# Presentation Script

## 1. Introduction (Chris)

Hello everyone.
Our project addresses a real workshop need at GTA WoodWorks. After fabrication, many displaced screws are discarded even though a meaningful portion are still reusable. Mr. Ginsberg, the owner, needs a system that can reclaim and sort these screws mainly by **rust** and **length**, while requiring minimal manual effort and fitting into the existing workshop without permanently occupying valuable workspace. The goal is not to completely replace the purchase of new screws, but to act as a practical supplement that makes reuse worthwhile.

From the beginning, we recognized that this was not just a technical sorting problem. It was also a workshop adoption problem. A system that is too complex, too large, or too inconvenient would not realistically be used, even if it could perform more functions. Because of that, our design process consistently emphasized practical functionality, compactness, and evidence-based decisions.

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## 2. Brief of Final Chosen Concept (Keira)

- Our final chosen concept uses **computer vision for rust detection** and a **gravity ramp for grouped length sorting**.
- This concept was selected because it balanced:
    - strong performance in the key requirements
    - a compact footprint
    - lower added complexity
    - better suitability for real workshop use
- That is why the final concept combines one active sensing method, computer vision, with one passive sorting method, the gravity ramp.

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## 3. DfX and Design Priorities (Emma)

- Our main DfX priorities were **functionality** and **sustainability**.
- **Functionality** meant the design had to be:
    - simple to operate
    - reliable during repeated use

    - suitable for a real woodworking shop where space and input time are limited
- **Sustainability** meant:
    - reclaiming reusable screws instead of discarding them
    - reducing the use of electrical energy & power consumption
    - keeping the system compact enough to remain usable long term

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# 4. Goals and Rescoping (Angela)

- Our design goals were to:
    - accurately identify reusable Robertson screws for reclaim
    - reduce time and manual effort compared with the current workflow
    - operate within workshop space constraints
- Stakeholder input helped us narrow the scope:
    - Mr. Ginsberg said that about 99 percent of screws are Robertson
    - rust and length were the main sorting needs
    - head shape was removed from scope because it has a high requirement for camera and lighting based on literature and our own testing failed to yield consistent results
- Length sorting was also changed into broader practical bins:
    - Short (¾ - 1 inch)
    - Medium (1 ¼ - 2 inch)
    - Long (2 ¼ - 3 inch)
- This made the system more aligned with actual workshop practice and easier to achieve reliably.

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# 5. Evaluation Criteria (Angela)

- Based on the pairwise comparison, we ranked the 4 most important objectives:
    - fit within a 30 by 30 centimeter footprint during operation
    - operate continuously for at least 5 minutes
    - Rust sorting accuracy
    - Length sorting accuracy
- These were the most important criteria in concept selection.

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# 6. Diverging Process (Emma)

- We used a **lotus chart** and **SCAMPER** to explore possible concepts.

- The lotus chart explored to diverge based on objectives
- SCAMPER then adapt ideas into integrated systems.
- From this process, we developed three concepts.
- All three concepts used the same:
    - input system of screws
    - conveyor belt base to transport screws
- They differed in how they detected rust and sorted by length.

Explain intake

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## 7. Tesla: Magnet + IR (Keira)

- Tesla used:
    - a magnetic Hall sensor for rust-related sensing
    - an IR sensor for length measurement
- Its advantages were:
    - simple sensing hardware
    - relatively compact added components

The idea was that rusted and unrusted screws would have varying deviations from the baseline hall sensor reading

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## 8. Ohm: Electric Sensor + Computer Vision (Emma)

- Ohm used:
    - an electric sensor to measure resistance for rust detection
    - computer vision in the sorting process
- The idea was that rusted screws would show higher resistance.

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## 9. ReScrewer: Computer Vision + Gravity Ramp (Chris)

- Concept 3 used:
    - **computer vision** for rust detection
    - a **gravity ramp** for grouped length sorting

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## 10. Converging: Measurement Matrix (Emma)

- We compared the three concepts using a measurement matrix.
- The four key criteria were the pairwise comparison:
    - **D1** footprint
    - **B3** continuous operation for at least 5 minutes
    - **A1** corrosion sorting accuracy
    - **A2** grouped length sorting accuracy

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## 11. Pugh Chart and Final Selection (Emma)

- In the first Pugh chart round:
    - Magnet + IR was shown to be the weakest concept
    - it underperformed in the two most important functions, corrosion and length sorting
- This removed it from final consideration.
- In the second round:
    - Computer Vision + Gravity Ramp was compared directly with Electric + Computer Vision
    - the analysis showed that Computer Vision + Gravity Ramp was the better overall design
- The reason was that it achieved strong functional performance while occupying less space and using a simpler system.
- The matrix showed:
    - Tesla was the most compact, but the magnetic field difference was not strong enough to differentiate rust from unrusted
    - Ohm took up too much space due to the additional ohmeter attachment on the side
    - ReScrewer was able to put out good performance from the computer vision model while being under the size restraint
- This supported the idea that the best concept was the one with the best overall balance, not simply the most accurate or the smallest.

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## 12. Team Position (Keira)

- Our team position was to:
    - design for workshop environment
    - Prioritise high adoptability
    - prefer efficient systems

- This directly influenced our design decisions:
  - the 30 × 30 cm footprint and 5 minute continuous operation were major priorities
  - head shape was scoped out
  - length was grouped into practical bins

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## 13. Sustainability (Chris)

- Our final design also reflected sustainability priorities.
- We believe that a reclaim system only reduces waste if it is practical enough to remain in use over time.
- Sustainability in our design came from:
  - reclaiming reusable screws
  - keeping the system compact and usable
  - Minimising electrical components and power consumption

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## 14. Next Steps (Chris)

- The main next steps would be:
  - integrate the input system, conveyor belt, and ramp sorting mechanism into one, cohesive, automated machine
  - validate the system directly in the GTA WoodWorks environment
  - Add another lifter and rotator to increase the rate of screw intake into the conveyor belt
  - Implement the ability for the conveyor belt to stop when the screw aligns in the frame for clearer photos
  - Consider manufacturing a better physical model with sustainable materials such as wood