Perfection Spring and Stamping Corp.

Defining What We Do….

Prototypes (For Stampings, Springs, & Fourslide Parts)

A prototype is an original type, form, or instance of something serving as a typical example, basis, or standard for other things of the same category. The word derives from the Greek πρωτότυπον (prototype), "primitive form", neutral of πρωτότυπος (prototypes), "original, primitive", from πρ□τος (protos), "first" and τύπος (typos), "impression".

Semantics

In semantics, prototypes or proto instances combine the most representative attributes of a category. Prototypes are typical instances of a category that serve as benchmarks against which the surrounding, less representative instances are categorized (see Prototype Theory).

Design and modeling

In many fields, there is great uncertainty as to whether a new design will actually do what is desired. New designs often have unexpected problems. A prototype is often used as part of the product design process to allow engineers and designers the ability to explore design alternatives, test theories and confirm performance prior to starting production of a new product. Engineers use their experience to tailor the prototype according to the specific unknowns still present in the intended design. For example, some prototypes are used to confirm and verify consumer interest in a proposed design whereas other prototypes will attempt to verify the performance or suitability of a specific design approach.

In general, an iterative series of prototypes will be designed, constructed and tested as the final design emerges and is prepared for production. With rare exceptions, multiple iterations of prototypes are used to progressively refine the design. A common strategy is to design, test, evaluate and then modify the design based on analysis of the prototype.

In many products it is common to assign the prototype iterations Greek letters. For example, a first iteration prototype may be called an "Alpha" prototype. Often this iteration is not expected to perform as intended and some amount of failures or issues are anticipated. Subsequent prototyping iterations (Beta, Gamma, etc.) will be expected to resolve issues and perform closer to the final production intent.

In many product development organizations, prototyping specialists are employed - individuals with specialized skills and training in general fabrication techniques that can help bridge between theoretical designs and the fabrication of prototypes.

Basic prototype categories

There is no general agreement on what constitutes a "prototype" and the word is often used interchangeably with the word "model" which can cause confusion. In general, “prototypes” fall into four basic categories:

Proof-of-Principle Prototype (Model) (also called a breadboard). This type of prototype is used to test some aspect of the intended design without attempting to exactly simulate the visual appearance, choice of materials or intended manufacturing process. Such prototypes can be used to “prove” out a potential design approach such as range of

motion, mechanics, sensors, architecture, etc. These types of models are often used to identify which design options will not work, or where further development and testing is necessary.

Form Study Prototype (Model). This type of prototype will allow designers to explore the basic size, look and feel of a product without simulating the actual function or exact visual appearance of the product. They can help assess ergonomic factors and provide insight into visual aspects of the product's final form. Form Study Prototypes are often hand-carved or machined models from easily sculpted, inexpensive materials (e.g., urethane foam), without representing the intended color, finish, or texture. Due to the materials used, these models are intended for internal decision making and are generally not durable enough or suitable for use by representative users or consumers.

Visual Prototype (Model) will capture the intended design aesthetic and simulate the appearance, color and surface textures of the intended product but will not actually embody the function(s) of the final product. These models will be suitable for use in market research, executive reviews and approval, packaging mock-ups, and photo shoots for sales literature.

Functional Prototype (Model) (also called a working prototype) will, to the greatest extent practical, attempt to simulate the final design, aesthetics, materials and functionality of the intended design. The functional prototype may be reduced in size (scaled down) in order to reduce costs. The construction of a fully working full-scale prototype and the ultimate test of concept is the engineers' final check for design flaws and allows last-minute improvements to be made before larger production runs are ordered.

Differences between a prototype and a production design

In general, prototypes will differ from the final production variant in three fundamental ways:

Prototypes are often constructed via non-production intent materials. Production materials may require manufacturing processes involving higher capital costs than what is practical for prototyping. Instead, engineers of prototyping specialists will attempt to substitute materials with properties that simulate the intended final material.

Prototypes are generally constructed via non-production intent manufacturing processes. Often expensive and time consuming unique tooling is required to fabricate a custom design. Prototypes will often compromise by using more flexible processes.

Prototypes are generally constructed from a design that has been developed to a lower level of fidelity than production intent. Final production designs often require extensive effort to capture high volume manufacturing detail. Such detail is generally unwarranted for prototypes as some refinement to the design is to be expected. Often prototypes are built using very limited engineering detail as compared to final production intent.

Characteristics and limitations of prototypes

Engineers and prototyping specialists seek to understand the limitations of prototypes to exactly simulate the characteristics of their intended design. A degree of skill and experience is necessary to effectively use prototyping as a design verification tool.

It is important to realize that by their very definition, prototypes will represent some compromise from the final production design. Due to differences in materials, processes and design fidelity, it is possible that a prototype may fail to perform acceptably whereas the production design may have been sound. A counter-intuitive idea is that prototypes may actually perform acceptably whereas the production design may be flawed since prototyping materials and processes may occasionally outperform their production counterparts.

In general, it can be expected that individual prototype costs will be substantially greater than the final production costs due to inefficiencies in materials and processes. Prototypes are also used to revise the design for the purposes of reducing costs through optimization and refinement.

It is possible to use prototype testing to reduce the risk that a design may not perform acceptably, however prototypes generally cannot eliminate all risk. There are pragmatic and practical limitations to the ability of a prototype to match the intended final performance of the product and some allowances and engineering judgment are often required before moving forward with a production design.

Building the full design is often expensive and can be time-consuming, especially when repeated several times -- building the full design, figuring out what the problems are and how to solve them, then building another full design. As an alternative, "rapid-prototyping" or "rapid application development" techniques are used for the initial prototypes, which implement part, but not all, of the complete design. This allows designers and manufacturers to rapidly and inexpensively test the parts of the design that are most likely to have problems, solve those problems, and then build the full design.

This counter-intuitive idea—that the quickest way to build something is, first to build something else—is shared by scaffolding and the telescope rule.

Advantages of prototyping

- May provide the proof of concept necessary to attract funding
- Early visibility of the **prototype** gives users an idea of what the final system looks like
- Encourages active participation among users and producer
- Enables a higher output for user
- Cost effective (Development costs reduced)
- Increases system development speed
- Assists to identify any problems with the efficacy of earlier design, requirements analysis and coding activities
- Helps to refine the potential risks associated with the delivery of the system being developed
- Various aspects can be tested and quicker feedback can be got from the user
- Helps to deliver the product in quality easily
- User interaction available in during development cycle of prototype