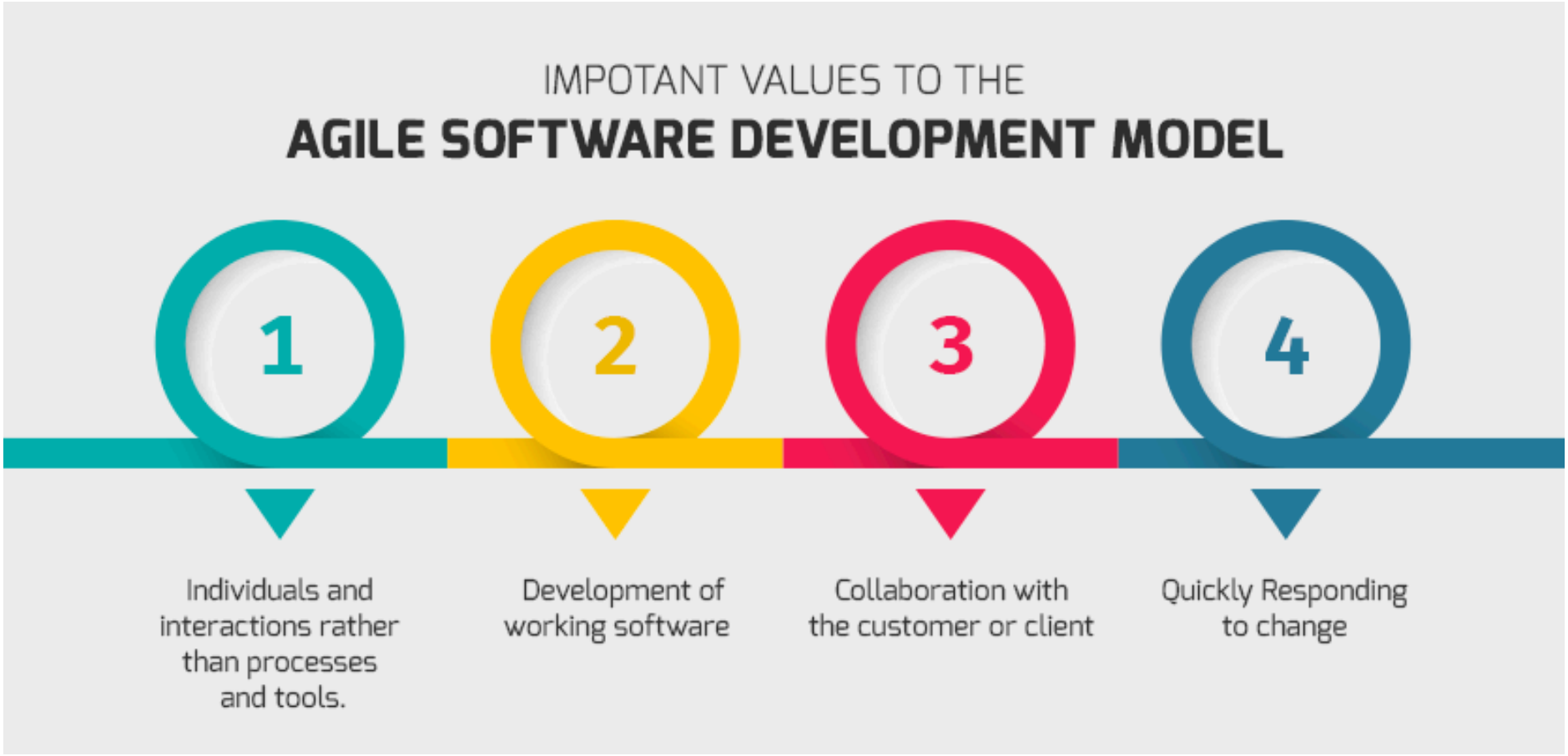
Agile Hardware Development



Apply Software Engineering Best Practices to Hardware Deign

Lowering the Cost of Software

Maximizing productivity of software engineers ...

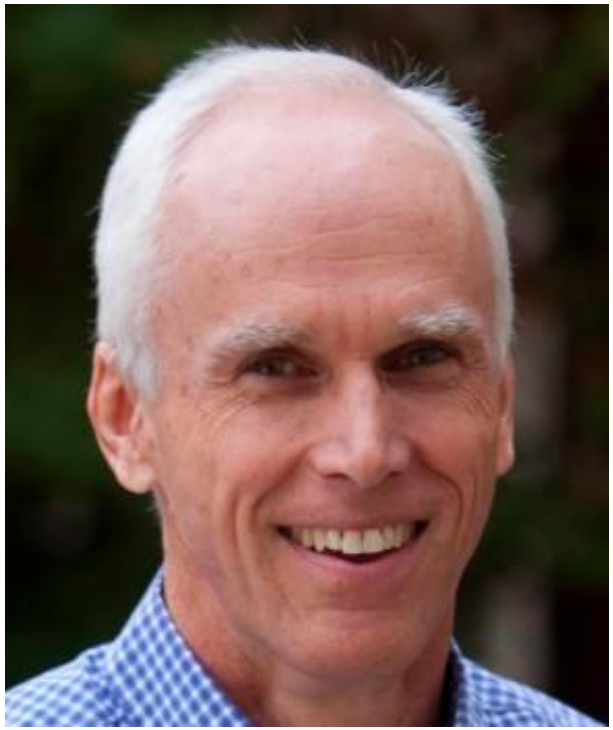
#1 Reuse software

#2 Develop easy to (re-)use libraries

- **Encourage experiments with different abstractions**
- **Libraries standardized as part of language**
- **Prog. Lang. features to improve libraries**
- **Maintainable and evolvable: OSS, tests, ...**
- **Invest in infrastructure, pay technical debt**

"C# supports library-oriented programming."
Anders Hejlsberg

"A typeless (scripting) language makes it much easier to hook together components."
John Ousterhout



Languages

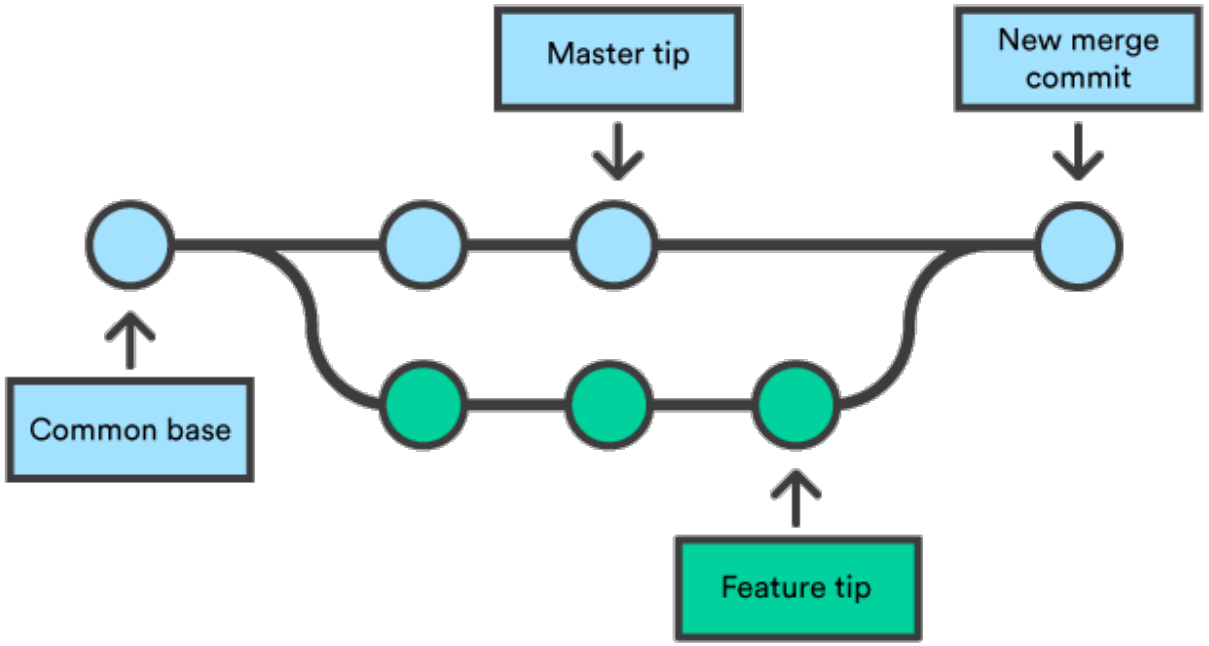
Add features that make it easier to develop and use libraries

- Importing modules, namespaces
- Version and package management
- Parameterized type systems: FIFO[T]
- DSLs: macros and meta-programming
- Runtime introspection and reflection
- Extensible meta-object protocols
- ...

LLVM enables new PL

Workflow

Distributed version control: git and GitHub



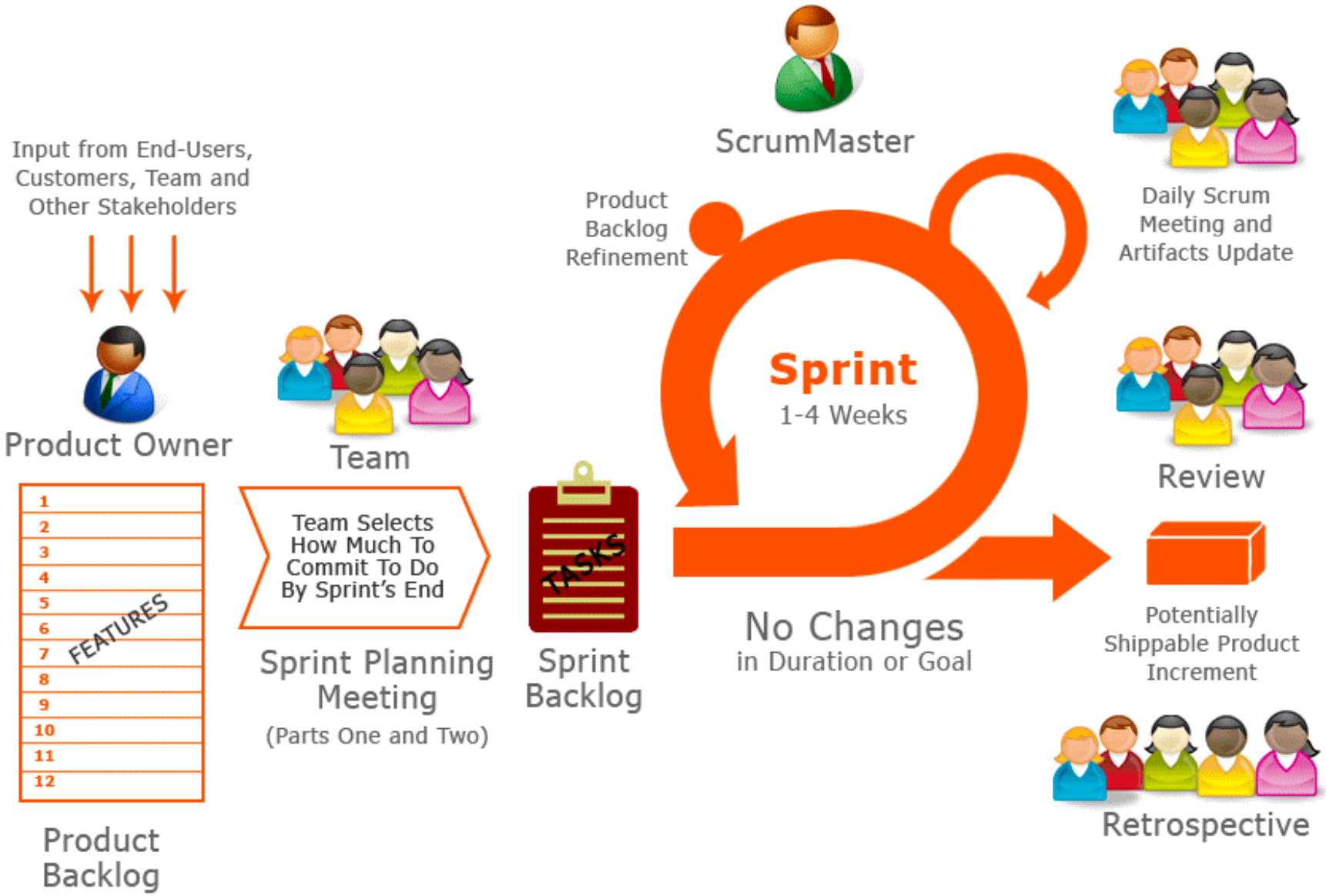
Continuous integration: travis, ...

- **Virtual machines and containers**
- **Configuration management**

Release management

Testing, Testing, Testing, Testing, Testing

- Test-driven development
  - Tests as specification
  - Tests as development plans
- Unit-testing frameworks
- Engineers must check-in code w/ tests
- Economics of testing: cost vs benefit



Agile Development Process