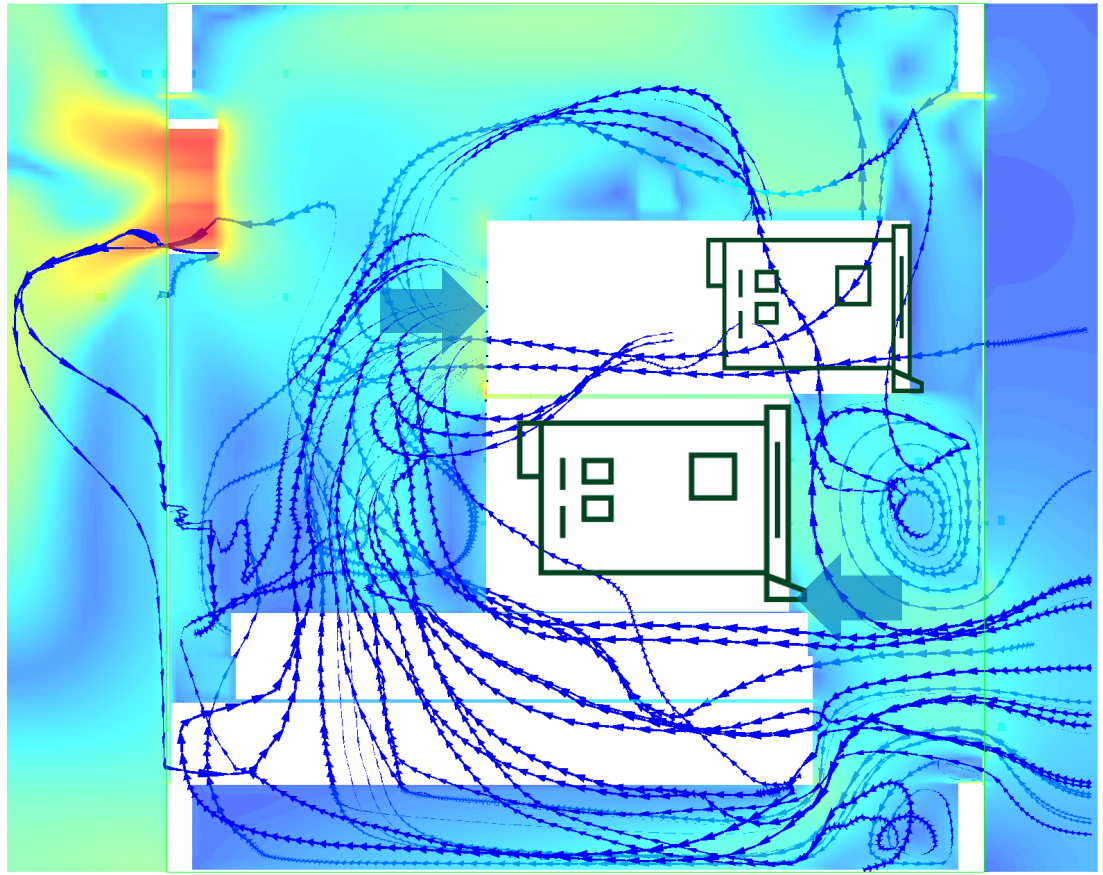
Airflow and Thermals Vs…





Airflow Thermals Vs…



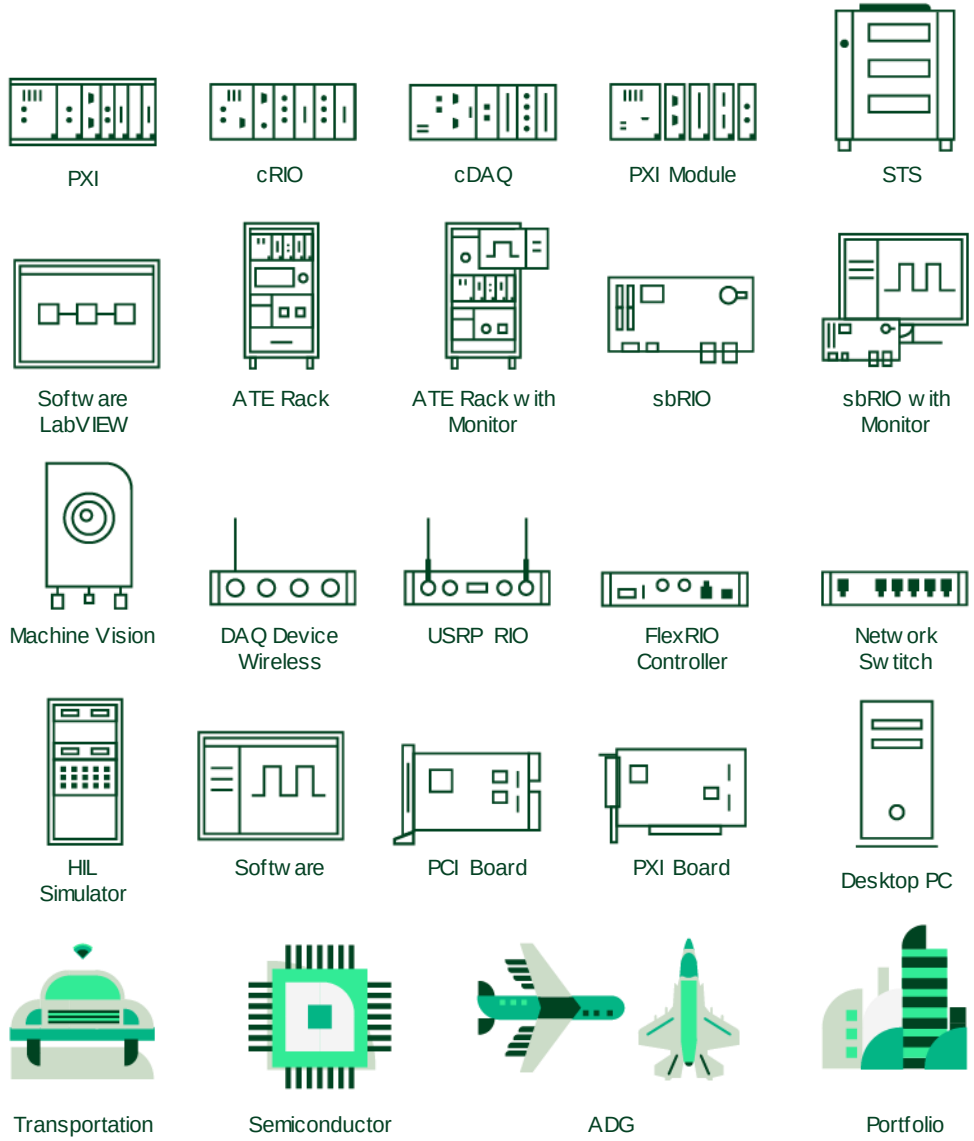


Power Allocation

- It’s helpful if heat is near the exhaust… but it might screw everything else up
- How variable is the power dissipation of equipment?
- When do we care about thermals vs other things?
- Maybe put together some rule of thumb.
- More…

Elements

Key Hardware and BU Icons



Asset Library

Preview in presentation view to click each asset link.

Style Guide >

Image Library >

Iconography >

Copy and paste this table to utilize the table styles and color. Add columns or rows using the Table Layout Tab.

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Charts and Infographics

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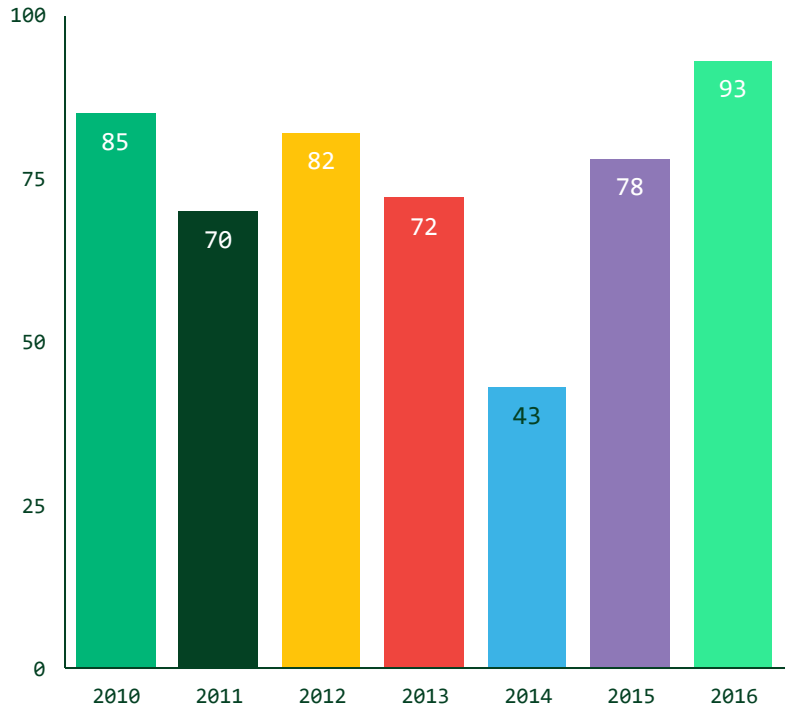

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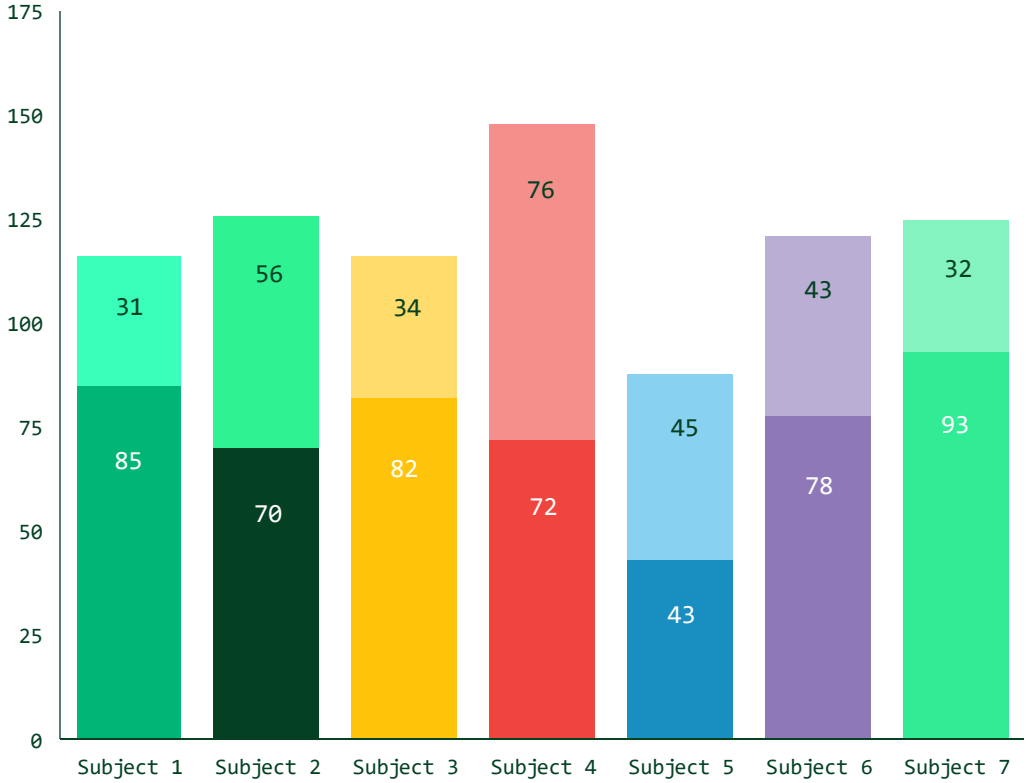
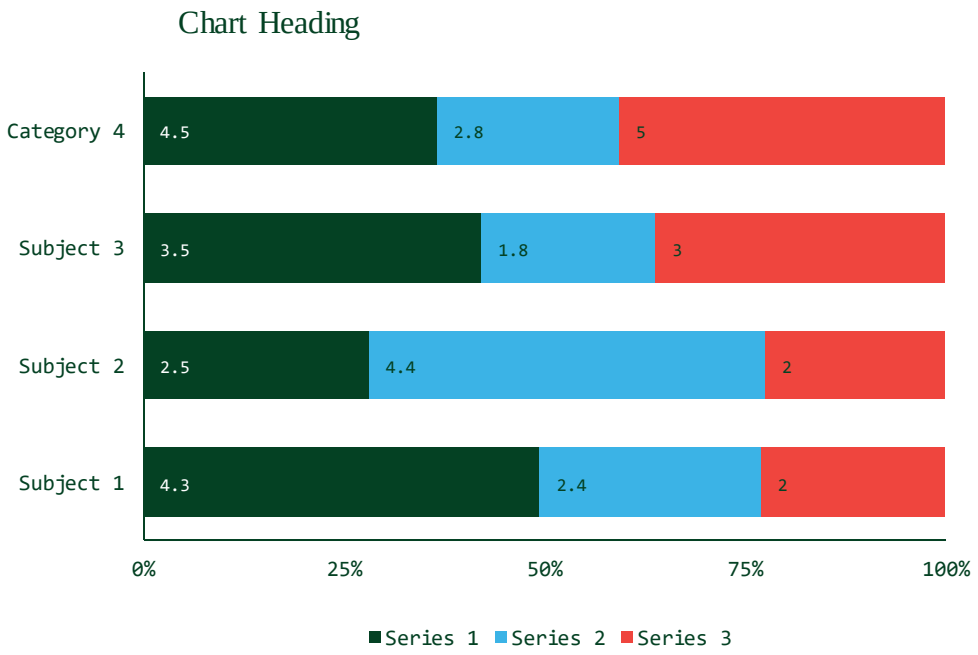
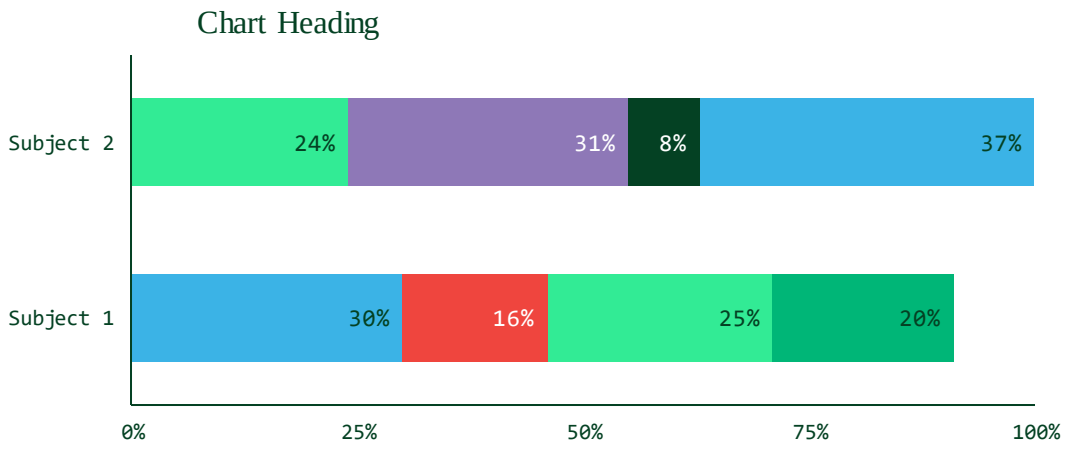
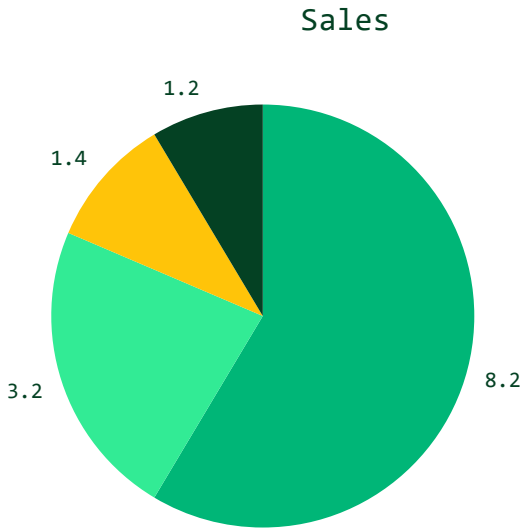


Simple Option for all users



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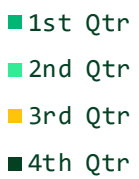
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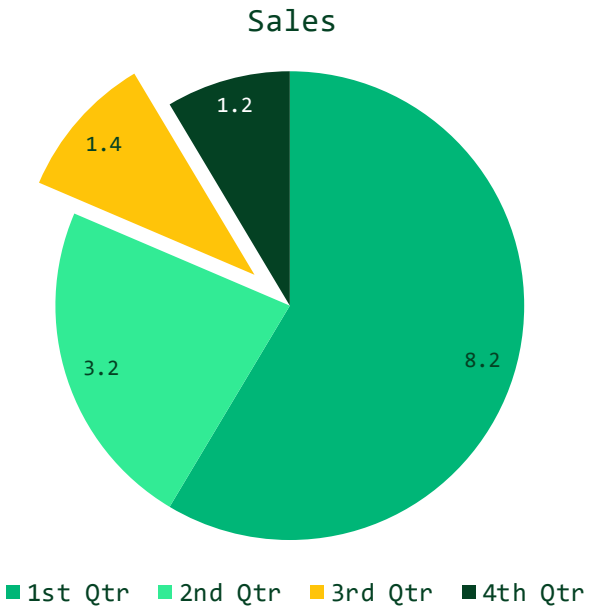
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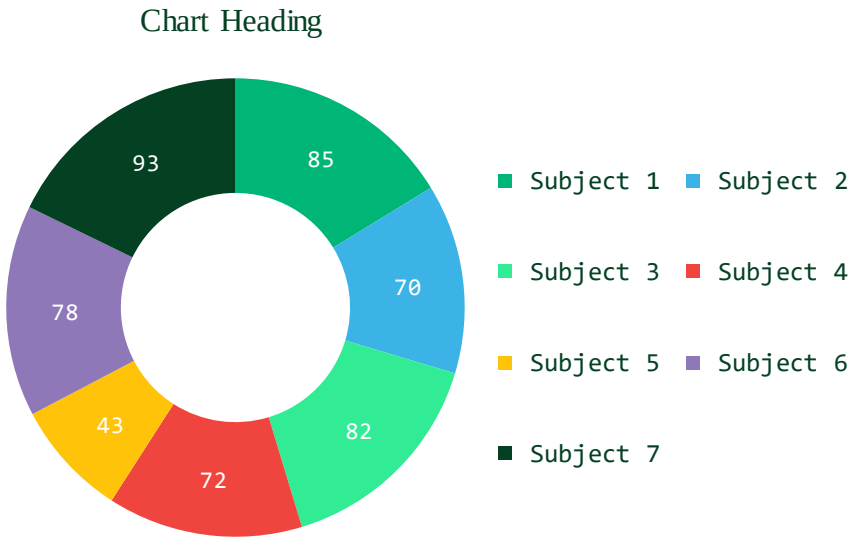
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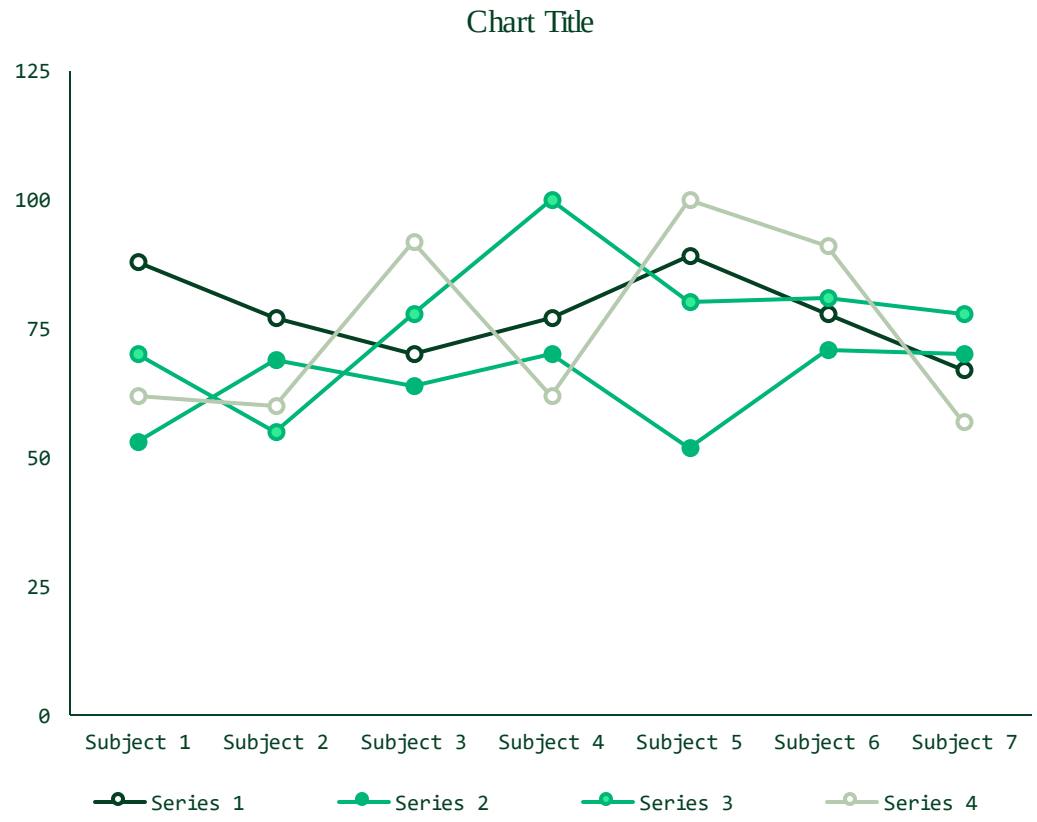
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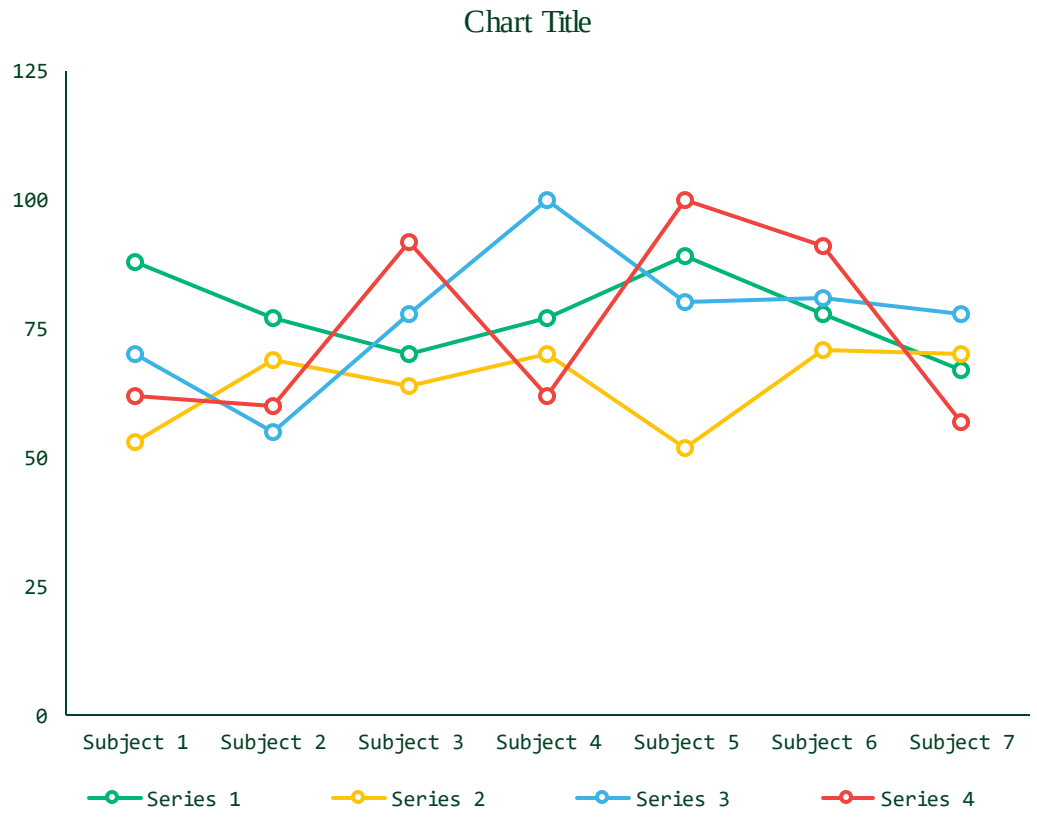
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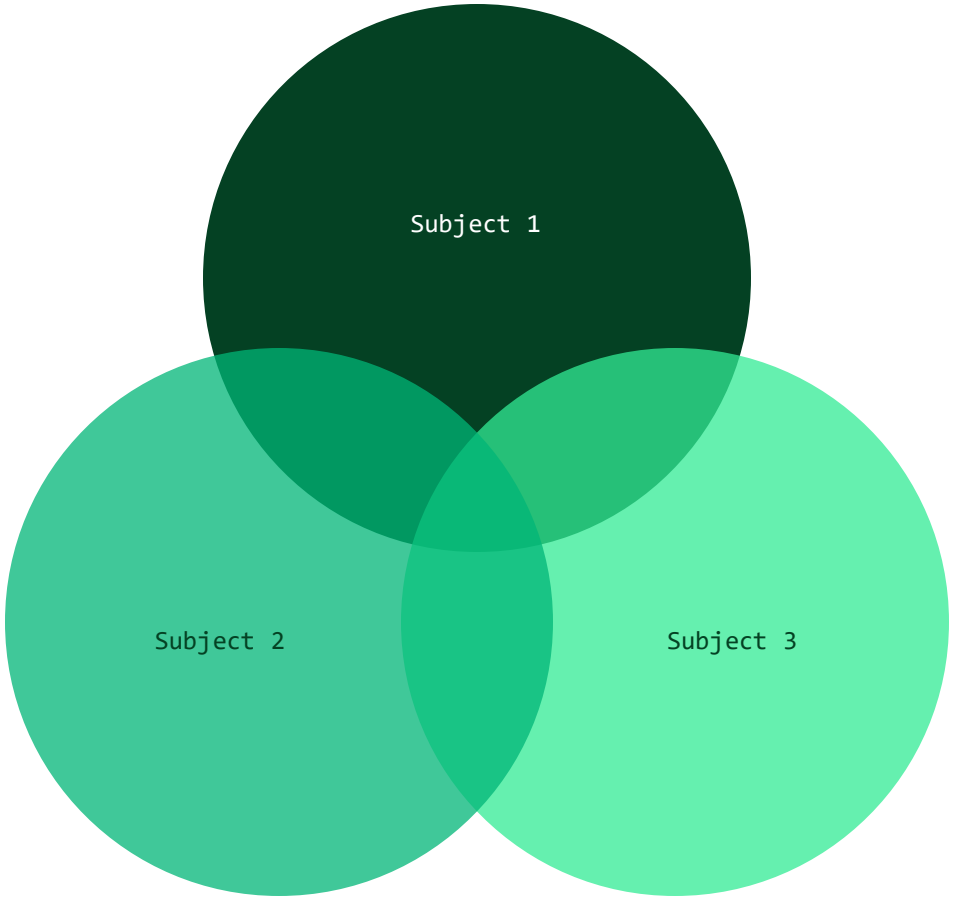
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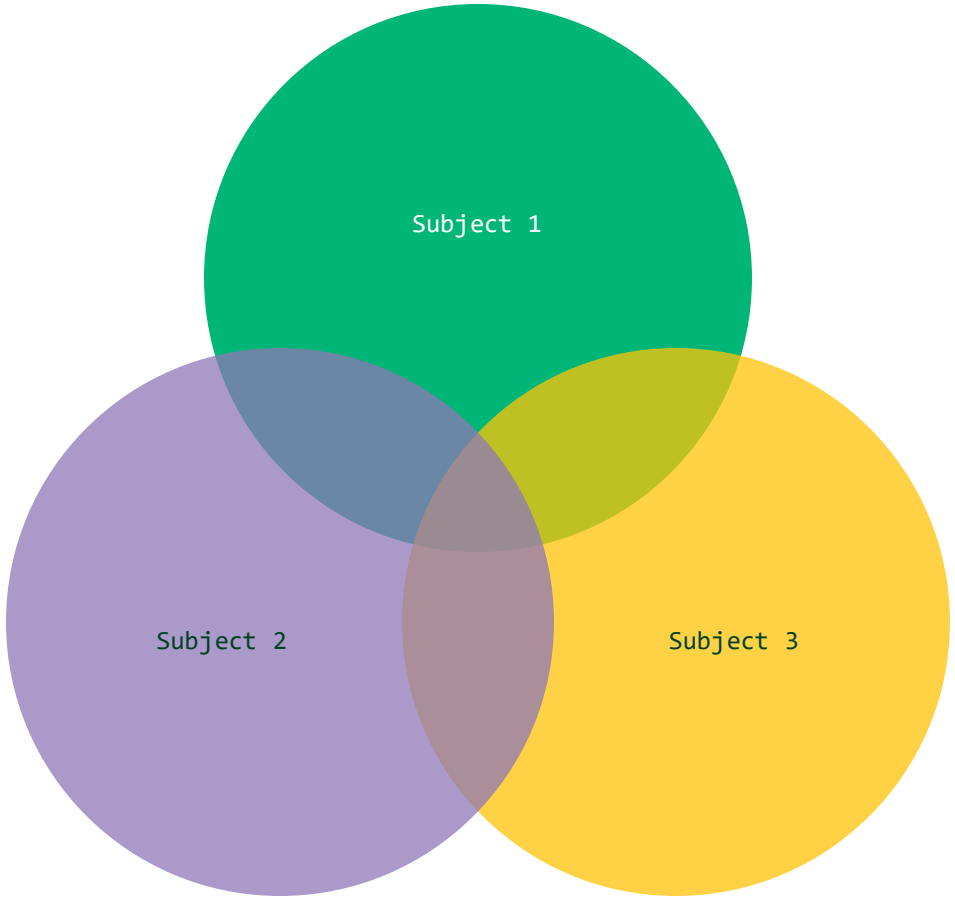
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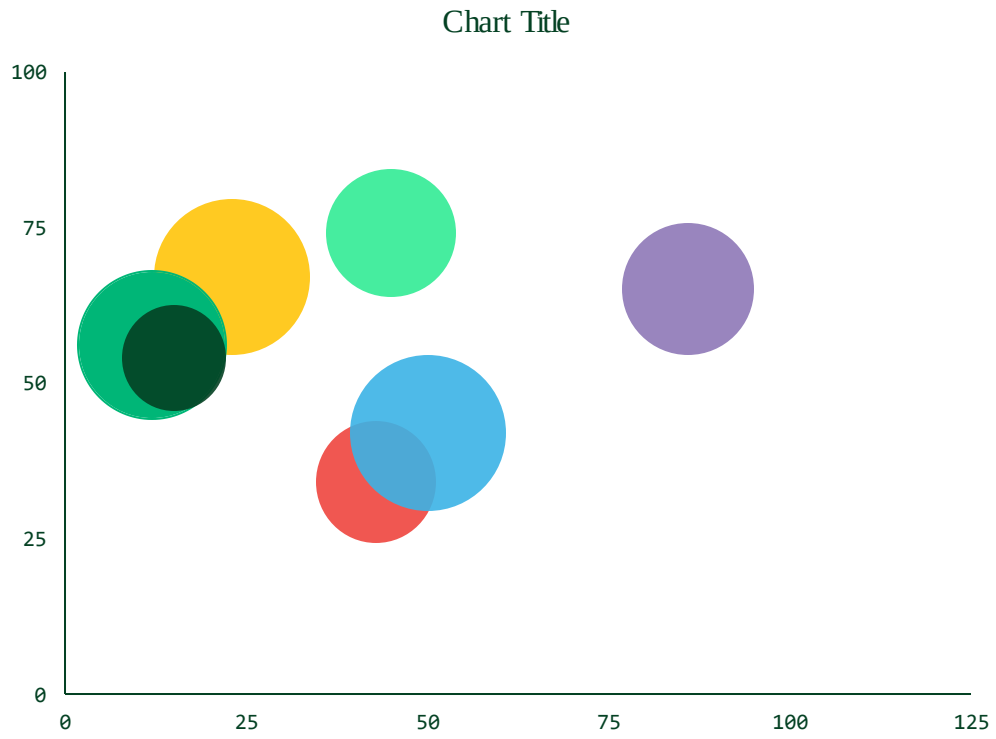
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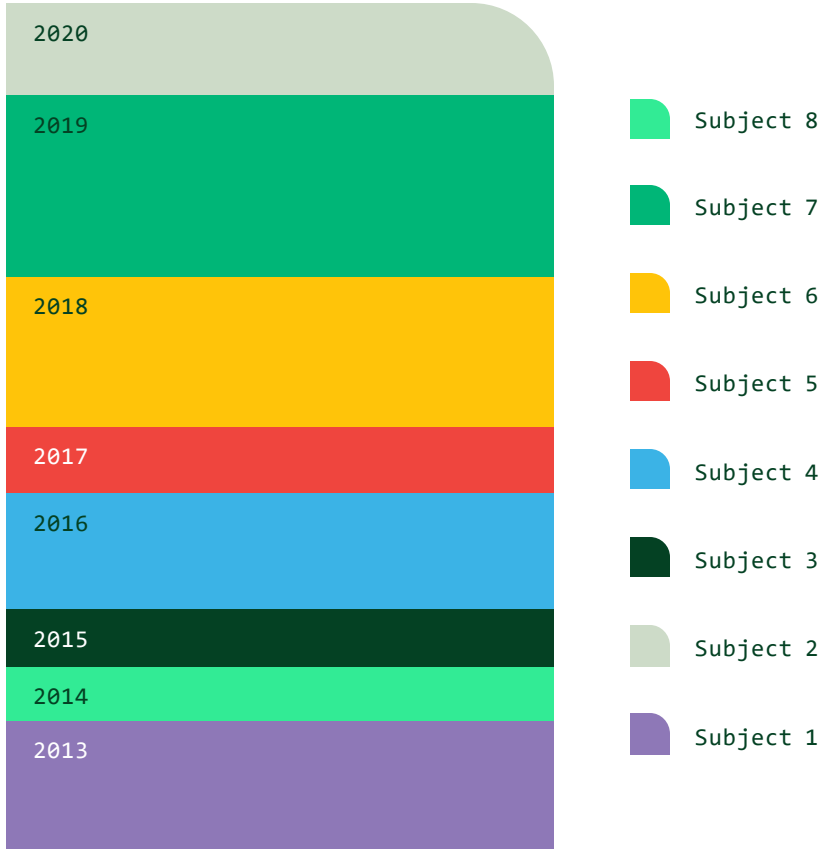
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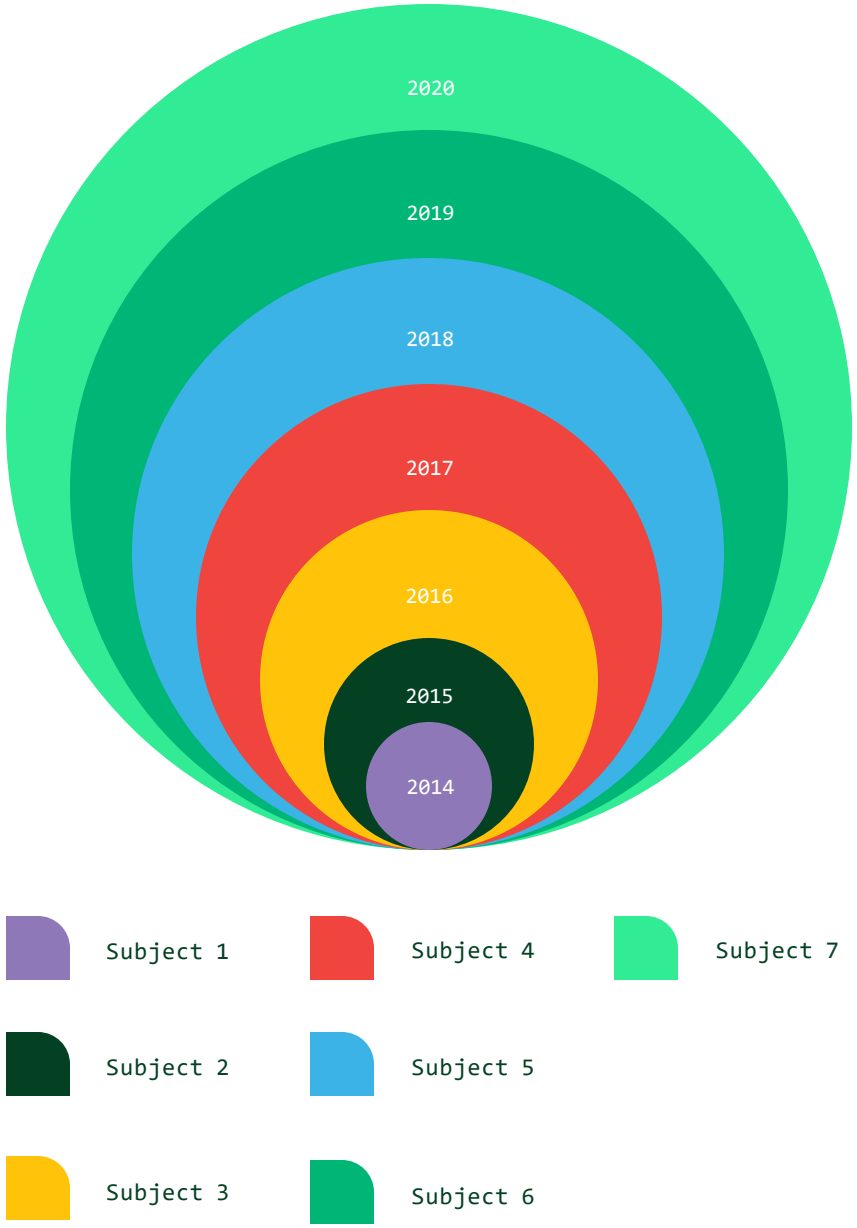
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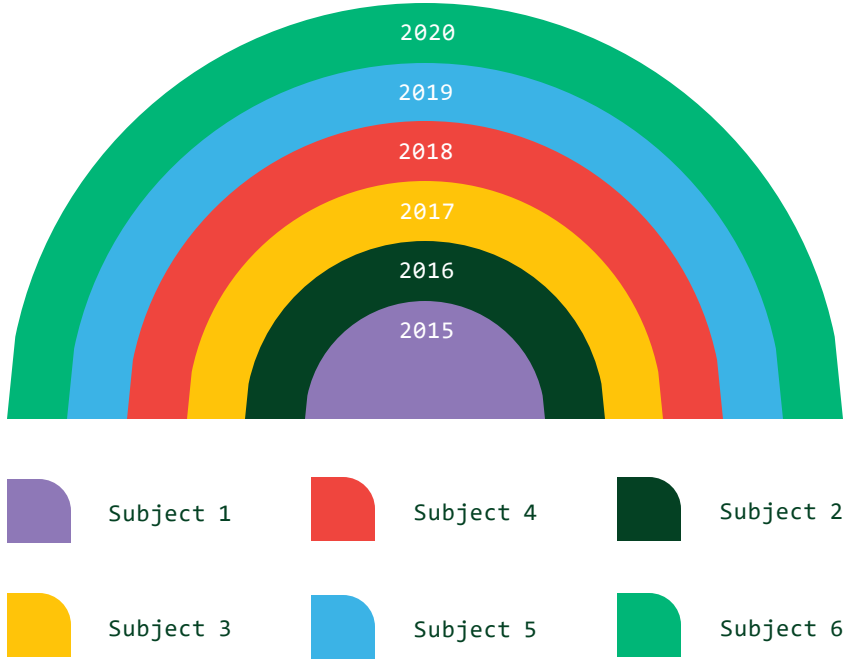
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