Why Engineers Don’t Do RDM

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A Good Engineer Is a Lazy Engineer

Some Engineering Creeds

- „A good engineer is a lazy engineer.“

  → „Master the essential abilities. You got too much to do to focus on other stuff.“
  → Everything must be **efficient and / or effective**

- „There is a method. If there is none: Create a method!“

  → For the many different engineers‘ tasks, there is almost always a **standardized method**
  → While engineers are usually good in finding new solutions to technical problems, their methods seldomly change

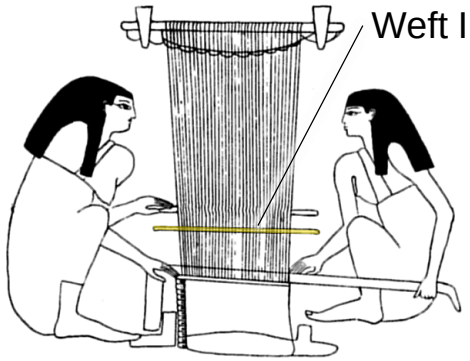
[1]

Futuristic Case Study – Engineering Research

Futuristic Case Study – Engineering Methods

Current Process Analysis

- Determine process goals
  - High production speed
- Identify bottlenecks
  - Weft insertion speed
- Address bottlenecks with new approach
  - Increase weft insertion rate
  - Rail gun?
- Data output: Process analysis, novel approach



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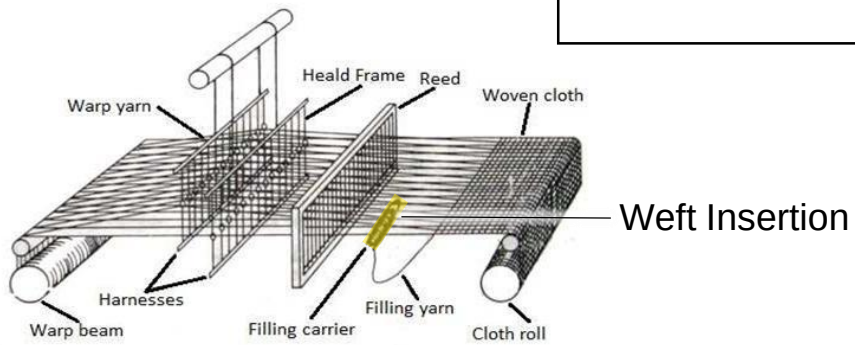

Figure: Basic structure of a loom

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Process Analysis | List of Requirements | Problem Partitioning | System Solution | Mock Up | Detailed Design | Prototype | System Integration | Process Evaluation | Research

Railgun Case Study – Engineering Methods

List of Requirements

- Determine detailed solution goals
- Data output: LoR as a spreadsheet

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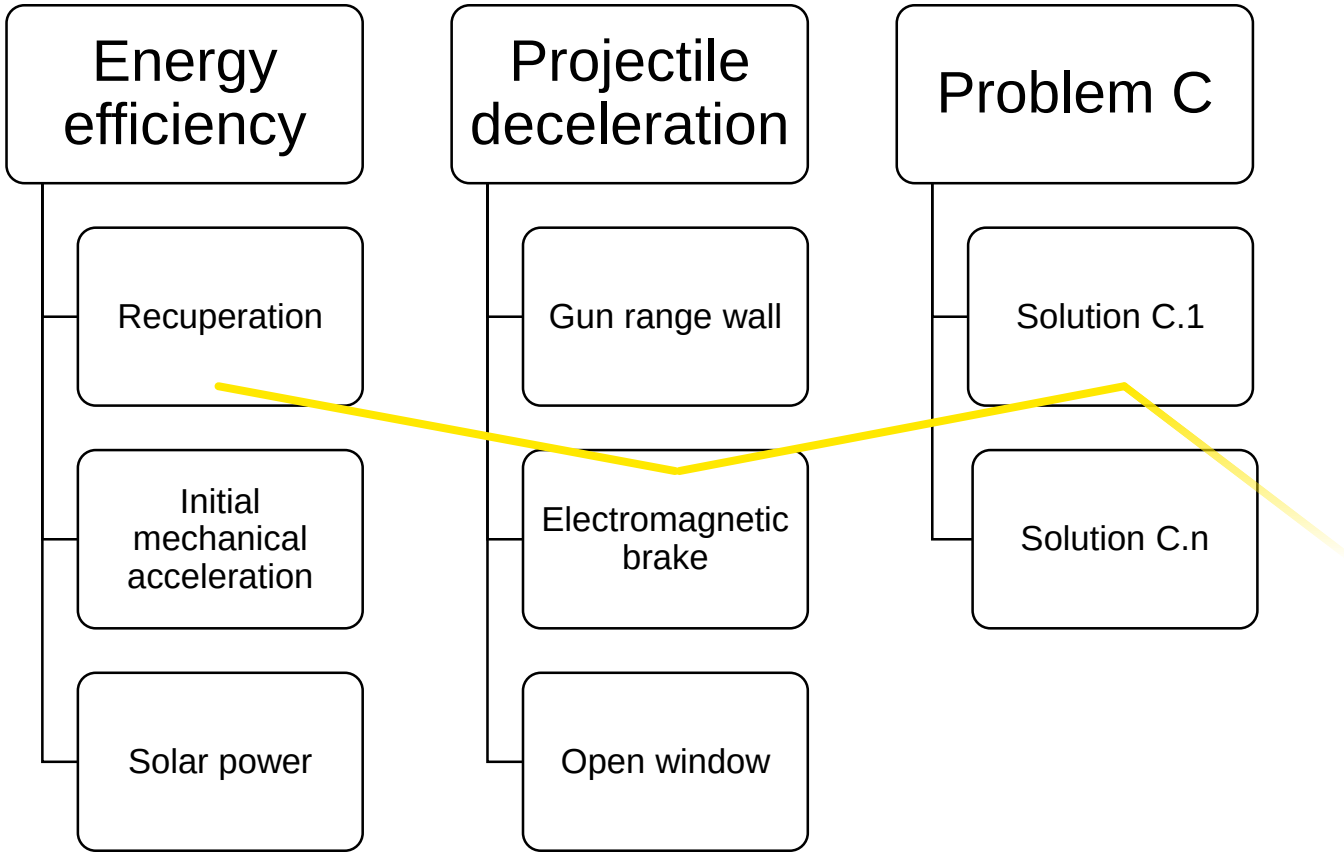
ID	Requirement	Acceptance Criteria	Stakeholder
M01	**Thread Integrity** – The weft yarn must remain intact	≤ 0.5% fiber damage per 100.000 insertions	Materials / R&D
M02	**High Accuracy of Shot Placement**	Max deviation ±0.5 mm at 1 m distance	Controls/Engineering
M03	**Electrical Safety & Machine Protection**	Safety shutdown < 10 ms; interlocked covers	Safety Engineering
M04	**Reliable Timing with Machine Cycle**	≥ 12.000 insertions/min without misfire	Production
M05	**Integration Compatibility**	Retrofit kit + < 2 h installation time	Mechanical Engineering
		Documentation & certifications	

Process Analysis | List of Requirements | Problem Partitioning | System Solution | Mock Up | Detailed Design | Prototype | System Integration | Process Evaluation | Research

Railgun Case Study – Engineering Methods

Problem Partitioning & System Solutions

- Problem set
- Sub-problems
- Sub-solutions
- Solution set



- Data output: Lists of sub-problems, matrices of solution possibilities and subjective evaluation of multiple engineers

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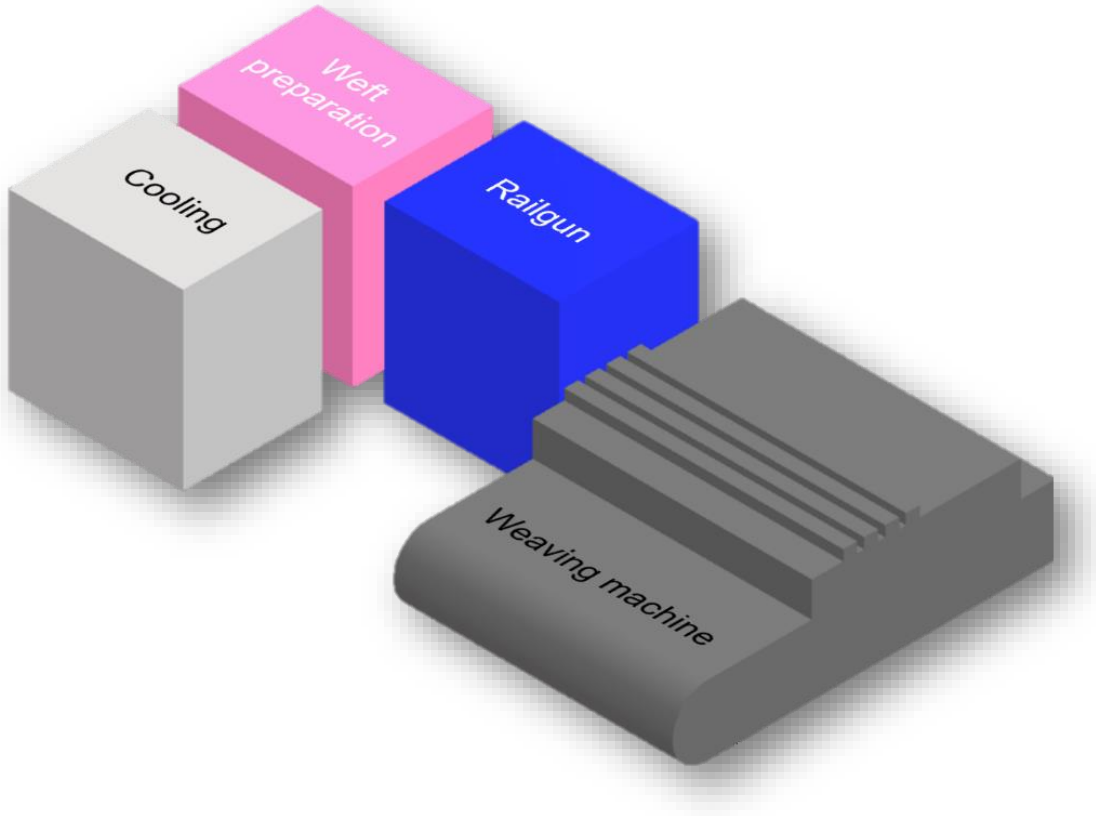
Railgun Case Study – Design Process

Mock-Up

- Usually multiple mock-ups from which to choose one
- Data output: First CAD models, decision process documentation

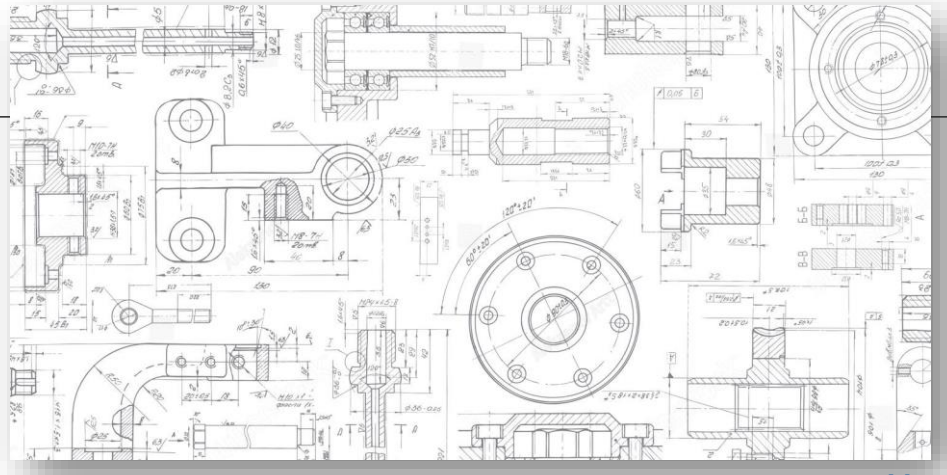


Railgun Case Study – Design Process

Detailed Design

- Progression from mock-up to finished system design

- Data output: Paper sketches, part lists, drawings, CAD models, circuit diagrams, rendered images, software code etc.



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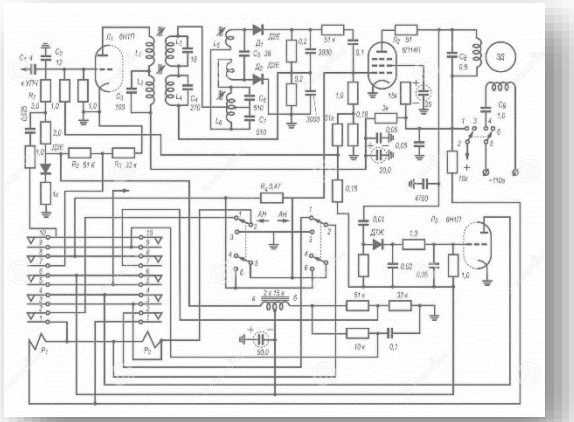

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Process Analysis | List of Requirements | Problem Partitioning | System Solution | Mock Up | Detailed Design | Prototype | System Integration | Process Evaluation | Research

Railgun Case Study – Design Process

Prototyping and Manufacturing

- Translating CAD data into machine code (often G-CODE)
- Procuring necessary parts / components

- Data output: code, procurement documentation, manufacturing process documentation

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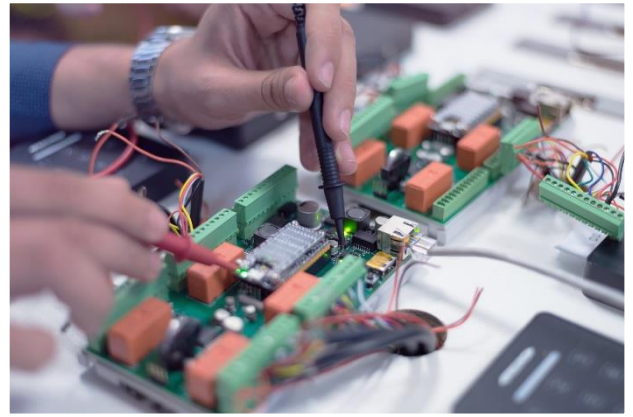

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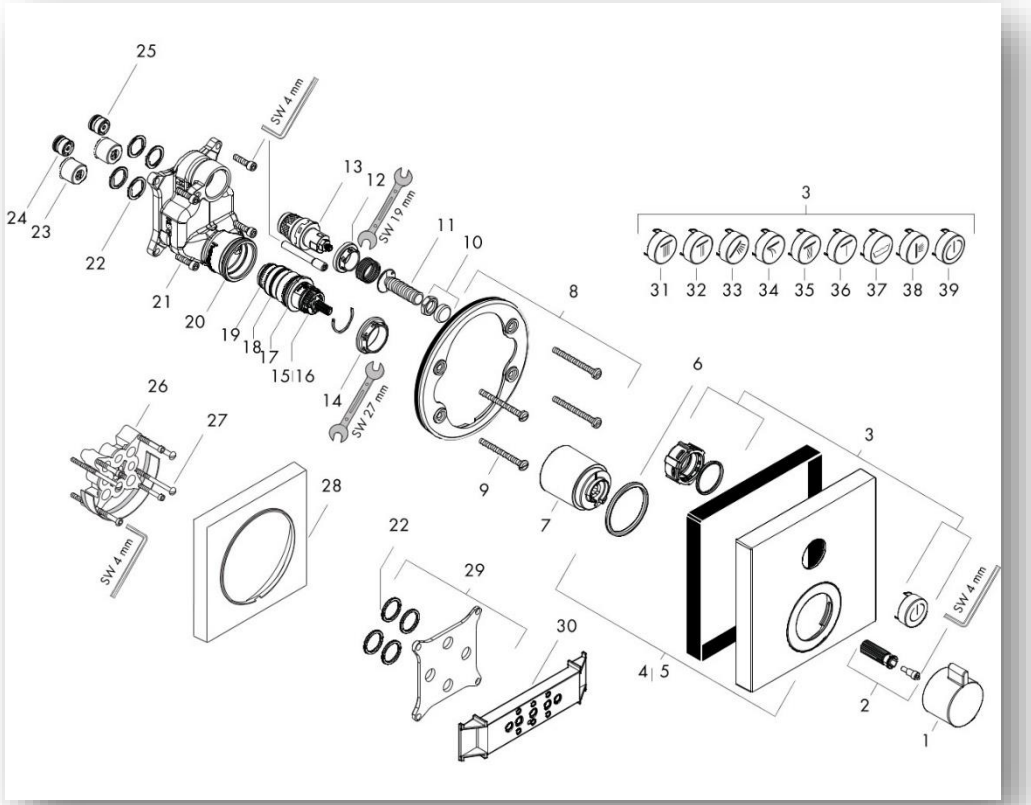
Process Analysis | List of Requirements | Problem Partitioning | System Solution | Mock Up | Detailed Design | Prototype | System Integration | Process Evaluation | Research

Railgun Case Study – Design Process

System Integration

- Combining the different components to a functioning system
- Data output: Assembly & set up manual, (safety) data sheets, assembly documentation, GUI etc.



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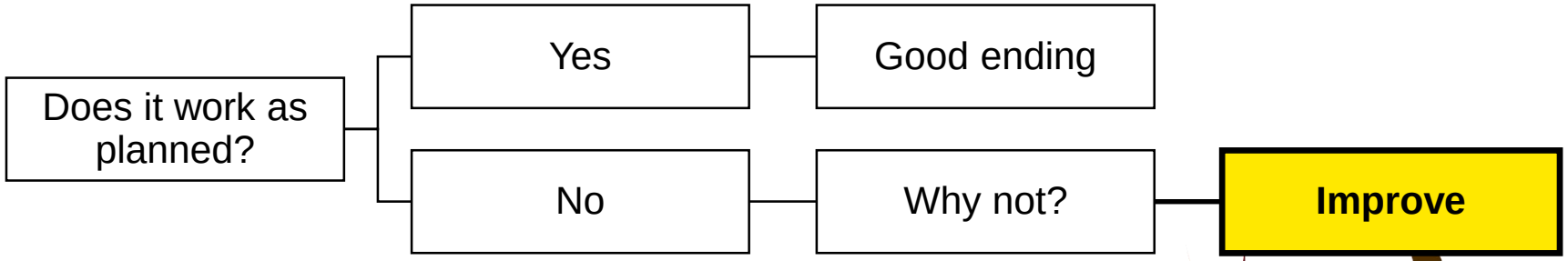
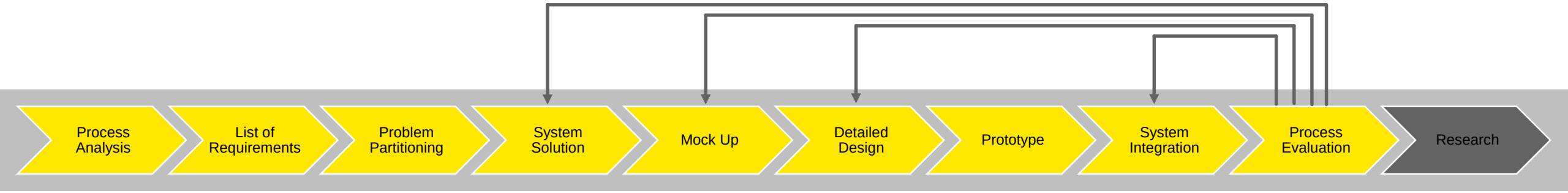
Process Analysis | List of Requirements | Problem Partitioning | System Solution | Mock Up | Detailed Design | Prototype | System Integration | Process Evaluation | Research

Railgun Case Study – Design Process

Process Evaluation



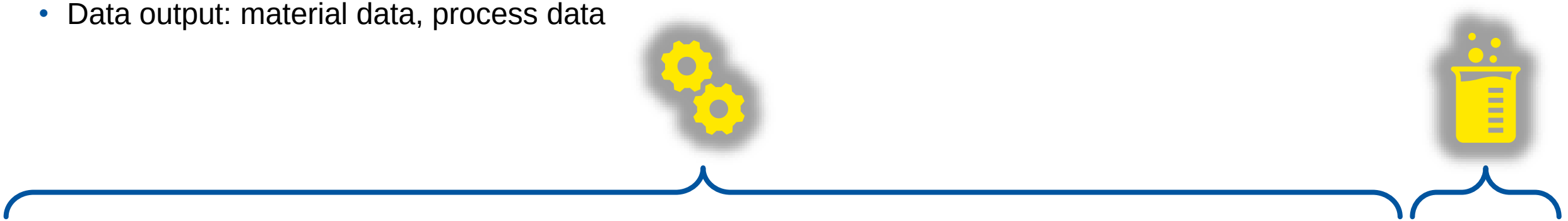
- Data output: Process Data, Trouble Shooting
  Documentation, everything from before



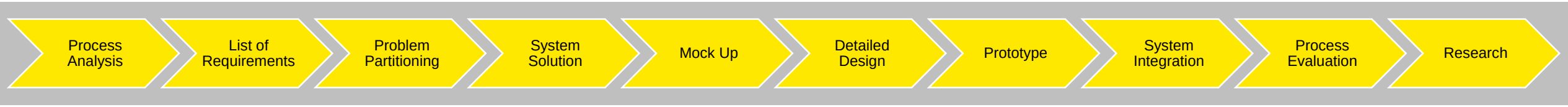
Railgun Case Study – Design Process

Scientific Research

- Parameter studies, process enhancement etc.
- Data output: material data, process data



documentation is painful → bad docum.



Our Approach to Implement RDM at a Multifaceted Research Facility

What we do - Start softly

One step after the other

- We start with proper experimental documentation

  → electronic lab notebook (ELN)

ELN integration

We…

- Formed a small team of 6 scientists
- Set up a structure for 100 scientists + their students across 13 research groups
- Prepared templates for all equipment and material we use
- Already integrated all our testing machines into eLabFTW
- Did a pilot phase with our small team

Structure

Pilot

- Found a sufficient amount of admins for all our teams
- Do regular admin meetings
- Offered roll-out workshops

Roll-Out

- Implemented it in onboarding of new scientists
- Include it in special lectures aswell as students‘ works
- Regularly exchange with other (engineering) institutes

Knowledge Transfer

Future RDM at our institute

As soon as our ELN works somewhat smoothly, we will address other RDM aspects like

Data Management Plans

Publishing

Archiving

Why Engineers Don‘t Do RDM

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