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# Fundamentals of Electronic Rapid Prototyping

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Lead Embedded Systems Engineer

*Gearbox Europlacer*

*Nairobi, Kenya*





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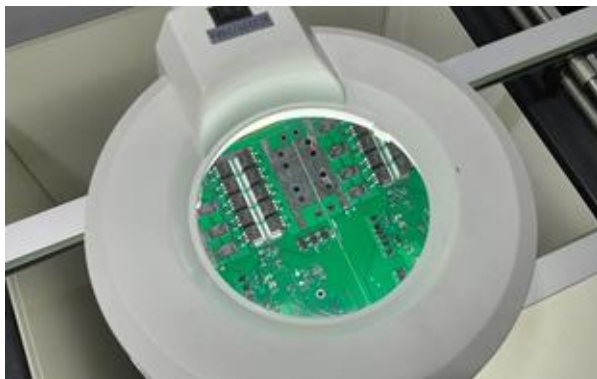
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## Gearbox Europlacer (GBE) – Who Are We

We are an Electronics Manufacturing Services company based in Nairobi, Kenya. We leverage the rapid growth of the electronics sector in the region by providing the following services to mature companies, start-ups, and innovators across Africa and the rest of the World.

GBE delivers value by providing:

- Highly competitive, world-class **manufacturing services** to customers needing IoT devices across the world.
- **Product development services** for companies looking to enter the African market with best-fit products





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## Who Am I

**Designation:** Lead Embedded Systems Engineer

**PCB Design :** KiCAD, Altium Designer

**Main Languages :** C, C++, python

**Background :** Electrical and Electronics Engineering.





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## Introduction

- In today's presentation, we explore...
  - What Rapid Prototyping in Electronics means
  - Why it matters in modern electronics
  - The tools, platforms and workflows
  - Common mistakes and best practices
  - How we get from prototype to a product (at Gearbox Europlacer)



## Fundamentals of Electronic Rapid Prototyping

- What is rapid prototyping in the electronics context?
  - Rapid electronics prototyping is a fast-tracked development process used to quickly turn an *initial concept* into a *functional, testable device*.
  - it focuses on *high-speed iteration* to validate hardware and firmware designs before committing to *expensive* mass production





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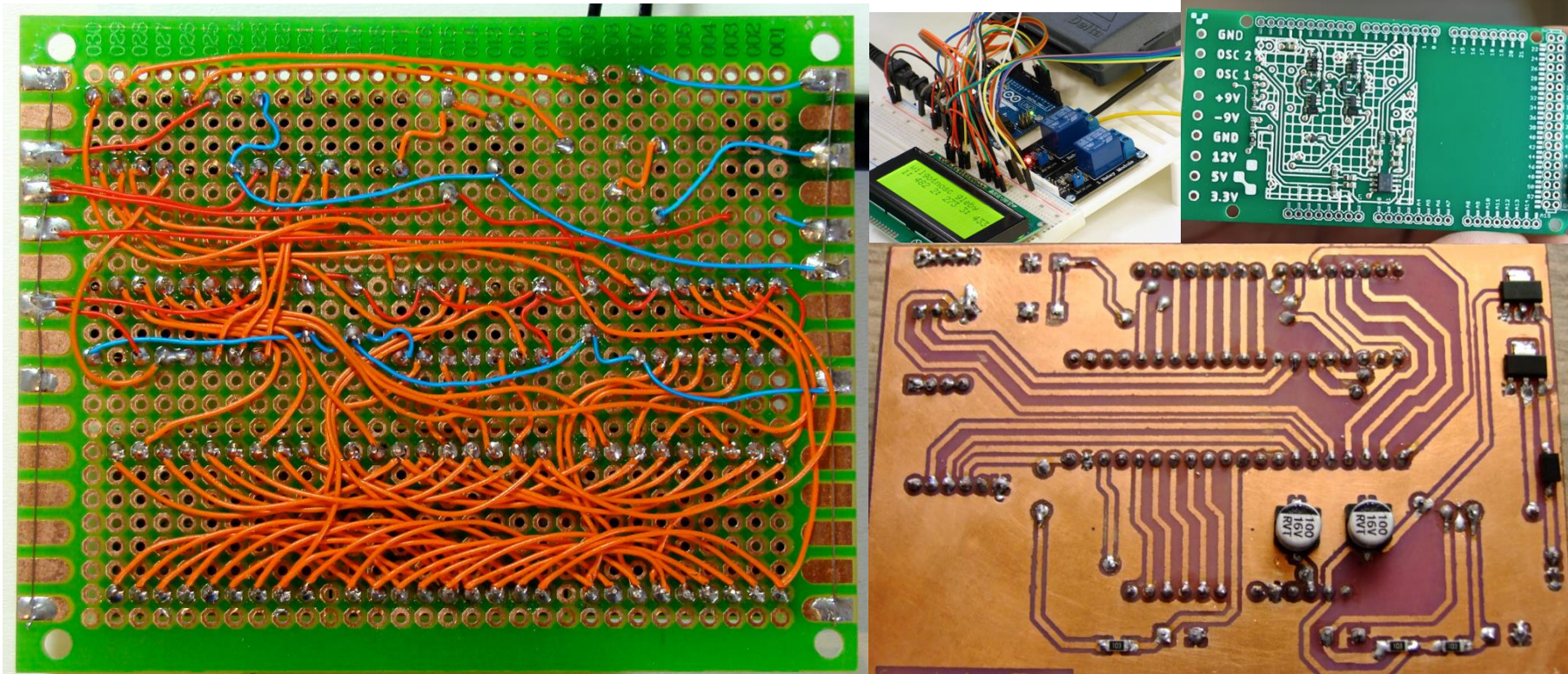
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## Fundamentals of Electronic Rapid Prototyping

- What is rapid prototyping in the electronics context?





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## Fundamentals of Electronic Rapid Prototyping

- Why does it matter so much (especially considering it takes time and additional resources)
  - Every experiment has a learning curve because of the unknowns.
  - The idea is to fail early and in a controlled environment, with minimum resources. Learning fast and accelerating the next iteration of the experiment.
  - Downstream, :
    1. Hardware is extremely expensive to correct, because of scale, Bill of Materials in the millions
    2. Legal implications of design failures are more sinister
    3. This messes up both time to market and cost of production for a project.

“Fail fast, fail cheap”





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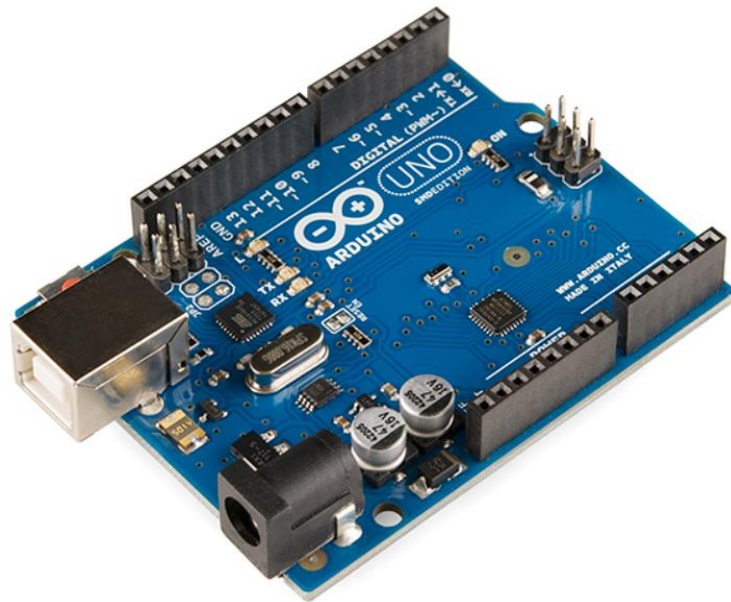
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## Tools, Platforms and Workflows

- The tools of electronics rapid prototyping
  - Arduino



```
Blink | Arduino IDE 2.0.0-beta.2
Arduino Nano 33 BLE at /dev/...
Blink.ino
19
20 This example code is in the public domain.
21
22 http://www.arduino.cc/en/Tutorial/Blink
23
24
25 // the setup function runs once when you press reset or power the board
26 void setup() {
27   // initialize digital pin LED_BUILTIN as an output.
28   pinMode(LED_BUILTIN, OUTPUT);
29   Serial.begin(9600);
30 }
31
32 // the loop function runs over and over again forever
33 void loop() {
34   digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)
35   delay(1000); // wait for a second
36   digitalWrite(LED_BUILTIN, LOW); // turn the LED off by making the voltage LOW
37   delay(1000); // wait for a second
38   Serial.println("LED is blinking");
39 }
40
Output Serial Monitor x
Message (⌘+Enter to send message to 'Arduino Nano 33 BLE' on '/dev/tty.usbmodem143201')
New Line 9600 baud
LED is blinking
LED is blinking
```

Why it's a good prototyping tool:

- Readily available
- Massive community support
- Easy to find modules(peripherals and HATs)
- Inexpensive





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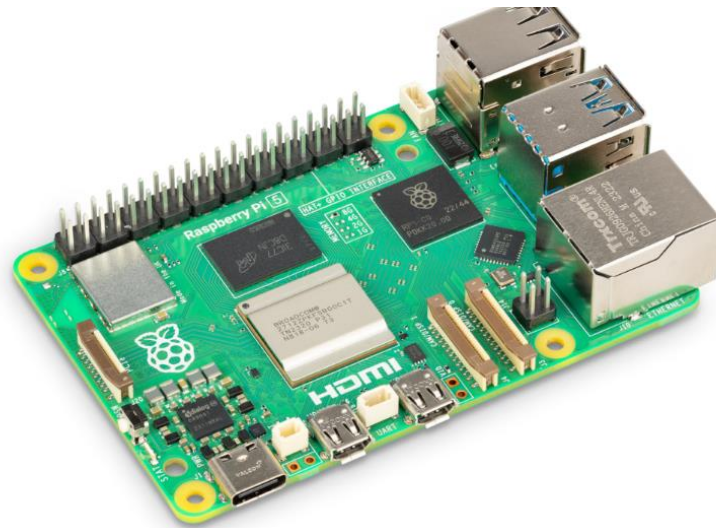


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## Tools, Platforms and Workflows

- The tools of electronics rapid prototyping

- Raspberry Pi



Why it's a good prototyping tool:

- Readily available
- Massive community support
- Easy to find modules(peripherals and HATs)
- Entry into Industrial Embedded Linux





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## Tools, Platforms and Workflows

- Other tools





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## Common Mistakes and Best Practices

### • Common Mistakes

- Skipping design reviews - Technical
- Ignoring DFM and DRCs
- Vague Product Specification
- Incomplete or vague testing definition and protocols – process
- Failure to escalate design issues early





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## Common Mistakes and Best Practices

- **Best Practices**

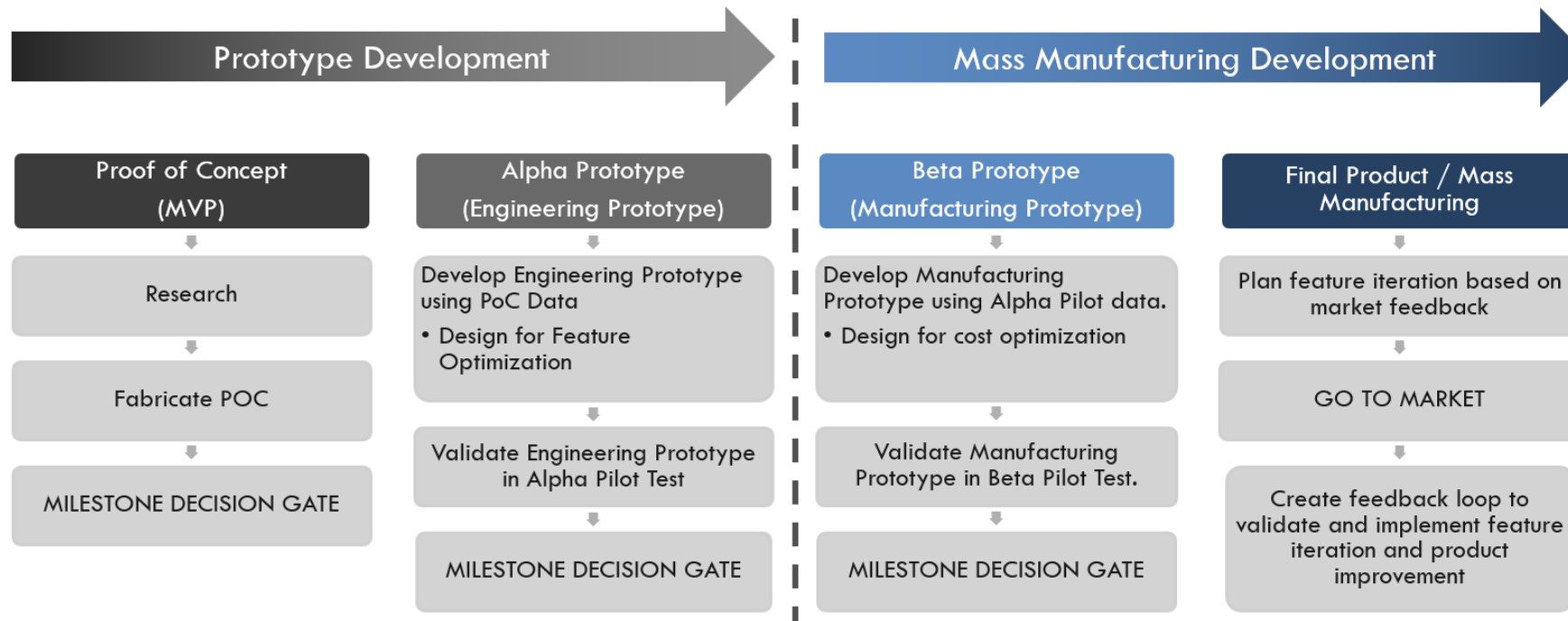
- Modular Approach
- Emphasis of Testability e.g. test points, and good testing protocol
- Parallel development





# How we get from prototype to a product(at Gearbox Europlacer)

## PRODUCT DEVELOPMENT HIGH-LEVEL ROADMAP





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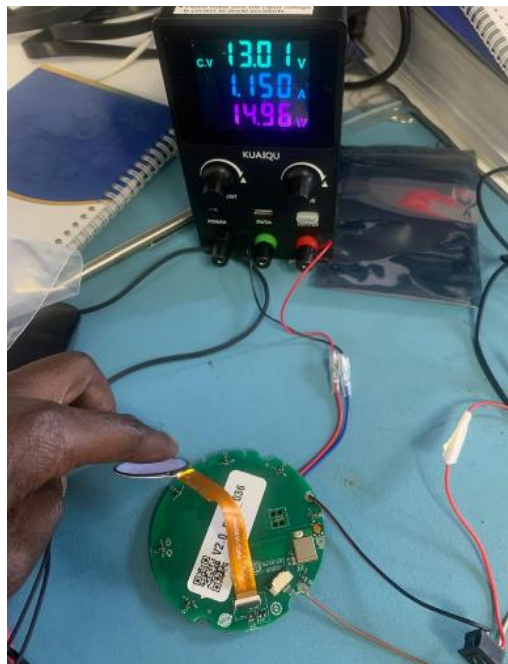


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## How we get from prototype to a product(at Gearbox Europlacer)



## .References / Bibliography

- **Paul Scherz & Simon Monk** – *Practical Electronics for Inventors* (4th Ed.)  
(Excellent reference for breadboarding, power, and debugging fundamentals)
- **Simon Monk** – *Make: Electronics & Make: More Electronics*  
(Hands-on, experiment-driven prototyping approaches)
- **Charles Platt** – *Encyclopedia of Electronic Components* (Vol. 1–3)  
(Component-level understanding critical during rapid prototyping)

