Automated Documentation for Open Source Hardware

Pieter Hijma

4 Februari 2024

Open Hardware and CAD/CAM at FOSDEM 2024

Goal

Automatically generate IKEA-style assembly instructions
for Open Source Hardware.

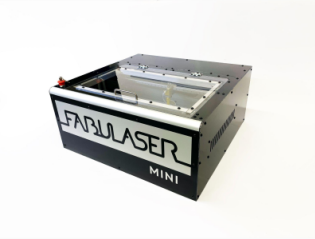
About me

- self-employed software developer / researcher: open source software
  - pieterhijma.net
- currently contract Ondsel
- working on FreeCAD: managing model data
- co-founder of the Open Toolchain Foundation

Example Open Source Hardware (OSH)

The Open Lab Starter Kit by InMachines Ingrassia

- 8 machines
- 3 versions each



Automated Documentation

Problem

- Documentation is crucial for OSH
  - replication
  - collaboration
- However, documentation is:
  - labor intensive
  - always out-of-date

Related Work

Approaches

- Document after the fact
- Document while doing

State-of-the-art

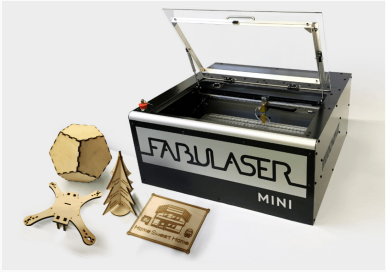
- GitBuilding
  - text oriented
  - lacks a "semantic relation" between the source and documentation

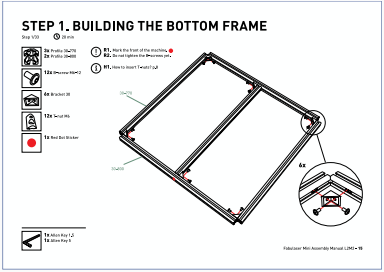
Our goal

- Integrate design and documentation process
- Generate assembly instructions automatically
- Support design evolution

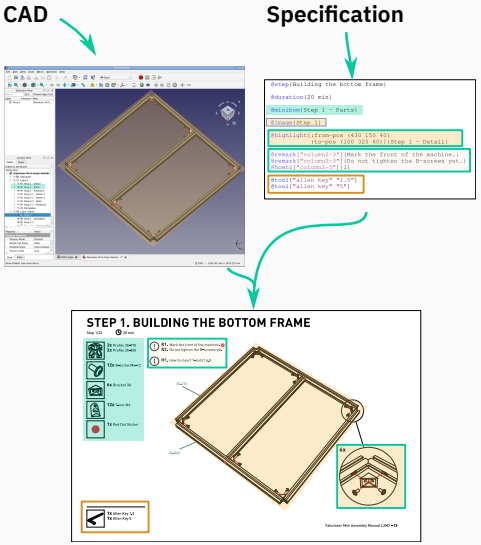
The Fabulaser Manual

- high quality
- 3 persons, multiple months
- difficult to adapt to new versions

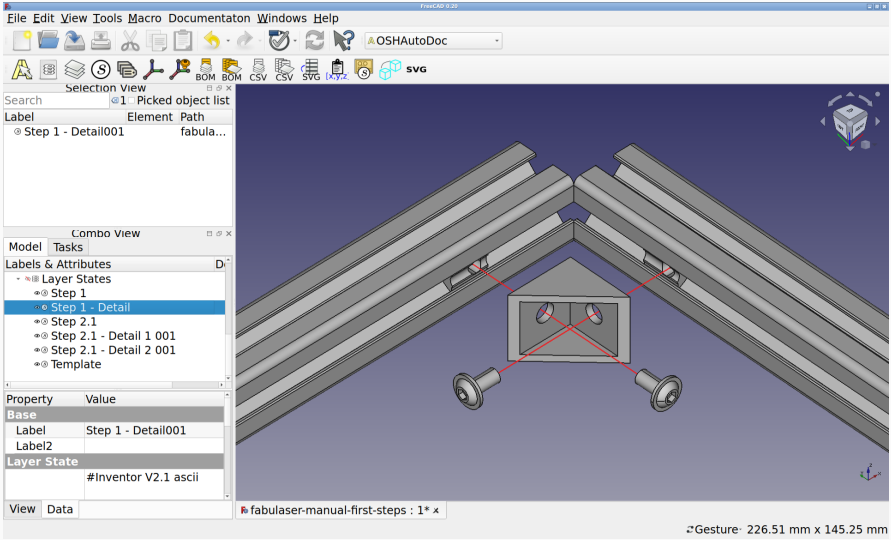




Automated Documentation: Overview



OSH AutoDoc Workbench



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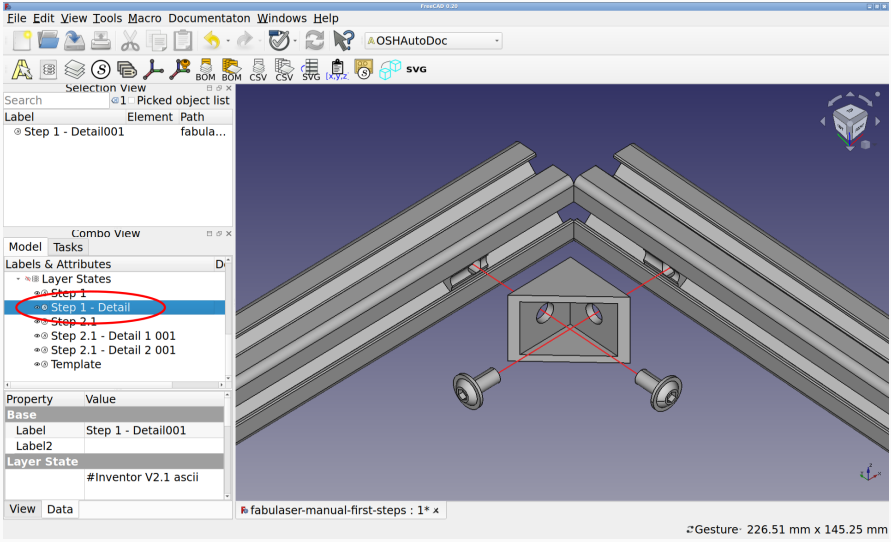

Automated Documentation: Detail

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@step{Building the bottom frame}

@duration{20 min}

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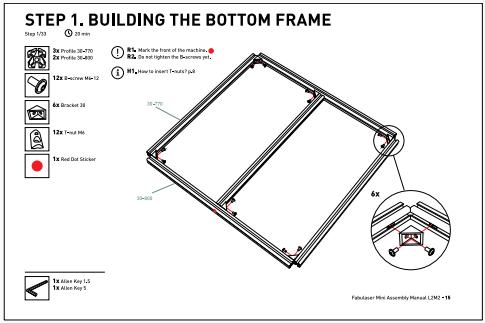

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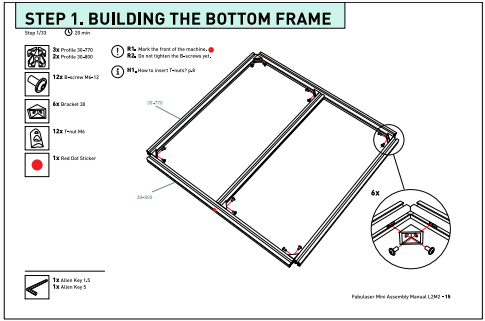

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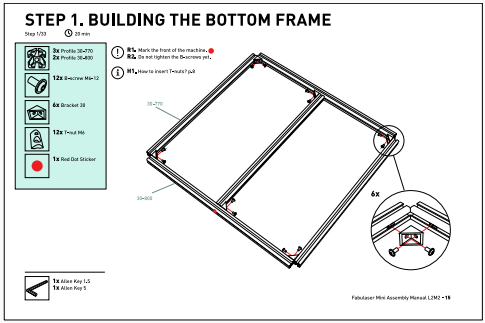

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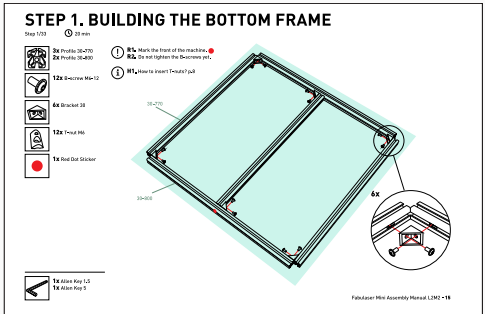

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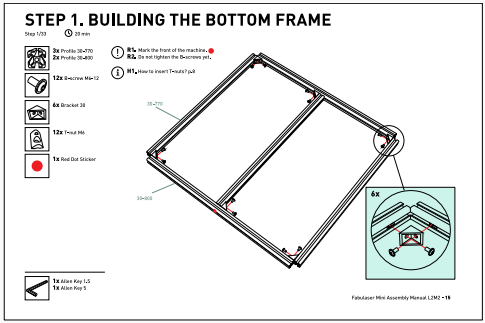

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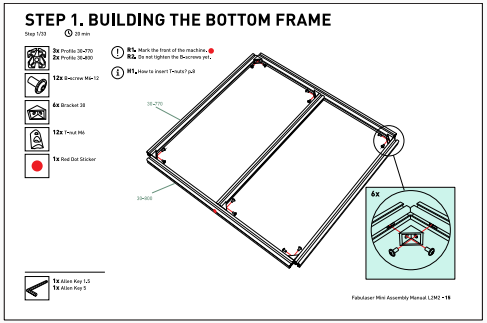

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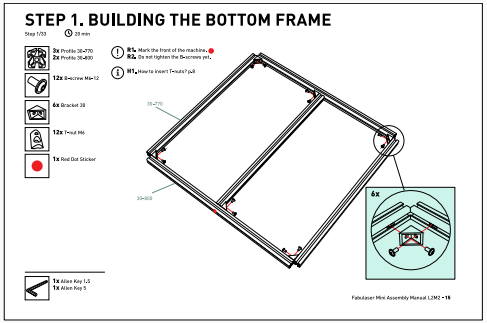

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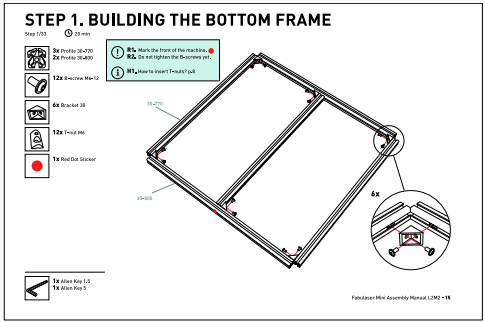

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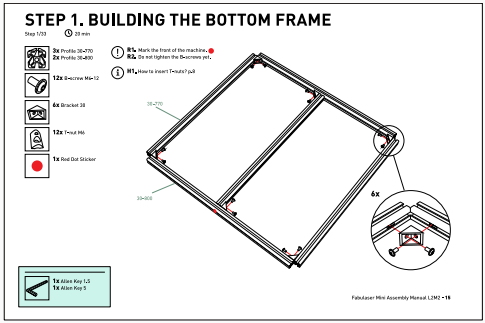
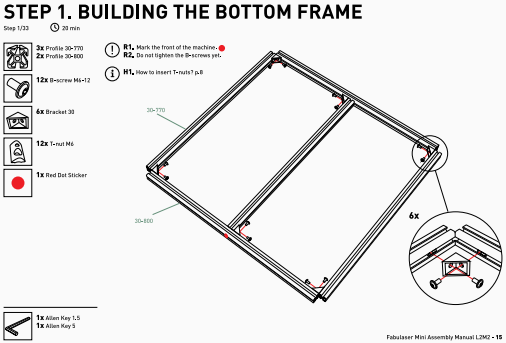
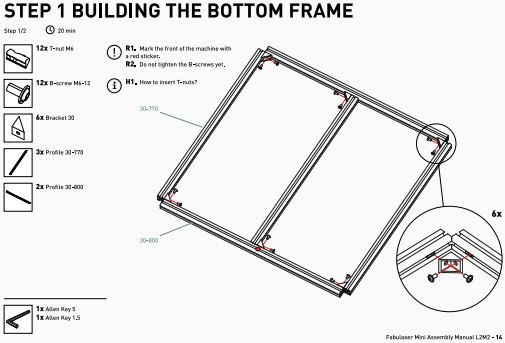


Results: Comparison to Original

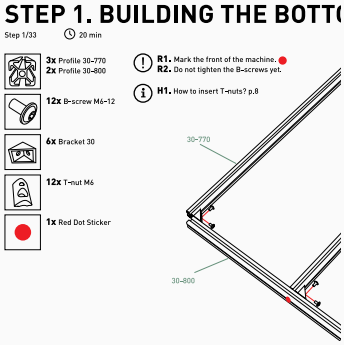


(a) Original



(b) Generated

Results: Comparison to Original



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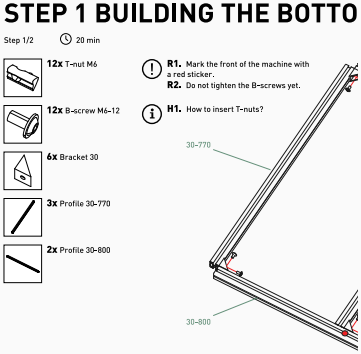

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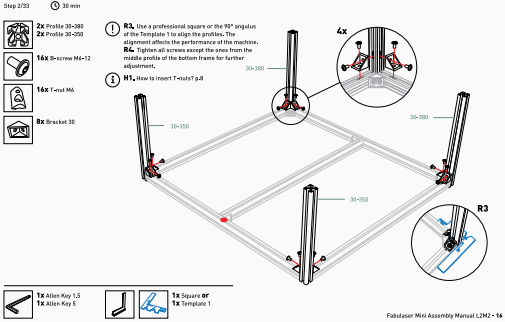

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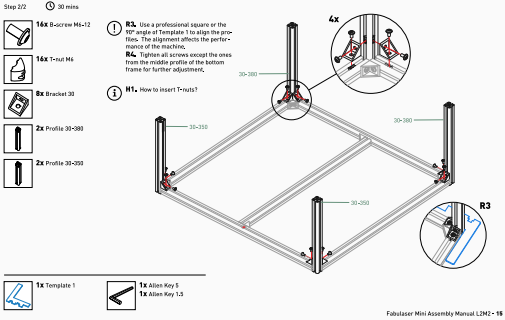
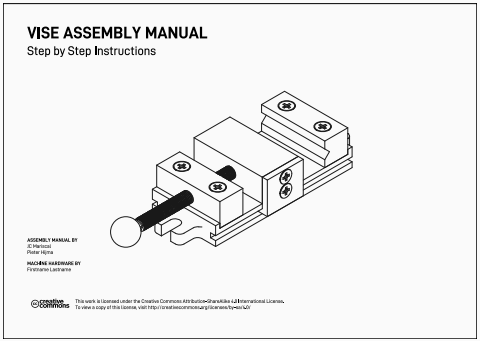


(b) Generated

Results: Indication Time



Machine	Nr. Steps	Time to Complete
Vise	6	24 minutes
Vertical Lathe	5	26 minutes

Design Evolution

Going from Version n to $n + 1$

- Minor changes do not require action at all
- If actions are required, they are limited in scope
  - limited set of abstractions

Acknowledgement

Collaboration

- J.C. Mariscal-Melgar - Helmut Schmidt University
- Daniele Ingrassia, Marc Kohlen, Liane Sayuri Honda - InMachines Ingrassia

Past funding

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Automated Documentation

Our research proposes a novel solution to the Documentation Update Problem in the collaborative environment of Open Source Hardware.

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