Making the Case for Modernizing Concept Design

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Introduction

Every stage of product development is important, but some are actually a little more important than others. One of those is concept design. No other phase is as critical in determining the profit or innovation of new products. In fact, findings from the ***Trends in Concept Design*** conducted in July 2011 study found that 7 in 10 say that concept design is a rich source of intellectual property for their company. Furthermore, nearly half of the respondents to the same study also stated that 71% or more of a product's cost is fixed by the time they exit concept design. Essentially, if you don't get the concept design right, the rest of product development could very well go horribly wrong.

But if concept design is so important, why is it so underserved? Unlike detailed design, verification and validation or manufacturing preparation, there has been a dearth of applicable enabling technology. And, as a result, findings from the same study show that no predominant technology is being used to support concept design. With such high stakes, why hasn't there been more help? The good news is that there may be emerging hope.

After years of sliding towards commoditization with minute innovations and small leapfrog enhancements, the CAD industry has vibrantly come alive again. More and more people are making the admission that 2D is a legitimate means to design. Direct Modeling is increasingly available and interoperable with Parametric Feature-based Modeling. And interestingly enough, many of the capabilities emerging from this resurgence in the CAD industry are directly applicable to the concept design stage. And that's where this eBook comes in. It sheds some light on the new face of enabling technology for concept design.

For the longest time, the prevailing attitude has been that the difficulties of concept design were just a reality that you just had to live with. And that became the bitter status quo. But believe it or not, that time has now passed. A better way exists, not in some distant future, but today.

This eBooks makes several references throughout to a survey-based study titled ***Trends in Concept Design***. The study, conducted by PTC, includes responses from 214 individuals in product development organizations and was completed in July 2011. The full set of results is accessible at http://www.ptc.com/go/concept-design

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A Look at Today's Physical Tools

Before we dive into how the latest changes in the CAD industry might affect concept design, it's important to understand what today's physical and digital tools offer. That way, we can clearly identify any advantages and benefits in contrast.

The Heritage of Concept Design

Nothing is more representative of traditional concept design than the napkin sketch. And when it comes to engineering, images of graph paper and engineering notebooks often float through our heads. However, in today's modern product development environment, these are no longer the predominant tools used to capture concepts. But then again, the most frequently used tool used for concept design is only at 27%. Just about anything and everything under the sun is used, resulting in a mishmash of media used to capture concept designs.

The Pros of Physical Tools

We often rush to deride traditional tools that aren't part of the digital age. But the use of hand drawn sketches and engineering notebooks do have their advantages. The barrier to use them is as low as you can get. Anyone can scratch things down at a moment's notice. Likewise, they are highly portable in the physical sense.

The Cons of Physical Tools

But with all that said, there are disadvantages. Physical sketches cannot be easily changed to explore tradeoffs and alternatives: one sketch is only one sketch. They have no scale or dimensions so they lack fidelity. Furthermore, they must be manually digitized to share with others. And the reality of today's product development environment is that it is undoubtedly distributed, often around the globe. And last but not least, they cannot be used for digital prototyping or 3D printing, important means to validate concept designs.

A Look at Today's Digital Tools

Despite its heritage with concept design, some organizations didn't stop with hand drawn sketches. As you can see from the research findings, some progressively explored new electronic or digital means of capturing and maturing concept designs.

The Transition from Physical 2D to Digital 2D

Making the transition from paper to electronic sketching and drafting is more of a hop than a leap. Both are essentially 2D representations just in different mediums. With that said, there certainly are some advantages and benefits to doing it electronically.

The Pros of 2D Drafting and Sketching

What's good about 2D drafting and sketching? Well, first off, the transition from paper to the screen is comparatively easy. You're using a mouse and keyboard instead of that pencil, but the representation of the concept design itself are similar across the two mediums.

Additionally, having the concept design in an electronic format makes it far easier to share and collaborate with colleagues, even across the globe.

The Cons of 2D Drafting and Sketching

Much like the use of physical tools to capture concept designs, the use of 2D sketching and drafting has been much derided in part due to the incessant chant in the industry urging you to move to 3D modeling. And though it certainly is a legitimate means to capture and mature concept designs, there are some unmistakable disadvantages.

Although there certainly are exceptions, most 2D tools are focused on providing drafting capabilities with the goal of generating engineering drawings as opposed to concept design. They often focus on individual drafting entities making it difficult to intelligently explore alternatives and options. They can't be used extensively for digital prototyping. And they can't be used at all for 3D printing or rapid prototyping.

Going with the Big Vision of 3D

While some organizations went from physical to electronic with their concept design, others followed a grander vision. Thinking that product designs ultimately ended up as a full-fledged 3D model, some organizations chose to start using those same 3D CAD applications for concept design. The result so far has been a mixed bag.

The Pros of 3D Modeling

There certainly are positives. Developing a 3D model for concept design removes a lot of ambiguity. It leaves little room for interpretation, or more problematically misinterpretation, that can turn into errors downstream. Like the 2D sketch or drawing, it's easier to share with design and engineering colleagues. Existing and legacy 3D models can be used more easily as the basis for new concept designs. And, perhaps most importantly, 3D models can be used extensively for digital prototyping, including renderings and simulation, as well as 3D printing very early on in product development.

The Cons of 3D modeling

But it's not quite all roses. There's a price to pay for all those advantages. Those 3D CAD applications were originally intended for detailed design work, where the goal is to lock down the form and fit of finalized designs, not for capturing and maturing concept designs. As a result, the barrier to use for 3D modeling can be quite high. Parametric feature-based modelers especially require users to be able to manage the interdependencies and potential failures of features. Furthermore, many modern CAD applications like to have an individual file for each part. Often in concept design, you want a simple and single representation of the entire concept design.

A New Age for Concept Design

When a new enabling technology promises to markedly change an organization's effectiveness, there are a few unique and innovative capabilities that set it apart. But in the case of modernizing concept design, it's far more about getting an entire set of tools to work together.

It Takes Many Tools, Not Just One

Over the course of the last few pages, we've looked at a number of different approaches and how they support concept design. Each has advantages and disadvantages: a point not lost when some started thinking about how the recent changes in the CAD industry could benefit concept design efforts. And ultimately, that's been the theme behind the new face of enabling technology for concept design: use combinations of 2D and 3D direct modeling to get the job done.

Recreate part of the design data during the concept design stage because design tool formats aren't compatible	59%
Leverage existing designs when creating concept designs, rest start from scratch	74%
Recreate concept designs once the concept design is released to downstream engineering stages	61%

Interoperability in a Procedural Flow

But here's the catch: these tools can't just be slapped together and be expected to address all of the problems associated with concept design. There's actually a progression that's typically followed.

The Past is Prologue

Findings from the ***Trends in Concept Design*** study show that 59% respondents leverage existing designs when creating concept designs. This could be 3D models or 2D drawings where cross sections are used for the context or reference of new concept designs. The new approach for concept design is to do exactly that: read in design data from anywhere and any application.

The Progression of Modeling

From there, many start developing their concepts in 2D: at least at first. The new approach let's you develop a concept design in the context of cross-sections from existing or legacy designs. But it doesn't have to end there as it often has in the past. In the new approach, you can take that 2D sketch and use it as the basis for a 3D model. Direct modeling, with its easier-to-use approaches to push and pull 3D geometry is a way to more easily transition from the world of 2D to 3D concept design. And some concept designs need to include embedded design intent and intelligence. That's why the new approach also allows for the use of parametric feature-based modeling in the same model where direct modeling approaches are used.

And that's the context for interoperability in the new approach for concept design. These tools can work with existing or legacy design data. They can pass 2D sketches seamlessly into 3D modeling environments. They can also work with geometry built with either direct modeling approaches or parametric feature-based ones. Essentially, all of these modeling modes need to work together.

Associative Control and Detailed Design

Another key transition is at the end of concept design when the engineering project is kicked off and detailed design truly starts in earnest. Traditionally, the design representations created during concept design aren't compatible with the 3D CAD applications used for detailed design. Findings from the study show that 61% of the respondents recreate concept designs once it is released to downstream engineering stages. However, another key concept in the new approach to concept design is to make this transition seamless with interoperability between concept design tools and detailed design tools.

Conclusion

At the beginning of this eBook, we looked at some research findings that underscored how important concept design is to the success of product development. The new approach to concept design might sound promising but it needs to offers some tangible benefits to justify a change.

What's In It for the Team?

Overall, the real advantages that lie in using these new approaches to concept design are basically twofold.

First off, they can dramatically eliminate a lot of the recreation of concept design representations. And from the statistics cited throughout these eBook, there's plenty of opportunity to remove that non-value added work. That, in turn frees up more time to be used in lots of ways: whether its exploring more alternatives, staying on schedule, or spending more time on maturing a concept design so it is better understood.

Second, the representations that are progressively created in this process are higher fidelity that can be used for digital prototyping and 3D printing. That means the engineering and business characteristics can be better understood. And by better understanding those traits and tradeoffs, designers and engineers can make better decisions and products.

What's In It for You?

But don't just assume all of the benefit gets passed on to the company. There's actually quite an advantage for the individual designer and engineer too.

When you think about moving through the concept design phase, all that effort spent recreating things isn't exactly the best use of your time. In fact, it's a mind-numbing waste of it. By practically eliminating that non-value added work, you can spend more time on the fun parts of the job: exploring design alternatives, understanding the impacts of potential choices or getting on with your personal life.

Likewise, creating higher fidelity concept designs and using the associated digital prototyping and 3D printing approaches also carries individual benefits too. It lets you make better decisions earlier on the product development cycle. It might seems innocuous at first, but ultimately that means you can avoid that firedrill call at 3PM on a Friday afternoon that means you have to work the weekend.

Final Thoughts

Despite its importance to developing new products, concept design has been one of the most underserved aspects of product development. But the landscape of enabling technologies looks to be changing that story to the benefit of companies and individuals alike.

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