ETA-DIY-BIG printer project

Meeting notes from 2019-11-26 meeting

Summary

Agenda

1. Build "big decision flow chart" for the project.
2. Talk about a project name (I hate this part - someone please just pick a cool name)
3. Take a first crack a writing down the project goals and objectives.

Meeting Attendees:

Mike, Doug, Mark (came in late and reviewed our porposed decisions)

Meeting Notes

- We reviewed the “big decision” flow charts, discussed several of the decisions we need to make and have proposals for them. Each proposed decision is documented on it's own page and will be open for public review, discussion, ridicule, etc via Slack until the next meeting (12/3, 9am). Those pages follow directly. In addition, on the decision flow chart pages, these proposed decisions are highlighted in Orange.
- Project Name - One decision proposal we have is to highly leverage Mark McComsey's printer design (his 3rd printer design). Since this will be a derivative of that, we decided to call the project the “Mark4” in his honor.
- Project goals and objectives: We did a brief review, but there is probably more to be done here.
- Short term goal: We have a short term goal (next 1-2 weeks) to identify ~$1200 of materials we can buy that will have a low risk of not being eventually used. We need this “low risk” bit because the design is not finalized and will not be before the budgeted money will expire. Things go on the shopping list as decisions get made.

Proposed Decisions

This section of the noted holds decisions we propose to lock in next week, including rationale. If you think we are heading in a wrong direction, please say something, including which other direction you think we should be heading.

Location of printer?

Proposed decision:

Printer will be located where exhaust fumes can be taken outside the building – proposed site is on the table under the exhaust hood. Depth of this bench is 700mm.

Proposal date: 2019-11-26
Proposed ratification date: 2019-12-03

Rationale

- Many materials we would like to print off-gas unpleasant fumes and need to be ducted .

Concerns

- Space under the hood needs to be shared with the kiln and planned ceramic printer.
- When placed on the existing bench, the print area for lox Z-axis values (first layers and short parts) may be too high for easy observation. We may need to have a lower platform for the printer and duct exhaust to the fume hood.

What material items does this decision allow us to purchase?

-

Next steps

- Collect feedback, ratify decision

What printer style?

Proposed decision:
Build a Core XY style printer. Lots of leverage from an existing design.

Proposal date: 2019-11-26
Proposed ratification date: 2019-12-03

Rationale

- No movement of the part being built means less moving mass. Lower torques that would tend to trip the part off the build plate and/or oppose the motion intended by the motors.
- Why not Hbot? CoreXY designs are more stable than Hbot. Online reference (http://www.doublejumpelectric.com/projects/core_xy/2014-07-15-core_xy/)
- Why not cartesian? A cartesian has 2 moving rails (one on X and one on Y). This means more moving mass, and the challenges associated with mass.
- Lots of leverage of an existing design means less risk of costly changes being required to meet part quality objectives.

Concerns

-

What material items does this decision allow us to purchase?

-

Next steps

- Collect feedback, ratify decision

Design leverage from where?

Proposed decision:
Make our design a close derivative of the printer Mark McComsey showed us on 11/24.

Proposal date: 2019-11-26
Proposed ratification date: 2019-12-03

Rationale
- Mark's design seems structurally very stable and robust.
- The Belt layout does not contain fundamental design errors of belts not parallel to rails.
- Mark has a design in Fusion 360 we can use.
- Mark has demonstrated the easy manufacturability of his component parts.

Concerns
- Mark is just getting started with his first prints now. What if changes are needed? We believe changes can be made without significant risk to materials we purchase.

What material items does this decision allow us to purchase?
- Aluminum plates for top and bottom (need to pick plate size)
- 4080 Aluminum extrusions for corner columns (need to pick a length)
- Garolite sheet 24" x 24" x 1/4" sheet for electronics mount

Next steps
- Collect feedback, ratify decision

Project Name?

Proposed decision:
Name this printer “The Mark4”.

Proposal date: 2019-11-26
Proposed ratification date: 2019-12-03

Rationale
- Name is in honor of the high leverage from Mark McComsey's third printer design.

Concerns
-

What material items does this decision allow us to purchase?
-

Next steps
- Collect feedback, ratify decision

Build Plate Size?

Proposed decision:
Printable area of 350mm (X) and 350mm (Y)

Proposal date: 2019-11-26
Proposed ratification date: 2019-12-03

Rationale
- This build plate size should enable printing of “helmet” sized objects

Concerns
- Mark's printable Y dimension is only 290mm. After discussing with Mark, he feels it will be easy to extend the Y by starting with a larger aluminum plate (24” x 24”)

What material items does this decision allow us to purchase?
- Aluminum plates for top and bottom (need to pick plate size)
- Aluminum plate for X-Bridge
- 4080 Aluminum extrusions for corner columns (need to pick a length)
- Garolite sheet 24" x 24" x 1/4" sheet for electronics mount
- X-Rails (400mm, track can be cut to shorter length if needed)
- Y-Rails (500mm – track can be cut to shorter length if needed)

Next steps
- Collect feedback, ratify decision

Part Max Z-Height?

Proposed decision:
Max part size we can build inside Mark's frame design.

Proposal date: 2019-11-26
Proposed ratification date: 2019-12-03

Rationale
- Mark reports his printer is designed to build parts up to 400mm tall
- We have not locked in on a single-screw Z-axis support (vs 3 screw), but Mark's design supports a 500mm Z-screw, plus motor below it. We feel the frame materials that support this should allow us to build to the 400mm Mark achieved.

Concerns
-

What material items does this decision allow us to purchase?
- 4080 Aluminum extrusions for corner columns

Next steps
- Collect feedback, ratify decision

Enclosed?

Proposed decision:
Printer will be enclosed, and thermally controlled. Follow Mark's direction, using polycarbonate “greenhouse” panels for sides, front, and top enclosure.

Proposal date: 2019-11-26
Proposed ratification date: 2019-12-03

Rationale

- An enclosed printer enables the area around the part to be maintained at a constant temperature, which should make more consistent parts.
- An enclosed printer enables management of fumes, allowing a wider range of materials to be printed.
- An enclosed printer reduces energy required to maintain the build plate temperature.

Concerns

- We will need a fan to mix cool air from outside the enclosure to maintain the internal temperature. Placement will be important to keep drafts from deforming a part while it is being printed.

What material items does this decision allow us to purchase?

- Polycarbonate sheet
- Exhaust fan

Next steps

- Collect feedback, ratify decision

Document repository?

Proposed decision:

We will use the BARN github (https://github.com/BainbridgeArtisanResourceNetwork) as a repository for the documentation of the project, the design, and the operating manuals for the project.

Proposal date: 2019-11-26
Proposed ratification date: 2019-12-03

Rationale

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- We will need a fan to mix cool air from outside the enclosure to maintain the internal temperature. Placement will be important to keep drafts from deforming a part while it is being printed.

What material items does this decision allow us to purchase?

- Polycarbonate sheet
- Exhaust fan

Next steps

- Collect feedback, ratify decision

Decision doc – Document repository

- 2019-11-26
  - Proposed decision: DIY a Core XY style printer
  - Rationale
    -
  - Next steps
    - If not objections, will lock this at our next meeting.

Topics for 12/3/2019

- This page starts a section of material to use in discussion of agenda topics for next week.
  - Which Extruder?
  - Include a Tool Changer?
  - Which electronics parts?

Which Extruder/hotend?

Information:

Requirements
- Default extruder should be dual-material

Features we like:
- Dual gear drive
- Direct drive (vs bowden)

Recommendations:
- (From Mark) Bondtech BMG-X2 and Mosquito hot ends

Include a tool-changer?

Information:

Requirements
- None

Features we like:
- A tool changer give flexibility for multiple materials
- Mark says his design can support the E3D tool changer (but he has not implemented it yet)

Recommendations:
- E3D style tool changer
- Jubilee “variant” of E3D tool changer

Which Electronics?

Information:

Requirements

- Support all the motors, thermocouples, switches, PWM signals etc that we need.

Features we like:

- >8 bit

Recommendations:

- Duet2 + Paneldu touchscreen + (if needed) Duex 5 expander
- Duet3 + HDMI touchscreen

Big decsion list – from proposal

- Design decisions
  - Build plate size
  - Max Z size
  - CoreXY belt layout (mostly pulley arrangement)
  - Idler pulley support (cantilever axles vs other, plate vs rails)
  - Motor mounting (direct vs coupler)
  - Motor selection (size)
  - Rail selection (linear vs something else) and placement.
  - Gantry design
  - Z-axis (single lead screw vs three)
  - Electronics (Duet 2 vs wait for Duet 3, UI)
  - Frame – anti-racking strength (hefty Al stock vs thinner stock with corner strengthening.
  - Manufactured mechanical pieces – 3D printed vs machined.
  - Power distribution and control.
  - Tool changer or permanent tool (and how many nozzles)
  - Extruder type (Bowden, direct drive)
  - Hot end selection
  - Enclosure design and thermal management.

Project Goals

1. Create an ETA community project
2. Make an “industrial grade”, large capacity 3D printer for ETA studio users
    - Big enough for helmets/masks
    - High print quality and fast print speed
    - Easy to use
    - Easy to maintain
    - Well documented

Decision flow – Fundamentals

Printer Style == CoreXY

tion repository == github – Mike to GET A PROJECT CREATED.

Where does the printer live in the studio?

Under fume hood.

Printable materials?
(Max bed temp)
(Max extruder temp)

min quality Print speed
PLA @ 100mm/sec

LEDs
Illumination?
Light show?

Design Leverage points

- Overall Layout == Mark McComsey's Design
- Tool changer (if used) == Jubilee (E3D variant)
- Belt Layout
- Other?

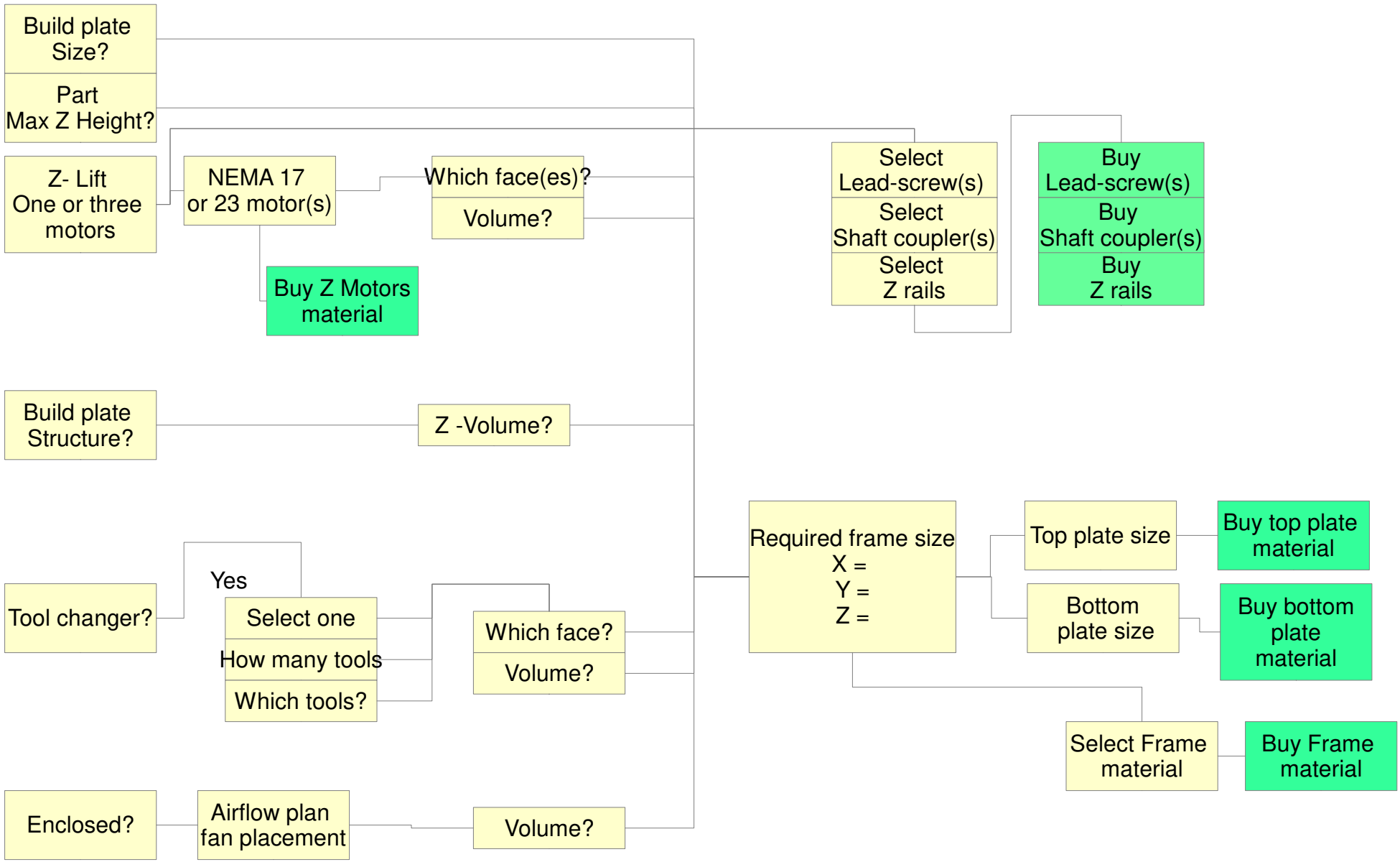
Video capture?

Telemetry?

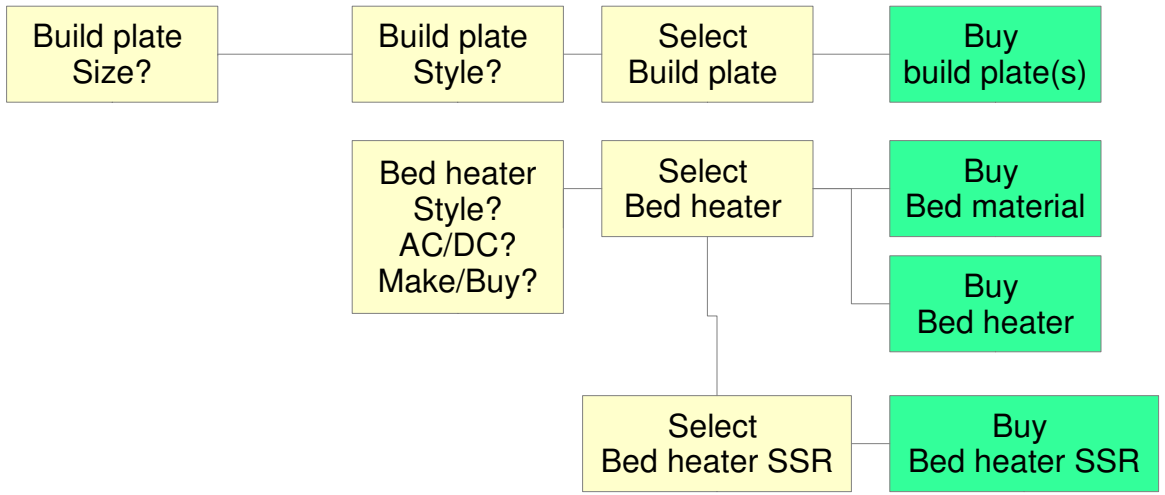
Analysis Core XY belt layout

- 2019-11-27 After the meeting
  - Good reference material
    - https://drmrehorst.blogspot.com/2018/08/corexy-mechanism-layout
    - https://drmrehorst.blogspot.com/2017/07/ummd-corexy-mechanism
    -
  - Rationale
    -
  - Next steps
    - If not objections, will lock this at our next meeting.

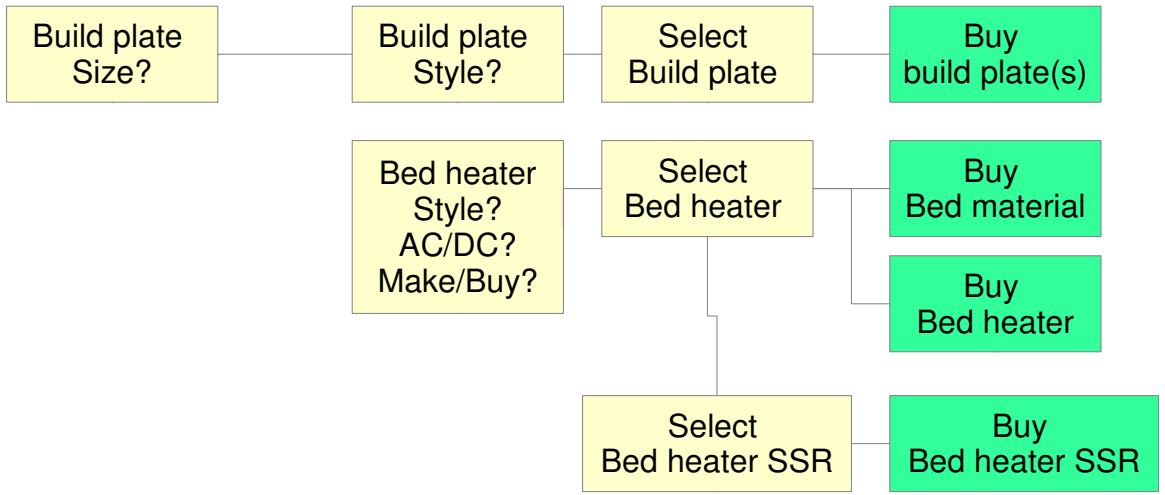
Decision flow – frame size



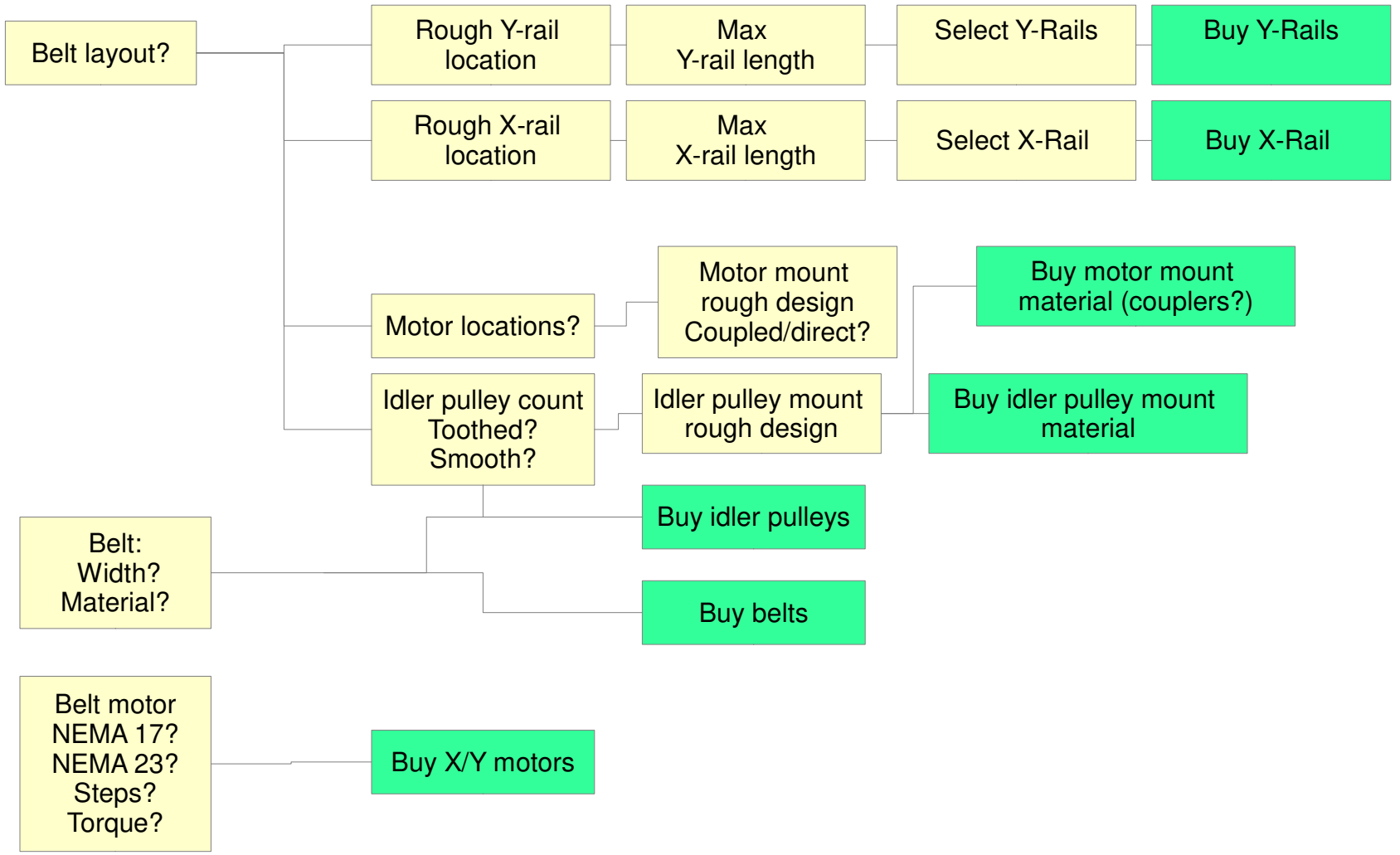
Decision flow – Build plate



Decision flow – Build plate



Decision flow – XY mechanics



Decision flow – Electronics

HW control board
8 vs 32 bit?

Select
controller board

Buy
controller board

Select
User Interface

Buy
User interface

Power budget
- Control board
- Bed heater
- XY motors
- Zmotor(s)
- Extruder(s)
- Hot end(s)
- LEDs
- (Enclosure cooling fan)
- PSU efficiency

Select
Power supply

Buy
Power supply

Decision flow – X crossbar