Preparing for fast-paced development

SET-BASED ENGINEERING

Early phases of new product development are characterized by a high level of uncertainty and are often referred to as the "fuzzy front end". Finding the right concept from the start is a dire task and late design changes are common. However, by identifying and closing knowledge gaps in the early phases, it is possible to perform industrialization in a more efficient manner. Set-Based Concurrent Engineering (SBCE) seeks to reduce uncertainties and close knowledge gaps early on in a project.

For years, SBCE has been a common way of working among lean leaders. By front-loading and setting this as a standard within the organization, these companies have successfully reduced the time-to-market and cost for development. Through exploring and developing different design solutions from the start, the concept selections can be made with more confidence, and late changes are minimized.

Although the fundamentals of SBCE can be easy to grasp, incorporating it and reaping its benefits is far more difficult. Implementing the methodology requires persistence as well as a change in mind-set.

This Triathlon newsletter gives a glance of the concepts and tools used in SBCE and how to successfully implement them in the organization. ■

CHALLENGING THE TRADITIONAL APPROACH TO PRODUCT DEVELOPMENT

In lean product development, two types of value streams are often defined: the knowledge and the product value stream. SBCE seeks to combine the two and create a standardized way to work, re-use knowledge between projects, and learn as much as possible from the early phases.

The knowledge and product value streams are illustrated in Figure 1. The knowledge value stream deals with how to capture and re-use knowledge from one project to another. The product value stream concerns how e.g. tasks, people and equipment are managed in projects. Both these value streams need to be integrated to secure efficiency in product development.

Focusing solely on the product value stream is a common pitfall for companies. This mindset inhibits the concept selection process since the transfer of knowledge between projects is not clarified. With this traditional approach, earlier mistakes can often be forgotten and repeated.

With SBCE, a set of concepts are evaluated in the early phases of the development process. The concepts are based on both new studies and earlier experiences from the knowledge value stream. By using "customer interests" defined by the project, such as cost or weight, different concepts can be compared.

The comparisons are then visualized by using trade-off curves (described on page 2) to illustrate how well different concepts relate to opposing customer interests.

By starting from numerous concepts, rather than from a few, obtaining the best concept is far more probable. This is simply because there are more possibilities to choose from.

Although a concept has been discarded, it is important to remember that it still can be valuable for the organization. By transferring the lessons learned to the knowledge value stream, discarded concepts will benefit future projects. ▶▶

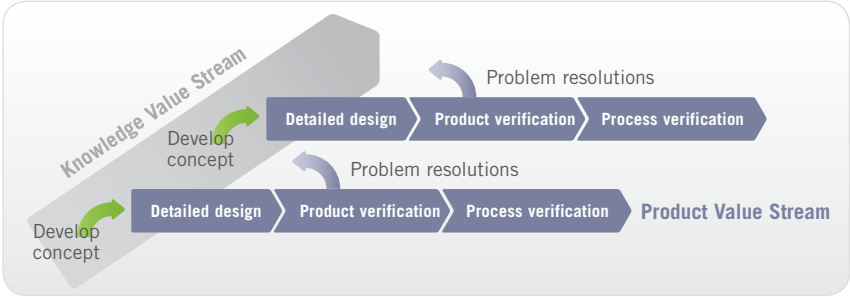

Figure 1. Illustration of the two value streams in an organization

A set-based way of working increases the effort required in the pre-study and concept study phases of a project. This seemingly unproductive increase in resources can initially appear alarming, from a managerial perspective. However, the total project time and cost will be reduced as the probability of late changes decreases. This is not only because more alternatives have been investigated before solutions are selected, but more importantly because most of the major knowledge gaps have been closed. With this approach, final development becomes a phase of "doing" rather than a continued phase of investigation and solution design. Hence, it is easier to estimate the resources needed and possible complications.

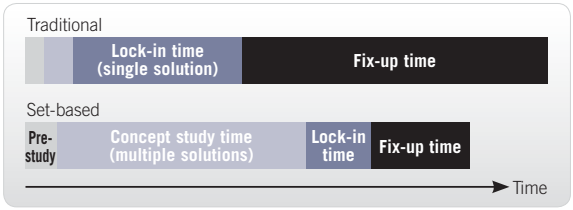

Figure 2. Comparing time spent in different phases during traditional development and set-based development

Another benefit of SBCE is the aforementioned transfer of increased concept study knowledge to future projects. This knowledge transfer, together with the reduction in development time, makes SBCE a very alluring approach to new product development. ■

TOOLS Facilitating an SBCE approach

Integrating events

An "integrating event" is a major milestone where all of the work in a project is pulled together so that the entire team can review the health of the overall product design. These events are especially useful in large projects where work is divided among sub-teams. When focusing on one area alone, it can be difficult for a sub-team to truly assess the interdependencies and impact of their work on the rest of the project. The integrating events help to identify areas that overlap or conflict and help to establish relations between sub-teams that would not otherwise meet.

A3 reports

Although simple in its design, the A3 report can act as a very efficient tool to create a common understanding of an issue and align the organization towards a solution. The purpose of the A3 is to illustrate an issue, from the background and current situation, to the wanted position and with a plan to get there. The format is not only useful for problem solving, but also for documentation purposes, e.g. to visualize the status of a sub-team's work at an integrating event.

By telling a story, the A3 report lays out an entire plan to solve a problem or make an improvement, large or small, on just one sheet of paper.

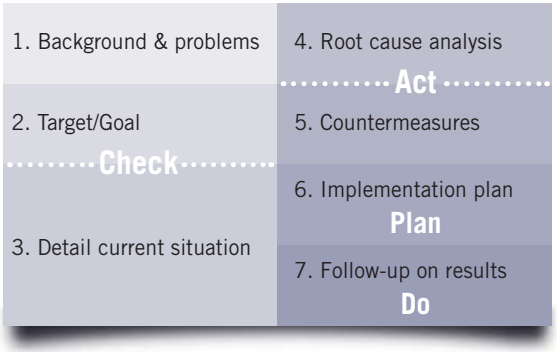

Figure 3. Example outline of an A3 report, illustrating the Plan Do Check Act (PDCA) approach

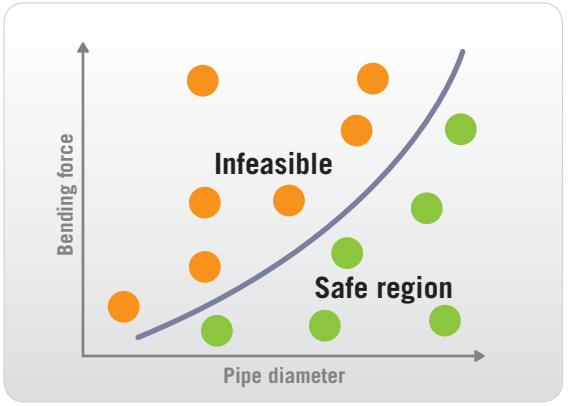

Figure 4. Simplified example of a trade-off curve containing a large set of evaluated concepts

Trade-off curves

The trade-off curve is a tool for visualizing and comparing different design options. It shows the dependency between two variables, for instance the diameter of a pipe and an exerted force. The chart demonstrates different design options, from which safe and risky solutions can be identified.

Using trade-off curves in product development provides a simple but powerful tool for organizing data into knowledge that can be re-used between projects. During integrating events, the trade-off curves visualize the feasible options and facilitate decision making. ■

BARRIERS to success...

Despite the obvious benefits of having an SBCE approach to product development and the perceived simplicity in utilizing that approach, a majority of the western world organizations attempting to utilize SBCE fail in realizing its benefits. Persistence and cultural change are key to this transformation.

Organizations fail to reap the benefits of SBCE due to mainly three reasons:

- Engineering culture is characterized by finding one solution fast
- Management promote early conceptual lock-in
- A short-term focus in realizing SBCE results

In general, engineers tend to focus on the solution rather than the problem. Therefore, effort is often focused on quickly finding a solution that seems feasible in order to enter the design-build-test cycle. Inability to overcome this mindset in the engineering organization prohibits the efficient utilization of SBCE.

Moreover, management assesses project progress by time and cost. Deciding on a solution in the early phases provides a perception that time-to-market will be short and reached at a low cost. Not surprisingly, early conceptual lock-ins tend to result in late design changes when more knowledge about the problem has been built up. The process is then iterated, resulting in significantly higher than anticipated time-to-market and cost.

As with all cultural changes, time is of essence and it is required to hold on to the belief that the investments made will pay off in the future. Our experience shows that a clear majority of those who start to adopt SBCE are aware of the patience required prior to the transition. This awareness is however rarely maintained during the transition. When short-term results are not shown, and it is perceived to take long time for reaching a solution, falling back on old behavior is common.

...AND HOW TO TAKE THE LEAP

Those aiming at adapting a set-based approach to development need to realize that this, as with most of Lean R&D, is not primarily about methods, it is about changing the corporate culture.

When an organization decides to make the move towards SBCE, it is highly advisable to start on a small scale. Preferably, this is done by testing the methods in a selected area of development, using a pilot case. Having secured some degree of managerial commitment and scope of initiative, the next step is to understand the starting point, i.e. the current situation. Assessing the current situation is important since:

- **It harmonizes the involved staffs' ideas about what is sought to be improved**
  This can be done by highlighting examples where earlier projects have suffered from late changes and less-than-optimal technical solutions, due to preemptive decisions.
- **It highlights areas where knowledge re-use is specifically important**
  Knowing where you start from, and what your project plans would look like without a set-based thinking, gives you a good basis for defining a way towards where you want to be. That is, making a plan for how to integrate the set-based thinking and methodologies in the specific situation.
- **Existing best practices can be used to head start the implementation**
  Good internal examples reduce the risk of "not-invented-here" reactions to the methodology.

As with all implementations, information sharing is key in the initiation phase. Those involved in the specific case should have the possibility to know which activities that are planned for, and for what reasons. Triathlon's most common approach is to use Visual Management methods in combination with shorter educational sessions. In order to focus on the right things, everyone participating in the later analysis sessions and integrating events should have some knowledge about the principles of SBCE before those meetings.

Our experience shows that in-depth activities in the pilot project should not be led by the same people who aim at learning the methods, at least not initially. Having someone with expertise to coach the discussion enables people to reflect on their own situation, and focus on learning the culture and behavior.

Finally, learning from the pilot cases is a good starting point for continuing the change in broader areas of development. The people involved in the pilot and the managers supporting the change are vital as coaches, ambassadors, and teachers in other areas. It is not until the knowledge gained is re-used, improved, and re-used again, that the full benefits of the methodology will appear.

Triathlon Consulting Group
Klippan 1A , SE-414 51 Göteborg Sweden
Phone: +46 (0) 31 704 12 90
Fax: +46 (0) 31 704 12 91

Box 21009
SE-100 31 Stockholm Sweden
Phone: +46 (0) 8 54 54 81 60

Triathlon Consulting Group

Triathlon is a growing management consultancy dedicated to strategy, operations and finance with a prestigious track record. Our clients are large and medium-sized companies within the manufacturing, high-tech and professional service industries.

By combining innovation and best practice, we develop distinctive and substantial value to our clients through long-term relationships and genuine understanding of their business needs. In our assignments we preferably work in teams together with client personnel so that we transfer our knowledge to the client organization.

Strategy
Developing strategies and governance to reach objectives

Operations
Improving operations by combining innovation and best practice

Finance
Setting up business structure and control to support strategy and operations

Need a success story of your own?
– Triathlon develops your business