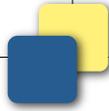


The logo for Tech-Clarity, featuring the word "Tech-Clarity" in a bold, sans-serif font. "Tech-" is in white and "Clarity" is in yellow, both set against a dark blue rounded rectangular background.

**Tech-Clarity**

**Improving Concept Design**

***Innovating at the Front End  
to Drive Revenue  
Opportunities***



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## Executive Overview

Competing in today's global economy is not easy, but regular streams of innovative concepts can give companies a competitive advantage. As Tech-Clarity's report [Top 5 Misconceptions about Innovation Management Software](#) finds, "*Bolstering innovation to a core competency helps manufacturers drive higher revenue, lower cost, and mitigate risk.*" A focus on the concept phase will help companies accomplish this.

The concept phase has unique requirements that distinguish it from detailed design. Companies must balance flexibility to innovate and explore ideas, yet ensure they are efficient as possible to quickly develop an ideal concept. Work done during concept design also sets the foundation for later phases to streamline the development process overall. Companies who can make a smooth, fast transition from concept design to detailed design have an advantage. This is difficult to achieve and as a result, many companies find their concept phase is less than optimal. However, considering the impact on innovation and revenue opportunities, concept design deserves some focus.

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***Considering the impact on innovation and revenue opportunities, concept design deserves some focus.***

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While the requirements to develop concept models are different from those of detailed designs, efficiency gains can be realized by leveraging the work done during the concept phase. The right technology can make this happen. Tech-Clarity's innovation report reveals, "*Enabling technology helps companies improve agility, productivity, and time to market by improving decision-making, visibility, and commercialization efficiency across the product lifecycle.*" The report further concludes, "*Tech-Clarity recommends taking advantage of the body of knowledge available and don't reinvent the wheel.*" This is an important point also stressed in Tech-Clarity's [The How-to Guide for Implementing PMI](#), which explains the value of using the intelligence already embedded in models. Reusing model information rather than recreating it frees the product development team to focus their valuable time on innovation and work that adds value.

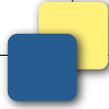
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***Highlighting the importance, survey results show Top Performers spend 19% more time on concept design compared to competitors.***

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To understand the best approaches to concept development, Tech-Clarity surveyed 190 companies about their concept development processes. Highlighting the importance, survey results show Top Performers spend 19% more time on concept design compared to competitors. Emphasizing the opportunity for improvement, survey results also reveal:

- Only 52% of the concept is reused during detail design
- Companies agree more should be reused



- Companies believe they would save 45% of overall development time by optimizing concept design reuse

Companies also overwhelmingly agree that a single tool that meets the needs of both concept development and detailed design would help. In fact, Top Performing companies are already 27% more likely than their lesser performing competitors to use a single tool.

This report provides guidance to help companies identify where to focus improvements in concept development as well best practices companies should look to adopt so that they make optimize their concept development processes.

### Understand the Importance of the Concept Phase

Today’s global economy creates lots of opportunity, but also means significant pressure from global competitors. In addition, options like Kickstarter have helped to lower the barrier to entry for innovative start-ups. With so much competition, it can be very hard for companies to set themselves apart. Innovation has become even more critical for companies to differentiate themselves and stand out from their competitors.

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*As the first stage of product development, companies agree the goal of the conceptual phase is to optimize innovation.*

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For companies looking to improve their competitiveness through innovation, the concept phase is a natural place to start. As the first stage of product development, companies agree the goal of the conceptual phase is to optimize innovation (Figure 1).

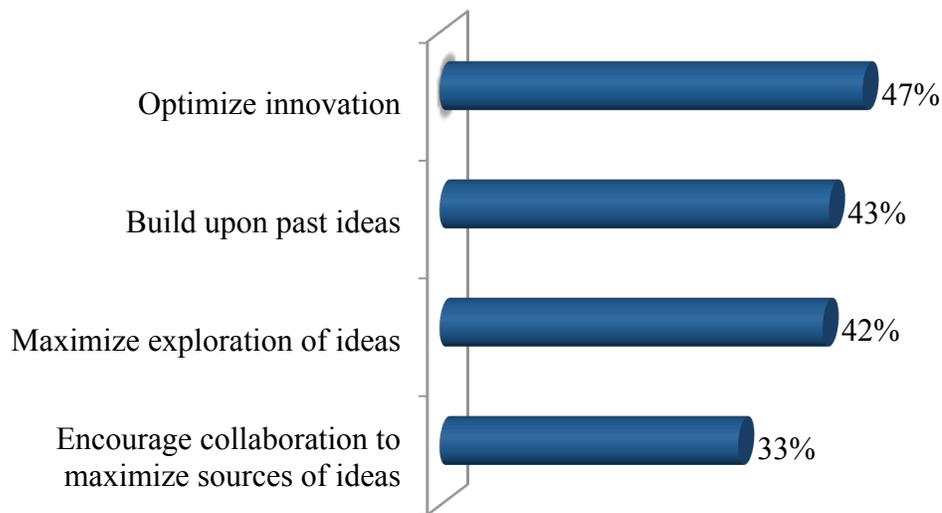


Figure 1 –Top Goals of Conceptual Phase



This stage should optimize flexibility to explore ideas and build off of existing concepts for successful innovation.

### Identifying the Top Performers

To identify concept design best practices, Tech-Clarity researchers isolated Top Performing companies by asking survey respondents to rank their performance in relation to their competitors on three key metrics. These metrics indicate successful concept development. Respondents used a scale of one to five, with five being extremely effective. The 20% top performing companies were defined as the Top Performers. Figure 2 shows the metrics used to define success as well as each group’s respective performance.

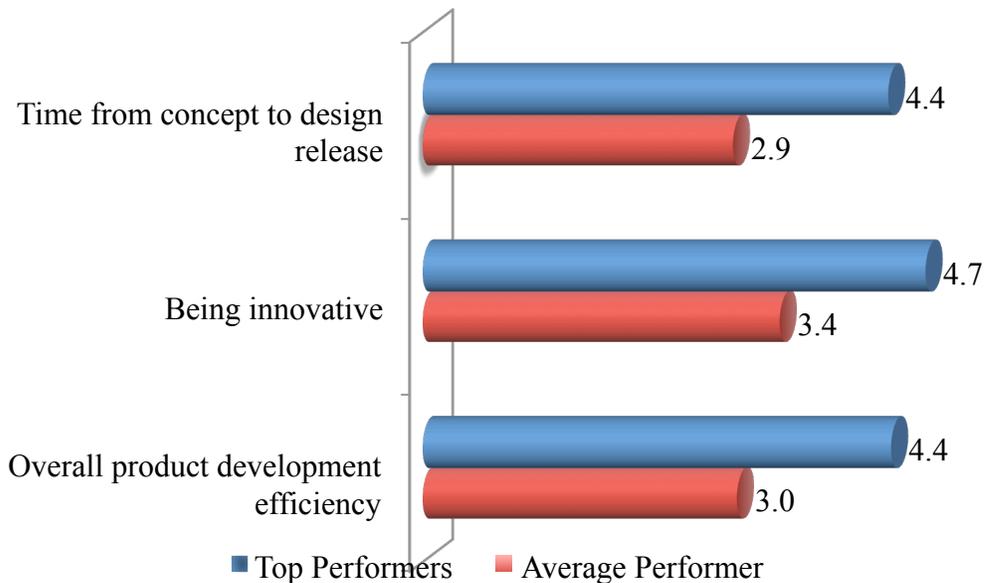
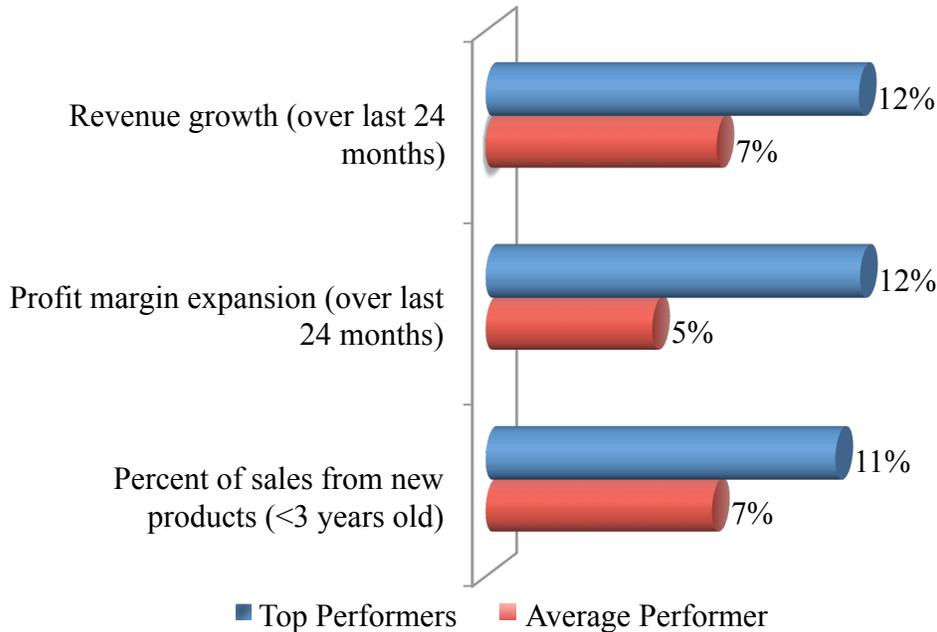


Figure 2 –Definition of Top Performers

When compared to competitors, Top Performers enjoy shorter development cycles, greater efficiency, and more innovative. As a result of their superior processes, Top Performers realize many business benefits (Figure 3).



**Figure 3 –Business Benefits of Top Performers**

A more optimal concept phase enables them to be more innovative which means greater customer demand and higher revenue. Their newest products, representing the latest innovations, are also a bigger piece of the revenue mix when compared to competitors. Shorter development times allow them to get to market fast so they can capture market share. Also, product cycles have shrunk so much, there are smaller windows for revenue opportunities before products are superseded. Being quick to market maximizes this window of opportunity. Shorter development time also means less development investment. With lower development costs and higher revenue, profit margins are better.

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***Since implementing their current tools for concept design, all companies have seen improvements to their concept development process, but Top Performers have seen even greater benefits.***

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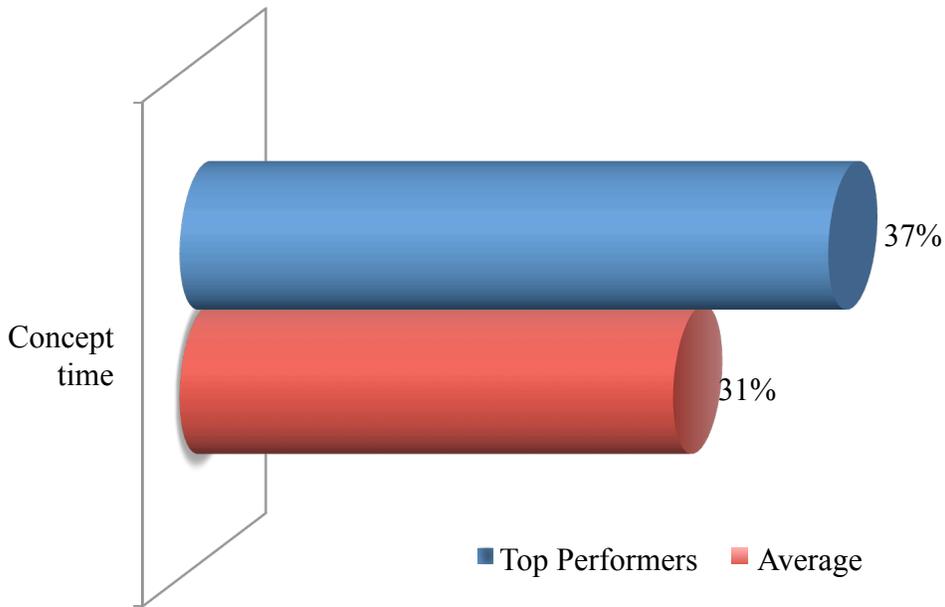
Since implementing their current tools for concept design, all companies have seen improvements to their concept development process, but Top Performers have seen even greater benefits (Table 1).



Since Implementing Current Concept Tools	Top Performers	Average Performer
Change in concept development time (man hours)	11.7% Reduction	9.9% Reduction
Time from concept to design release (man hours)	12.4% Reduction	7.9% Reduction
Number of design iterations evaluated (leading to greater innovation)	10.5% Reduction	7.3% Reduction

**Table 1 – Benefits Since Implementing New Current Tools for Concept Design**

While Top Performers have reduced the number of man-hours during the conceptual phase, it still makes up a larger portion of the overall development process compared to their lesser performing competitors.



**Figure 4 –Percentage of Overall Development Time Spent on the Concept Phase**

Compared to competitors, Top Performers spend 19% more time on the concept phase. The extra time illustrates the importance Top Performers place on getting the concept right.



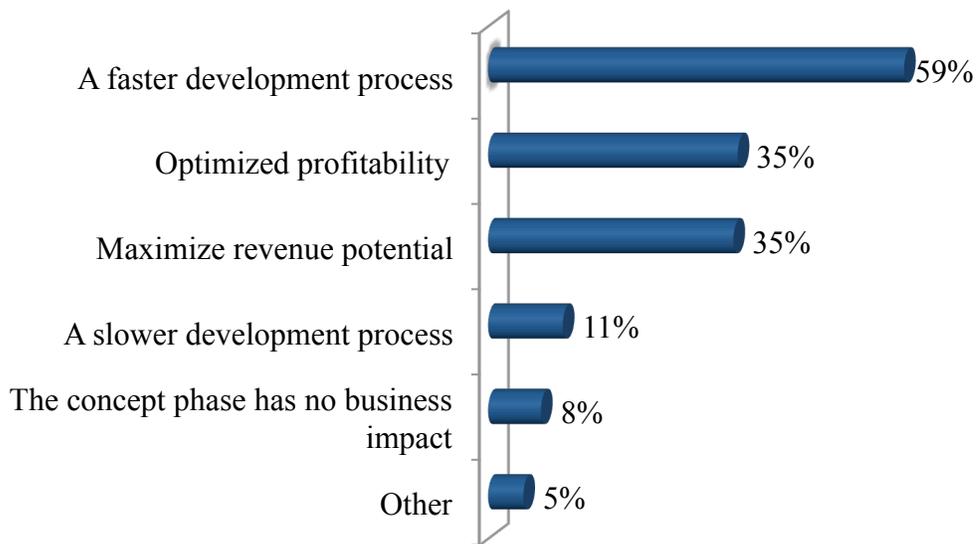
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*Compared to competitors, Top Performers spend 19% more time on the concept phase.*

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### Optimize the Conceptual Phase

An overwhelming 92% of companies agree an optimal concept phase has a business impact (Figure 5). In fact, 82% report that the concept phase has a positive impact on the business. Most companies agree that taking the time to get the concept right actually accelerates the development process which can lead to higher revenues and greater profitability. Only 11% think using this time can slow things down.



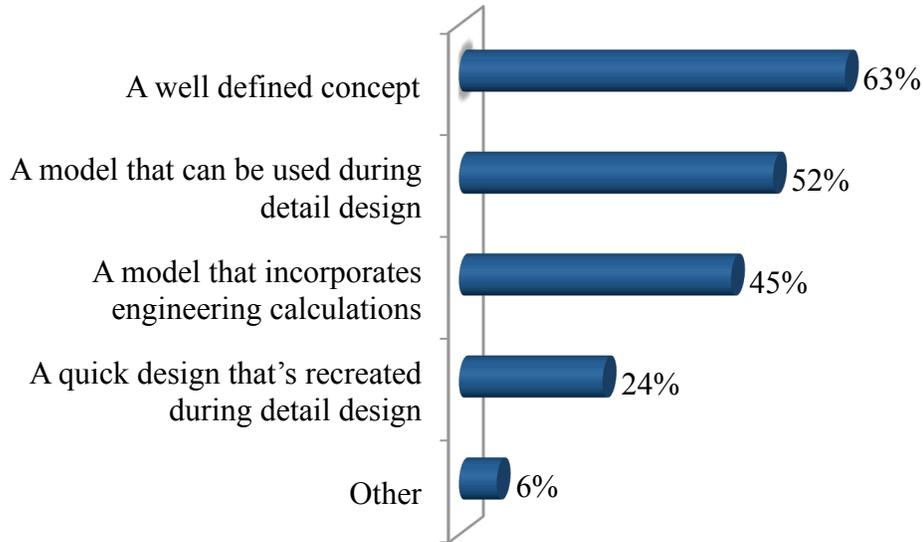
**Figure 5 –Business Impact of Optimizing the Conceptual Phase**

Understanding the expected outcomes of the concept phase provides a good starting point for focusing improvement efforts. The majority of companies agree the end result should be a well-defined conceptual model. The majority also believe this model should be usable in the detailed design phase. In fact, Top Performers are 24% more likely than their competitors to consider the ideal result a concept model they can reuse during detailed design. Avoiding rework during detailed design contributes to their ability to be more efficient and leads to their overall reduction in development time.

---

*In fact, 82% report that the concept phase has a positive impact on the business.*

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**Figure 6 –Ideal Result of Conceptual Phase**

Many also consider it ideal when critical engineering formulas are embedded into the conceptual model. This captures key engineering knowledge from the beginning and makes it available for downstream development. Only 24% believe the emphasis of the conceptual phase should be a very quick design that's recreated during the detail phase.

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***Top Performers are 24% more likely than their competitors to consider the ideal result a concept model they can reuse during detailed design.***

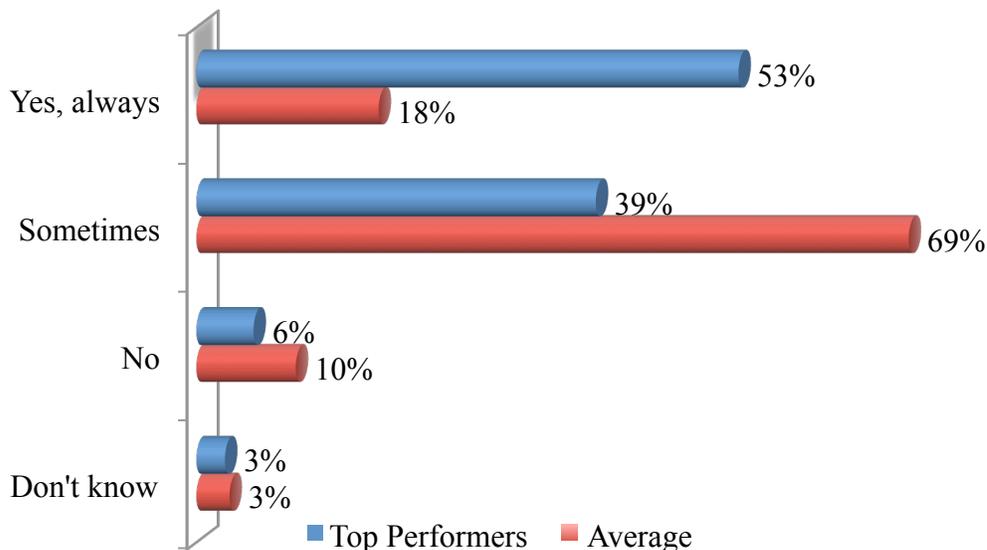
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While companies agree on the ideal result of the concept phase, it is so hard, only 26% say they can consistently produce it. In fact, consistently producing an ideal concept is a key differentiator between Top Performers and their competitors (Figure 7).

---

***While companies agree on the ideal result of the concept phase, it is so hard, only 26% say they can consistently produce it.***

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**Figure 7– Does Your Company Produce the Ideal Result during Concept Development?**

Clearly there’s opportunity to improve the conceptual process. We will next look at what makes this process so hard to help prioritize where to focus improvements.

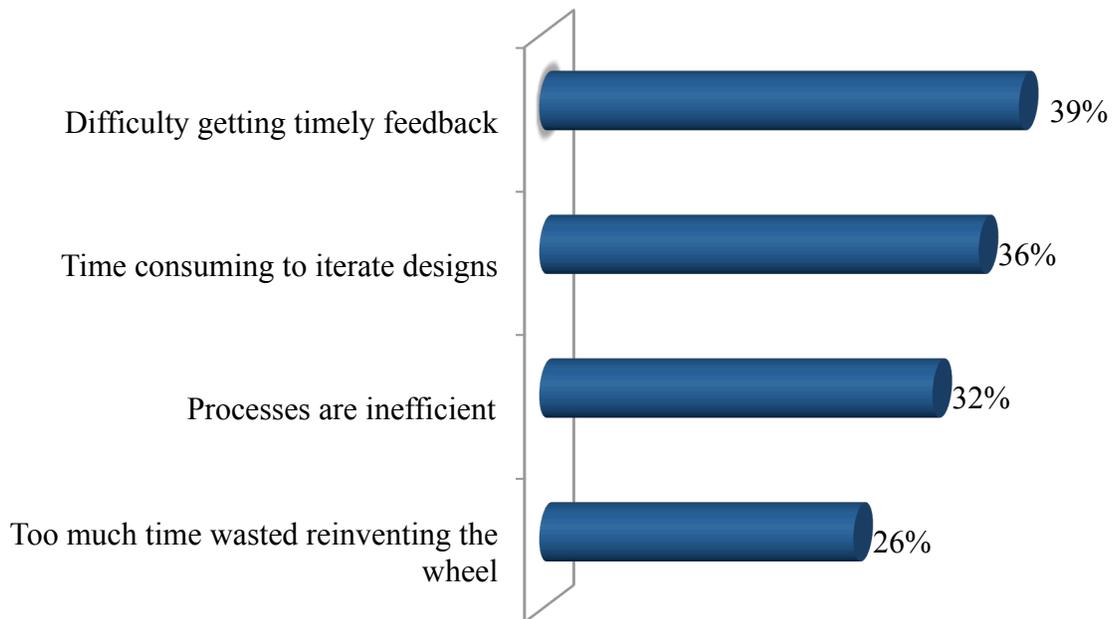
### **Recognize the Challenges of Concept Development**

The biggest challenges with the conceptual phase involve better collaboration and taking advantage of work already done (Figure 8). Feedback and suggestions improve innovation, but getting timely feedback is the hardest thing about developing concepts. Plainly, companies need better ways to share concepts and exchange feedback.

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*The biggest challenges with the conceptual phase involve better collaboration and taking advantage of work already done.*

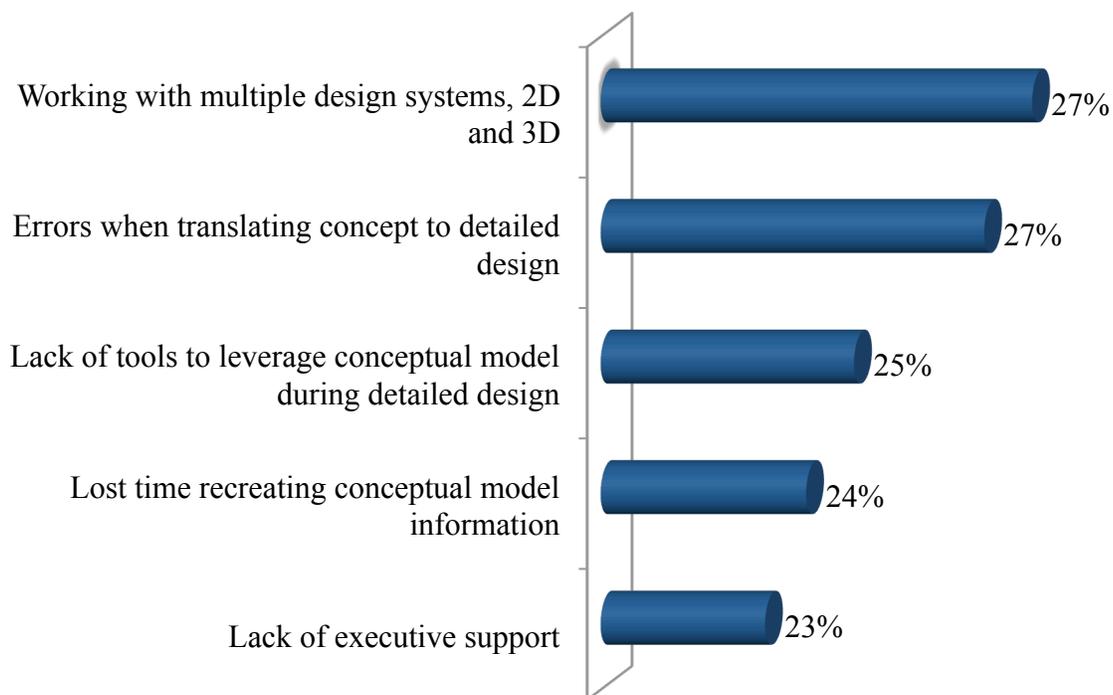
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**Figure 8 – Top Challenges Developing Concepts**

Companies also have difficulty with the way they develop concepts. Models and layout rigidity limit options to iterate which leads to wasted time reinventing the wheel and difficulties building off of existing ideas. This results in inefficiency and wasted efforts.

Much of what prevents companies from producing ideal concepts points to challenges with converting the concept to a detailed design. Why is this? Figure 9 points to incompatibility between the tools to develop a concept model and those used to detail the design.



**Figure 9 – Top Challenges Converting Concepts to Detailed Designs**

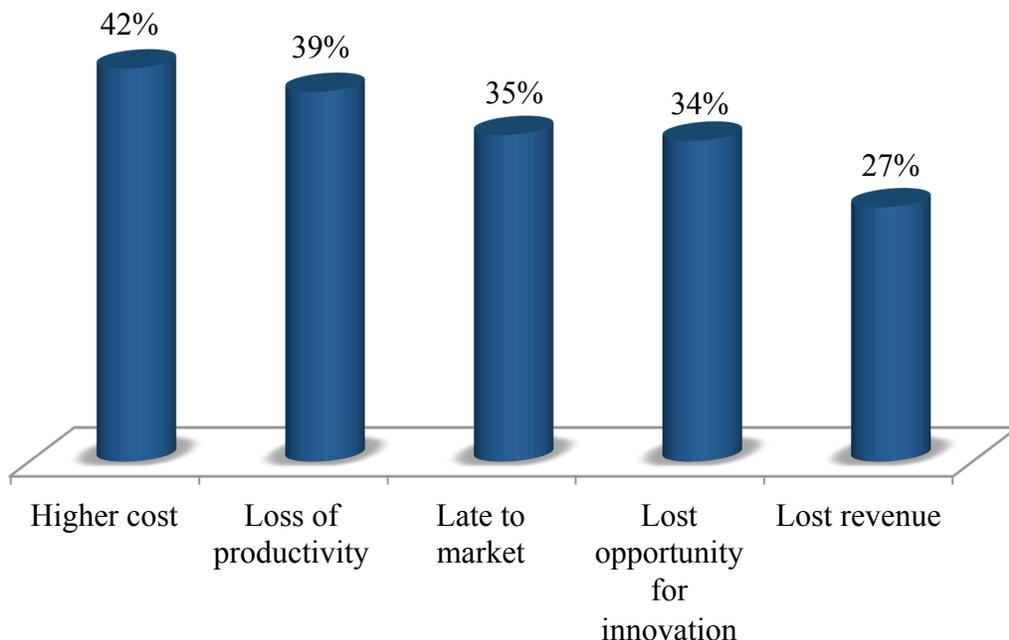
Companies report on average they use 3.6 different CAD tools and 2.7 of those are used during concept development. These different tools make bringing all of this design information together very difficult. Incompatibility between these tools means much of the concept needs to be recreated which not only wastes time, but also can lead to errors.

One might think that since concept is such an early phase, before much has been invested into the product, problems during this phase wouldn't cost the business a lot, but this would be wrong. These problems trickle down and snowball. Respondents report these challenges end up costing the business in many ways (Figure 10).

---

***Companies report on average they use 3.6 different CAD tools and 2.7 of those are used during concept development.***

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**Figure 10 – Business Impact of Concept Challenges**

When concept work is not leveraged later on, it takes more effort to develop the detailed design. This adds time, increases development costs, and extends the product release date. Late to market means less time to recoup the development cost and a smaller window for revenue, not to mention a risk of losing market share. Only 7% of respondents say challenges during the conceptual phase have no business impact.

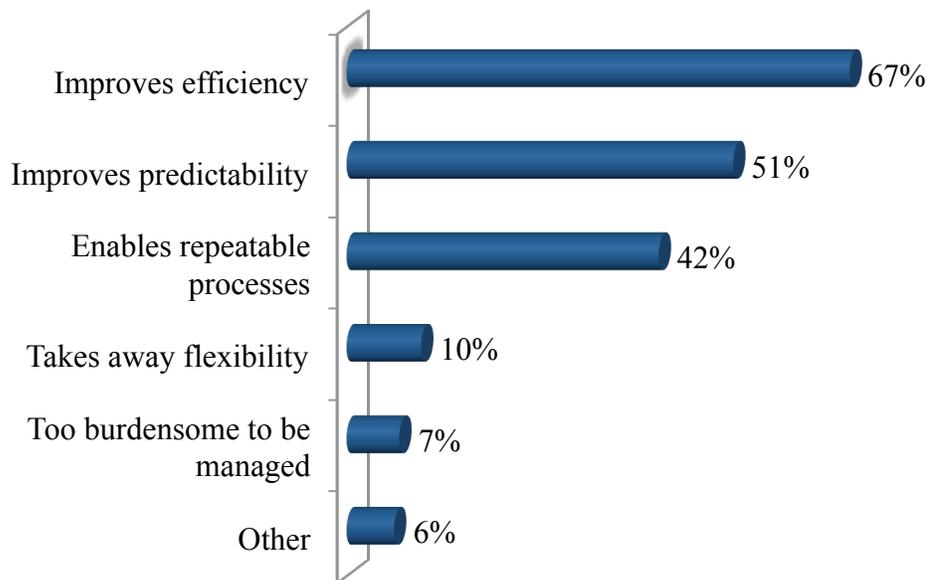
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*When concept work is not leveraged later on,  
it takes more effort to develop the detailed design.*

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### **Manage the Concept Phase**

Considering the focus on flexibility and innovation during the concept phase, does it make sense to manage it? With the opportunities for improvement and the potential cost to the business, respondents overwhelmingly agree it does (Figure 11).



**Figure 11 – Business Impact of Managing the Concept Phase**

Respondents report that managing the conceptual phase would address some of the inefficiencies while making innovation more predictable and repeatable. Very few believe managing the concept phase would take away flexibility or that it would be too burdensome.

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***Respondents report that managing the conceptual phase would address some of the inefficiencies while making innovation more predictable and repeatable.***

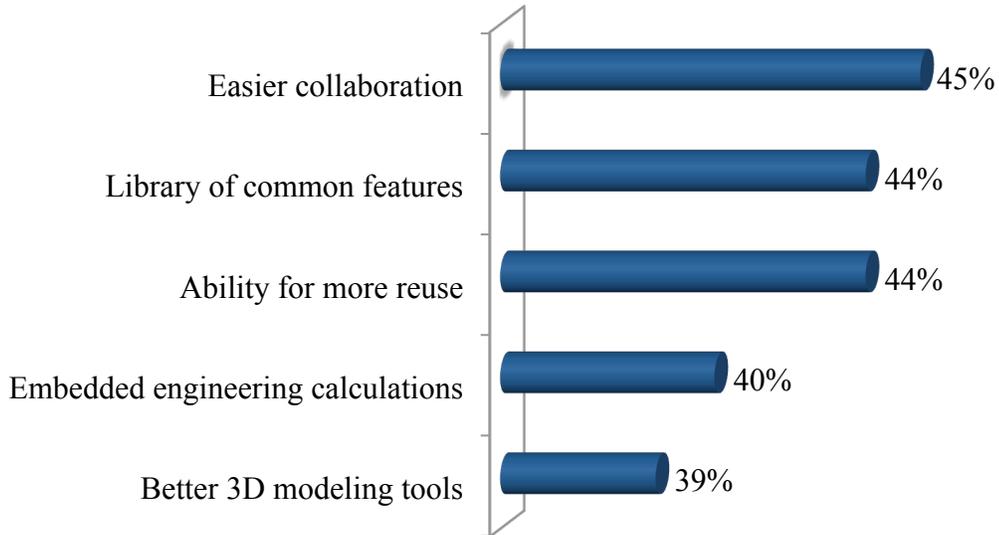
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The natural question is then, what would help improve it? Companies report easier collaboration, libraries, better modeling tools, more reuse, and the ability to embed engineering formulas into their concept models (Figure 12).

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***Top Performers are 48% more likely to identify better collaboration as a way to speed up concept development.***

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**Figure 12 – What Would Speed Up Concept Development?**

Figure 12 shows the results from all responses. When comparing the results across performance categories, the biggest difference between Top Performers and their lesser performing competitors is a focus on collaboration. Top Performers are 48% more likely to identify better collaboration as a way to speed up concept development.

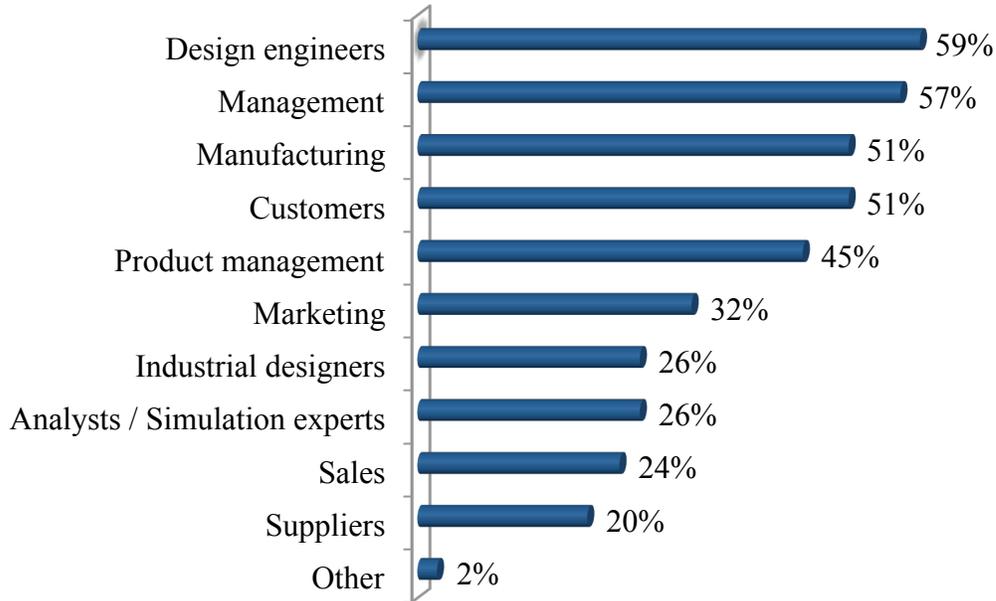
### **Facilitate Collaboration**

Excellent collaboration helps get the concept right. Feedback and perspectives from a variety of sources can lead to a stronger concept that has a better chance for market success. Companies tend to share their concepts with a wide range of roles (Figure 13).

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*Feedback and perspectives from a variety of sources can lead to a stronger concept that has a better chance for market success.*

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**Figure 13 – Who Provides Feedback on Concepts?**

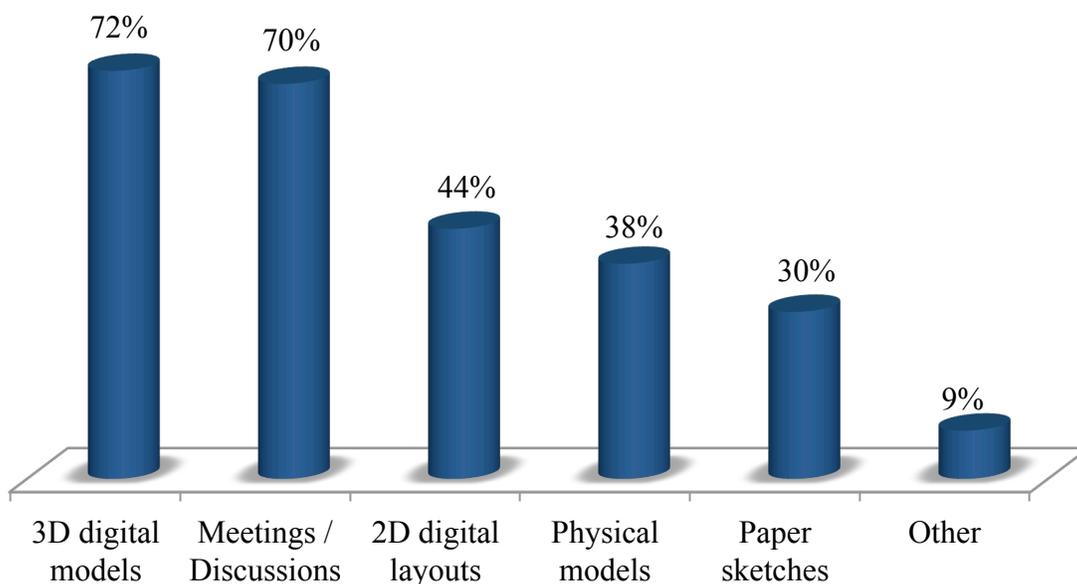
Yet, as seen in Figure 8, getting timely feedback is a top challenge. This clearly points to a need for easier ways to share concept models and layouts with less technical users who may not be familiar with CAD and modeling tools.

While companies across performance categories solicit feedback from a wide cross section of roles, Top Performers are more likely to solicit feedback from certain groups. When compared to competitors, Top Performers are:

- 37% more likely to get feedback from customers
- 44% more likely to get feedback from product management
- 42% more likely to get feedback from suppliers

These groups offer great perspective on products needs, potential uses, and manufacturability, but may not be CAD users so getting their input may be harder. Despite this, Top Performers have taken steps to include them in the process and it likely contributes to their ability to be more successful.

To get feedback on concepts, companies use a variety of methods (Figure 14).



**Figure 14 – How Concepts Are Shared**

What sets Top Performers apart is that they are 24% more likely to use 3D models. This likely contributes to their ability to get feedback from less technical roles. 3D models make it easy for anyone to visualize the product. The models do not have to be native CAD models either. Visualization files offer an easy way to share 3D models in a lightweight format that does not require access to a CAD tool. Top Performers are also 17% more likely to use 2D layouts as well. 2D layouts offer the benefit of a quick and easy way to explain a concept. Survey respondents report that quick 2D layouts can be a good choice to support brainstorming and the generation of new ideas. It also works well for schematics and electrical design.

**Enable Reuse**

As the results in Figure 12 indicate, enabling more reuse will improve the efficiency of the concept phase. Reusing past concepts and ideas will help with the development of the concept model, but the ability to reuse the concept model during detailed design will also save time. Overall, companies would like to reuse more of the concept model than they do now (Table 2).



	Percentage
Amount concept model is reused during detailed design	52%
How much should be reused?	64%
Development time saved if reuse was ideal	45%

**Table 2 – Amount of Reuse**

What is striking is how much time respondents believe they would save with more reuse. This reinforces the snowball effect of the concept phase. Reusing more of the concept model means the detail designer can reduce wasted efforts recreating design details. It also avoids tracking down and correcting translation errors made when converting the concept to a detailed design. The efficiency gains expand to other downstream activities.

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*Reusing more of the concept model means the detail designer can reduce wasted efforts recreating design details.*

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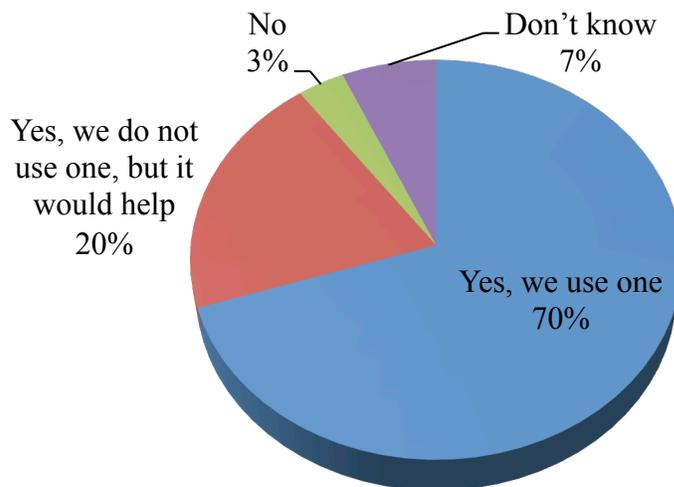
Respondents were then asked if using a single tool for both concept and detail design would help. An overwhelming 85% said it would.

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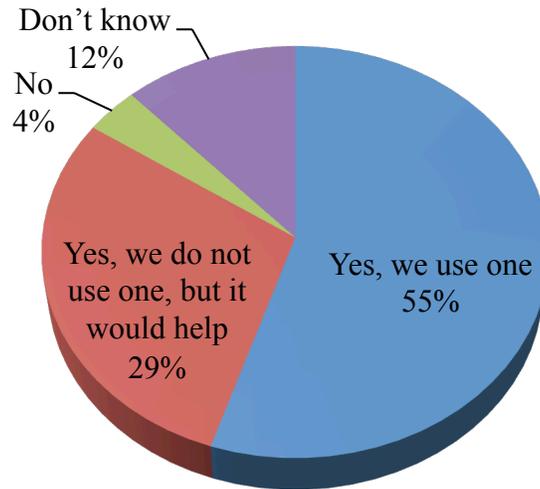
*As further support that a single tool could help, Top Performers are 27% more likely than their lesser performing competitors to already use a single tool.*

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As further support that a single tool could help, Top Performers are 27% more likely than their lesser performing competitors to already use a single tool (Figures 15 and 16).



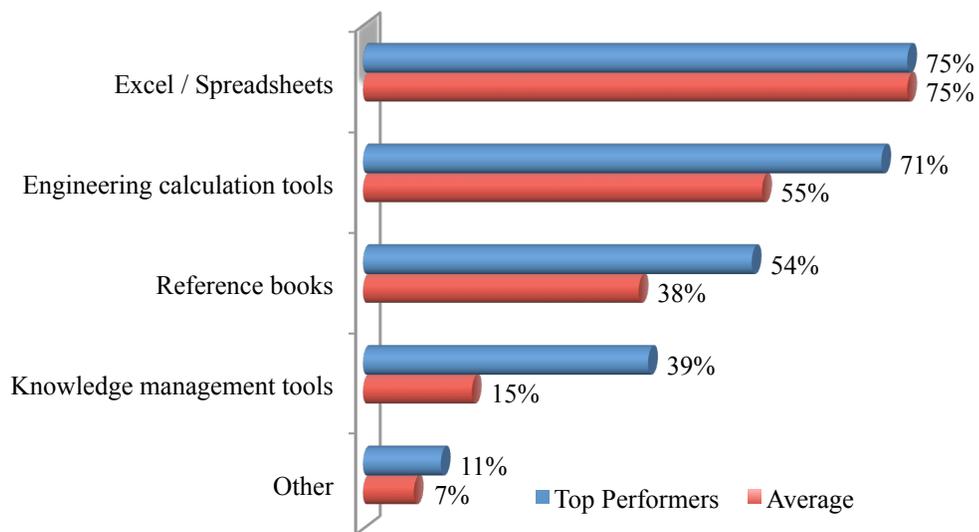
**Figure 15 – Top Performers: Would a Single Tool Help?**



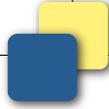
**Figure 16 – Average Performers: Would a Single Tool Help?**

### Capture Engineering Knowledge

Embedded engineering calculations are another area respondents indicate would help them. Figure 17 compares how Top and Average Performers capture engineering formulas.

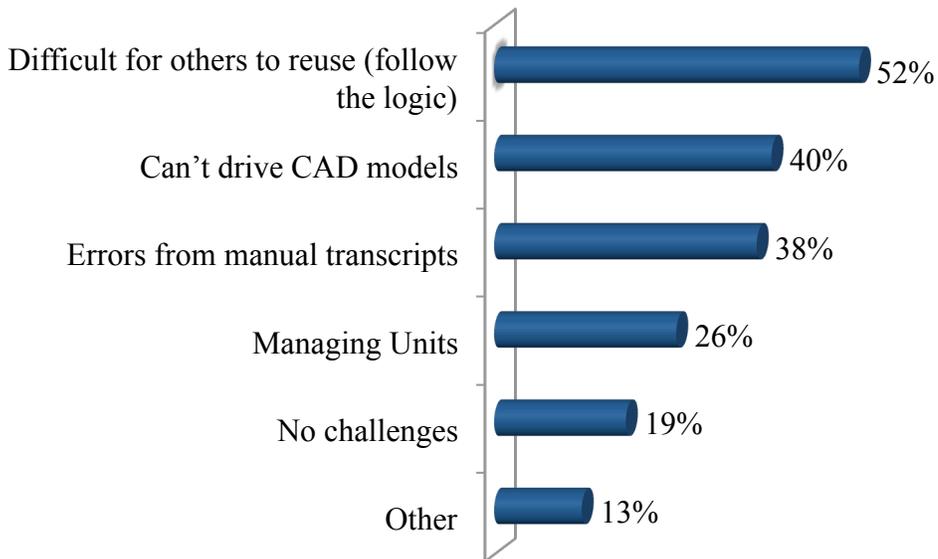


**Figure 17 – How Engineering Formulas Are Captured**



What’s interesting is how common spreadsheets are across performance categories, yet they are not what makes the difference in performance. While spreadsheets are easy, Top Performers are more likely than their competitors to use other tools too, including 29% more likely to use engineering calculation tools and 2.6 times more likely to use knowledge management tools.

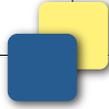
Why are other tools needed? Figure 18 reveals some of the challenges of using spreadsheets.



**Figure 18 – Challenges with Spreadsheets**

While easy to use and flexible, spreadsheets lack some of the intelligence embedded in other tools. As observed in Tech-Clarity’s report, *Creating the Environment to Innovate*, “*All but the simplest companies outgrow spreadsheets and other manual approaches due to complexity and the inability to share information.*”

In fact, only 19% say there are no challenges with using spreadsheets. To support embedding engineering calculations into concept models, companies should look for tools that are easy for others to reuse and can drive CAD models.



## Conclusion

A focus on concept design leads to greater innovation, which in turn drives revenue. Because of this, investments in the concept phase pay off as seen by the benefits companies enjoy after implementing their latest tools for concept design. In fact, this phase is so important, 82% rate the concept phase as having a positive business impact.

The most successful companies would like the concept phase to produce a well-defined concept and a model that can be used during detailed design. However, this is difficult to achieve and most companies are unable to consistently accomplish this. On the other hand, Top Performing companies are 2.9 times more likely to always produce an ideal result from the concept phase.

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*To support more reuse, 85% believe a single tool for concept and detailed design would help.*

---

The hardest parts of the concept phase include getting timely feedback, the time-consuming nature of iterations, and inefficient processes. The reasons for this are the use of multiple 2D and 3D systems, errors converting the design, and a lack of tools to leverage the concept model during detailed design. These issues result in higher cost, lost productivity, late to market, and lost opportunities. Another challenge is how much of the concept model is recreated during detailed design. Only half (52%) of a concept model is reused. Companies report that optimizing concept model reuse would save 45% of development time. To support more reuse, 85% believe a single tool for concept and detailed design would help.

Optimizing the concept design process can help companies become more profitable. By adopting best practices for concept design, companies may enjoy benefits similar to those of Top Performers.

## Recommendations

Based on industry experience and research for this report, Tech-Clarity offers the following recommendations:

- Focus on the concept phase to improve the ability to innovate
- Facilitate collaboration with a wide cross-section of roles to solicit feedback on concept designs and get a variety of viewpoints
- Enable non-CAD users and customers to provide feedback on concepts by sharing conceptual designs in a format they can use
- Look for opportunities to reuse more of the concept model during detail design

- Improve the efficiency of developing concept models by taking advantage of reuse libraries
- Consider a single tool that supports the requirements of both concept development and detail design
- Capture engineering knowledge using engineering calculation tools and other knowledge management tools rather than relying on spreadsheets

## About the Author

Michelle Boucher is the Vice President of Research for Engineering Software for research firm Tech-Clarity. Michelle has spent over 20 years in various roles in engineering, marketing, management, and as an analyst. She has broad experience with topics such as product design, simulation, systems engineering, mechatronics, embedded systems, PCB design, improving product performance, process improvement, and mass customization. She graduated magna cum laude with an MBA from Babson College and earned a BS in Mechanical Engineering, with distinction, from Worcester Polytechnic Institute.

Michelle began her career holding various roles as a mechanical engineer at Pratt & Whitney and KONA (now Synventive Molding Solutions). She then spent over 10 years at PTC, a leading MCAD and PLM solution provider. While at PTC, she developed a deep understanding of end user needs through roles in technical support, management, and product marketing. She worked in technical marketing at Moldflow Corporation (acquired by Autodesk), the market leader in injection molding simulation. Here she was instrumental in developing product positioning and go-to-market messages. Michelle then joined Aberdeen Group and covered product innovation, product development, and engineering processes, eventually running the Product Innovation and Engineering practice.

Michelle is an experienced researcher and author. She has benchmarked over 7000 product development professionals and published over 90 reports on product development best practices. She focuses on helping companies manage the complexity of today's products, markets, design environments, and value chains to achieve higher profitability.

## About the Research

Tech-Clarity gathered and analyzed 190 responses to a web-based survey on concept design. Survey responses were gathered by direct e-mail, social media, and online postings by Tech-Clarity and Engineering.com.

The respondents were comprised of 59% who were individual contributors, primarily industrial designers and design engineers. Another 26% were manager or director level, and the remaining 15% represented from VP or executive levels.

The respondents represented a mix of company sizes, including 38% from smaller companies (less than \$100 million), 9% between \$100 million and \$250 million, 11% between \$250 million and \$1 billion, 8% between \$1 billion and \$5 billion, and 14% greater than \$5 billion. 20% chose not to disclose their company size. All company sizes were reported in US dollar equivalent.

The responding companies were a good representation of the manufacturing industries, including Machinery and Industrial (35%), Automotive (21%), Aerospace and Defense (19%), Consumer Products (17%), High-tech and Electronics (13%), Life Sciences (10%), and others. Note that these numbers add up to greater than 100% because some companies indicated that they are active in more than one industry.

The respondents reported doing business globally, with most companies doing business in the North America (65%), 37% doing business in Western, about one-third doing business in the Asia-Pacific regions (33%), Eastern Europe (12%), and Latin America (17%).

Respondents included manufacturers as well as service providers and software companies, but responses from those determined not to be directly involved in developing products (including software vendors and consultants) were not included in the analysis.