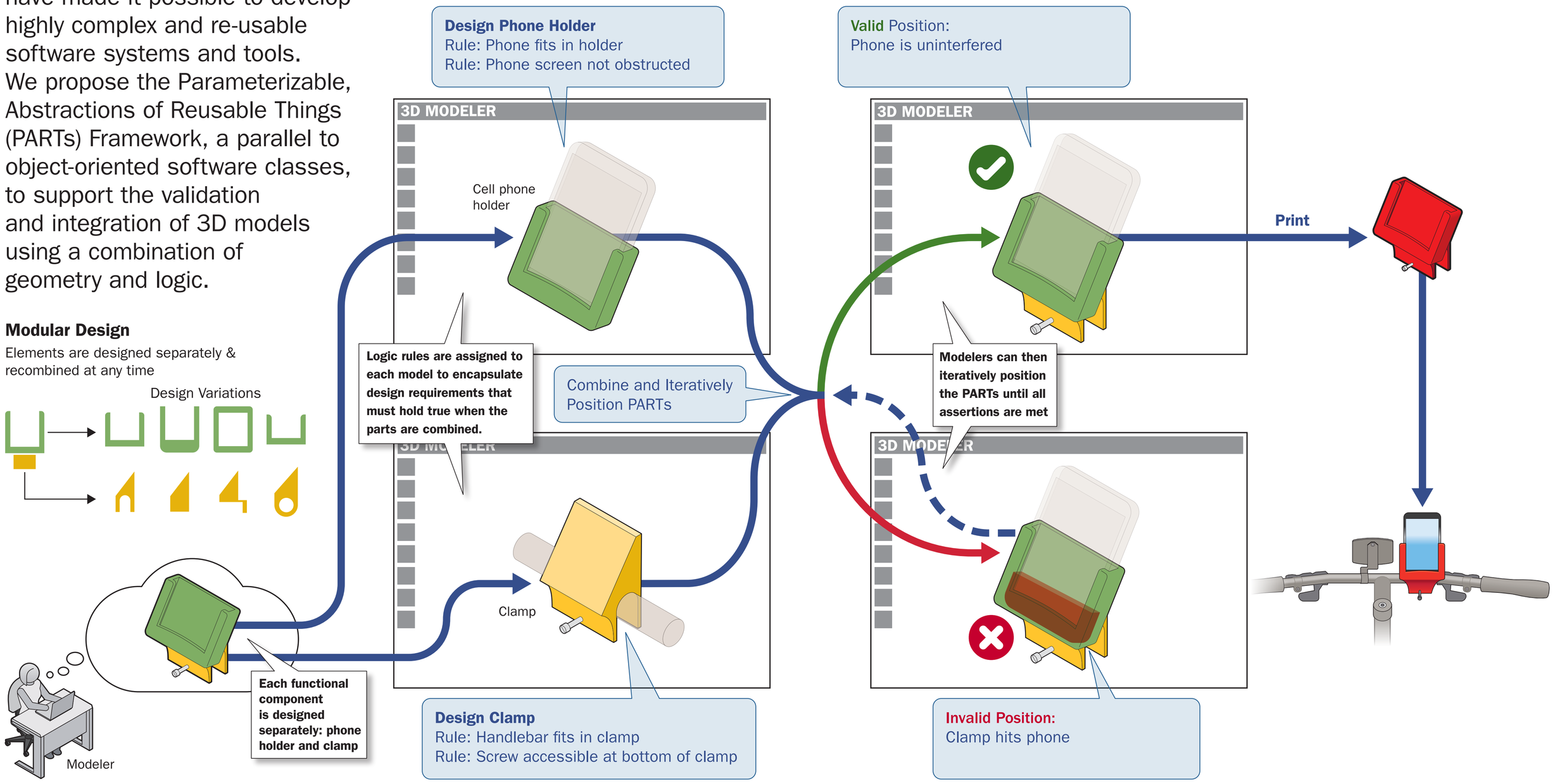
Software Engineering for Additive Manufacturing

3D printing, also called additive manufacturing, is a powerful medium to use to prototype and design objects. However, current tools for fabrication do not take advantage of basic concepts such as modularity and abstraction that have made it possible to develop highly complex and re-usable software systems and tools.
We propose the Parameterizable, Abstractions of Reusable Things (PARTs) Framework, a parallel to object-oriented software classes, to support the validation and integration of 3D models using a combination of geometry and logic.

With today's 3D modeling software, modelers can create modular models containing multiple 3D geometric surfaces and objects, and it is up to them how the objects integrate together. Additionally, they must manually check their assumptions about how those parts can be combined rather than depending on the software to validate those assumptions automatically.

In PARTs, 3D models are created the same way. However, programmers can assign assertions to the geometry to allow the software to identify when their assumptions are not met. Similarly, they can create integrators to ensure that their object is combined with others in particular ways that they specify. As a result, 3D models can be reused and integrated modularly

Modelers combine geometry and logic to define PARTs as a set of assertions and integrators. Shown are two parts of a smartphone bike mount. With PARTs, we can develop the phone holder and clamp individually, then iteratively combine them until their assertions and integration rules are met. Finally, we can integrate the PARTs together into a single geometry to print.



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