

New Product Dynamics and Silver Streak Partners LLC

Flexible Product Development: Costs and Benefits

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For firms that compete with innovative new products in dynamic markets, this study provides ideas and tools to balance the costs and benefits of flexibility in development projects.

Flexible Product Development (FPD)

For many years, product development “best practices,” such as phase-gate, have focused on making projects more predictable and reducing development cost by planning projects thoroughly and resisting midstream changes. This approach has deeply ingrained a fallacy in management thinking that midstream changes are waste and should be eliminated. However, change is not always waste: discovery and learning are essential to developing innovative products, and resisting change has two pernicious side effects. It punishes those who innovate and strait-jackets responsiveness in fast moving markets.

FPD supports innovation in dynamic markets.

FPD is a set of tools and methods that cope effectively with—and even embrace—mid-project changes. Based on ideas and experience from a variety of sources, including the agile software development movement, FPD reduces the cost of midstream changes and balances the benefits of change against the risk of ballooning budgets and slippery schedules. FPD principles include:

- Avoiding the pretense that thorough planning eliminates the need for change.
- Keeping important design options open until the last responsible moment.
- Using effective experimentation and front loaded prototyping to promote innovation, discovery, and learning.
- Specifying requirements in a way that keeps the development focused yet encourages in-process customer feedback.
- Reducing the cost of change throughout the development process.
- Building teams that are comfortable with ongoing change.
- Balancing the advantages of flexibility with the benefits of structured processes.

When these and other tools, as described in the book, *Flexible Product Development*, are applied with an understanding of flexibility’s costs and benefits, managers can expect significant improvements in business results from their new-product programs.

Overview

Flexible Product Development is an emerging approach that supports innovation in dynamic markets by reducing the cost of mid-project changes. This paper reports results of a study of the costs and benefits of flexibility based on first hand experiences.

The most notable discoveries were how deeply ingrained thinking about phase-gate processes can obscure leaders’ understanding of the costs and benefits of flexibility.

The study also provided indicators to balance costs and benefits and insights into organizational changes needed to adopt flexible methods.

The Study

The purpose of this study was to provide product development decision makers with a better understanding of the costs and benefits of FPD, based on actual development project experiences. We wanted to explore the drivers of midstream project changes, techniques used to reduce the disruption they cause, and the cost-benefit tradeoffs of flexibility.

We conducted individual interviews with 16 executives, managers, and technical leaders from a variety of industries and organizations. We used a semi-structured technique, starting with open-ended questions and delving into details to better understand participants' stories.

This study explored NPD leaders' experience with mid-project changes.

Periodically during the interviewing phase, we jointly reviewed results to improve and sharpen the focus of future interviews.

While we initially expected to learn objective and quantitative costs and benefits, the open interview process also provided a picture the cultural and organizational support necessary to implement FPD.

This report presents the principal ideas and themes that emerged from the interviews. We anticipate adding notes based on feedback and discussions during the online forum.

Findings

Change Happens

In the interviews conducted for this study, we asked participants to identify a couple of specific examples of a change in a development project. No one had any difficulty in recalling a change. That is, midstream change in a project is a common experience. This fits with data from Donald Reinertsen discussed on p. 32 of *Flexible Product Development* that, in *every* project, product requirements change during design.

Change can and does occur in any part of the project at any time.

And there are many other kinds of change beyond requirements. In some of our interview examples the original design didn't work out or lacked adequate performance. Conversely, in one case, a better design was discovered. In some cases, the project change was attributed to supplier delays, in some to a change in marketing strategy, in some to customers changing their minds or to understanding the customer better, in some to the market shifting, and in some to manufacturing difficulties.

In retrospect, it is a bit surprising that there were a preponderance of design-related changes, but this is probably due to a preponderance of R&D managers among the interviewees.

This confirms that change can and does occur in any part of the project at any time, not just among the engineers during the design phase. The idea—upon which many product development processes are built—that the project will be executed according to the original plan is an illusion.

Flexibility is a Competitive Advantage

All interviewees were asked to describe a situation where a mid-project change was required. In almost all interviews, the changes described were driven by unforeseen circumstances rather than weak planning.

Some typical situations showed the need for flexibility to support innovation:

- A company with well-established core technologies sought to move into a new application area, but was forced to re-define their product when it was unsuitable for the novel use environment they encountered.
- A supplier of high performance products found it necessary to update requirements when a competitor introduced a new technology with better performance.
- Developers at a semiconductor company defined a product around a superior digital signal processing algorithm, which required an improved analog signal capability. They had planned for two prototype cycles, but found the analog improvements required an extra cycle.

Other situations were typical of rapidly moving markets:

- In a market where requirements were set by industry standards, a company was forced to develop products while requirements were still emerging; waiting for stable requirements would have put the company far behind its competitors.
- A supplier was developing subsystems for a system being concurrently developed by their customer. It was impossible to freeze the subsystem requirements before starting development.
- A company addressing a rapidly moving market mothballed a project because the requirements could not be frozen. Without the tools to deal with flexible requirements, the opportunity languished for nine months, until requirements were more stable—and more nimble competitors had entered the market.

In all these situations, the mid-project changes were necessary to sustain the companies' competitive advantage, and in the interviewees' opinions, it was not possible to predict the needed changes in the normal project planning phase.

*More flexible competitors
gain market advantage.*

In some cases, interviewees recognized that more flexible competitors were gaining market advantage, and we believe that in all cases, firms with the capabilities to manage mid-project changes at minimal cost and disruption can develop more innovative products and maintain more nimble responses to dynamic markets to put themselves ahead of their competitors.

The Cost of FPD Is Not the Cost of Project Changes

Flexibility is about anticipating or preparing for project changes. However, there seems to be a widespread belief that the cost of flexibility is therefore the cost of making the change. This connection arose in the interviews when we asked about the costs and benefits of specific changes that occurred in projects.

This misses the crucial point that flexibility attempts to anticipate and prepare for changes. Thus, the cost of flexibility is the extra upfront cost of identifying and investigating possible changes so as to be ready for them when they occur and avoid the usually much more expensive cost of unanticipated changes later.

This is the most important revelation of this study. We tend to think of project changes as expensive and thus to be avoided, and we normally compare the benefits of making a change with the cost of making it, not with the cost of preparing for the change. If we don't prepare for the change, then we only have the cost of the change to consider, but usually the cost of preparing is much lower if we have the foresight to prepare.

Insurance is a good analogy for understanding this. We buy fire insurance on our house to protect against the possibility of it burning down. The alternative is to not buy the insurance and bear full responsibility for the cost of a fire (the cost of a change). In this case, we might become quite paranoid about the risk of fire, not wanting to use the fireplace, the stove, or the furnace.

If we buy fire insurance, we pay the premium (the cost of flexibility) to relieve us of unnecessary worry about the catastrophic cost of a fire. If a fire does not occur, we consider ourselves lucky and don't begrudge paying the insurance premium "for nothing." If a fire does occur, we are protected from the major part of the loss and can regroup far more easily.

Phase-gate thinking overstates the cost of flexibility.

Each change has its benefits: improved marketability, improved customer acceptance, lower manufacturing cost, and many others. Compare this benefit against the premium you paid to be able to make this change easily (flexibility). If you didn't prepare well for the change and paid the full cost of making it, retrospectively rethink the project to learn what you could have done to improve your flexibility next time. The idea is to shift more to paying the insurance premiums instead of paying for the fires so that you can become more equanimous about project changes, which are the essence of innovation.

FPD Reduces Variance in Project Outcomes

This finding is contrary to the common wisdom about structured processes: Structured processes, such as phase-gate, are thought to improve project predictability, but a flexible approach, where it is warranted, results in less variance in outcomes than a structured approach. A typical example abstracted from the interview data illuminates this seeming paradox.

A company has discovered a new application for its core instrument technology. A novel application requirement is that the instrument case must withstand pressure washing, be lightweight, and be electrically conductive. The lead customer has suggested a stainless steel case, but one of the design engineers also suggests a moldable material that meets the technical requirements.

Here are two ways they could plan the project:

A structured project plan

The design team is anxious to finalize the product definition and get started. They consider the design expense and schedule impact of the alternative case materials:

Case alternative	Design expense	Design time
Stainless case, including supplier qualification	\$100,000	6 months
Molded case, including tooling	\$200,000	6 months

Before finalizing the decision, the team considers development risks:

Case alternative	Risks
Stainless	Weight Cosmetics Manufacturing source
Molded	Customer acceptance Manufacturing source

Considering the lead customer's suggestion of a stainless case, the extra expense of designing a molded case, and the pressure to start the project soon, the team decides to plan the project around the stainless case, with an implicit risk mitigation plan: if the stainless case is not acceptable in the beta release, they will pull resources from another project and delay final release in order to design a molded case.

In this example, acceptability of the stainless case will determine project outcomes:

	Stainless OK	Change to Molded
Development expense	\$100,000	\$300,000
Release schedule delay	0 months	6 months

Note that if the stainless case is not acceptable, the structured approach incurs a potential variance of \$200,000 in expense and 6 months in schedule.

A flexible project plan

A flexible approach in this situation is to recognize that the case material is an important decision and that the team does not have enough information to make a clear choice now. The case material is an option to be kept open until the team has more information.

Contrary to common thinking, flexibility can make project results more predictable.

The team considers using front loaded prototyping to explore case materials early in the project. Roughly estimating size and weight of the electronics, they can build non-functional prototypes of the two cases to get early customer feedback. Then they will proceed with the alternative providing better overall

financial returns.

In this approach, the team estimates that the early prototypes will add \$30,000 to development expenses, without delaying the schedule, and the full cost of developing the case will be as estimated above.

Now the range of potential outcomes is:

	Stainless case	Molded case
Development expense	\$130,000	\$230,000
Release schedule delay	0 months	0 months

The flexible approach incurs potential variance of \$100,000 in expenses and no schedule variance.

Comparing structured and flexible approaches

Compared to the structured approach, the flexible approach cuts potential expense variance in half and eliminates schedule variance.

The cost of the flexible approach is \$30,000 if the stainless case is acceptable. But the flexible approach saves \$70,000 if stainless is not acceptable. Following the insurance analogy described earlier, a \$30,000 premium, insures the project by reducing the expense variance by \$100,000 and the schedule variance by 6 months.

The business value of a \$30,000 insurance premium depends on the likelihoods of the molded/stainless acceptability and the financial costs of a 6-month schedule delay. Other benefits of the flexible approach not quantified in this example are:

- Product sales may be improved by selecting one case or the other based on higher quality customer feedback.
- The company avoids the potential disruption to other projects that would be needed for an 11th-hour development of the molded case.
- By delaying the final selection of case material, even better solutions, such as other materials or suppliers, may appear.

Managing Project Delay Is an Important Benefit of FPD

We encourage companies to calculate their cost of delay (see chapter 2 of *Developing Products in Half the Time*), which is the profit lost if a new product is, say, one month late to market. Few companies actually complete this calculation, but most product development organizations are acutely aware of timeliness, and they assign prime importance to schedule compliance. Managers know that delay reduces their products' novelty, allows competitors to slip into the lead, and thus undercuts profits.

FPD helps balance the cost of project delay with the cost of preparing for change.

In a dynamic customer, market, or technology environment where mid-project change is likely, FPD can help greatly to manage schedule delay. FPD allows developers to keep options open, explore possible changes, and isolate areas of change so as to reduce the time impact if a change occurs. The project is still delayed, but not nearly to the extent that it would have been if FPD methods had not been employed. Moreover, actually making a change is optional with FPD: when you reach the fork in the road, you can choose to stay with the original schedule if you believe that timeliness outweighs the customer value you could add by changing.

In short, FPD reduces the schedule impact of a change and allows you to stay closer to schedule, even with midstream changes. Note that this is another perspective on the conclusion that FPD reduces variance in project outcomes.

Qualitative Indicators Help Balance Benefits and Costs

Although flexibility offers important advantages in some situations, it can incur unnecessary cost in others. Executives and developers should strive to achieve an effective balance between costs and benefits, and the effective balance will differ among individual projects and different product lines.

This study revealed some meaningful comparisons between the benefits and costs of structure and flexibility. Most of these benefits and costs are not purely quantitative, but they provide an effective qualitative measuring stick for decisions about where best to apply FPD tools.

The comparative benefits of structure and flexibility that we observed from the interviews are tabulated below. Note that adjacent items across the columns are not meant to be opposites.

Executives and developers can use this comparative benefits table as a yardstick to decide if they would benefit from more flexibility or more structure. When a firm seems to be enjoying most of the benefits of structured processes, but few of the FPD benefits, developers should explore applying FPD tools for a more effective balance.

COMPARITIVE BENEFITS	
Structured development processes	Flexible development processes
<ul style="list-style-type: none"> ○ Little effort wasted exploring unimportant design alternatives. ○ Little investment in unused flexible features ○ Close control over design changes ○ Few mid-project changes ○ Coordinating across functional groups requires little effort ○ Easy to plan development resources ○ Simple management oversight of projects. 	<ul style="list-style-type: none"> ○ Reduced cost of necessary changes. ○ Reduced chance of post-release changes. ○ Process more tolerant of innovation, learning ○ Product releases meet current requirements ○ Development effort adapts to changing market requirements ○ Ability to explore and learn without “sacrificial” product releases. ○ Can avoid schedule delays by trimming project scope.

Once the firm has recognized the need for a better balance between structure and flexibility, it is important for developers and managers to know that the effective balance point is not static, but varies over time and from one situation to another. To maintain an effective operating point, firms must define a system of red flags to alert them that their balance is shifting from the optimum. The idea is to constantly monitor these warning signals and take action to correct their balance as conditions change.

A benefit comparison provides a measuring stick to balance structure and flexibility.

While each company must create its own unique set of red flags, we were able to glean the examples tabulated on page 8 from our interviews and from our own experience.

To make use of the table of red flags, managers and developers should look at each statement to see if it applies to their organization. If it does, it may mean that the company’s systems are overbalanced toward structure or flexibility.

Perspectives about Flexibility Depend on One’s Position

In the interviews we purposely spoke with managers at various levels and from various departments. We found that some embraced flexibility and felt they needed more of it, while others felt that the organization was already too flexible. The latter group complained of the chaos imposed by others who re-directed projects for which the interviewee was responsible. Those leading the change experienced the benefits of FPD, whereas those who had to carry out the changes saw the costs of change.

RED FLAGS	
Processes are too structured.	Processes are too flexible.
<ul style="list-style-type: none"> ○ Developers are forced to make changes after first resisting them. ○ 11th hour project crises are being caused by late discoveries. ○ Developers are not following the established processes. ○ Market conditions often change before a product is released ○ Customers' knowledge of application and requirements appears to change during your development. ○ Available technologies (or your knowledge of them) change during the course of the development project. ○ Developers feel rigid development processes inhibit innovation. ○ It's less risky to fail following established processes than to succeed by deviating from the process. 	<ul style="list-style-type: none"> ○ Developers are confused by unstable, changing plans and priorities. ○ Managers have poor oversight of project plans and schedules. ○ Changes jeopardize critical product requirements (safety, etc.) ○ Changes incur high communication overhead on large or complex projects. ○ Changes have unforeseen side effects in complex, interconnected technology. ○ Development team has difficulty implementing changes due to inexperience or high turnover. ○ Developers are uncomfortable deviating from familiar structured processes.

This parallels the experience of Professor Alan MacCormack reported on pages 34–35 of Flexible Product Development. It is also similar to situations we often see where top management, sales, or marketing imposes changes in the product requirements unilaterally on the project team: those on the outside see the benefits, but those inside the project must pay the cost.

Warning flags help to sustain an effective dynamic balance.

The solution in all these cases, we believe, is two-pronged: improve up-down communication and dialog on the costs and benefits of a change, and ensure that authority for making flexibility decisions is explicit. The team needs an opportunity to push back on changes so that a balanced cost-benefit decision can be reached and so that the team believes in the changes they are making. Also, flexibility decisions need to be both fast and effective, with authority usually falling on the development team or a single manager. Disagreements and discomfort with flexibility often result from unclear authority structures.

FPD Requires Changes in Culture and Management Systems

The interviews provided numerous examples of how corporate culture and management systems can inhibit flexibility.

As a striking example, an interviewee from a semiconductor company reported on a project with a difficult design challenge. Executives approved a plan that forecast either two or three mask iterations, or "spins." But when the third spin was needed, executives regarded this as a failure and reduced bonuses for the designers. We imagine that it will be some time before designers present another flexible plan to those executives.

On the other hand, another company tracked schedule and cost performance very closely, but deviations were only triggers for high-level discussions about the need for changes. On a project aimed at a new market application, unforeseen requirements late in the project triggered a review. The executives understood the need for the change, and the project adapted without damage to the designers' paychecks.

While the second example shows a company culture that tolerates change, we note that a more flexible approach might have eliminated the need for schedule changes entirely. A more flexible process would illuminate the uncertainties surrounding the new application early in the project. Use of front-loaded prototyping might have discovered the full requirements before the need for a schedule slip.

Most firms will need organizational changes to move from phase-gate to FPD.

The fallacy that good planning eliminates change is often deeply ingrained in a company's culture and management systems. Without rooting this thinking out of the formal development process, an FPD initiative is likely to fail.

Some examples of corporate culture, development processes, and management systems that are likely to need changing to support FPD are:

- Project planning deliverables must include both fixed plans and uncertainty plans
- In areas of uncertainty, options must be created early and kept open until the uncertainty is resolved.
- Customers change their minds, so there must be an explicit process to loop back with the customer regularly
- Explicit decision making and decision tracking methods must be defined.
- Experimentation and prototyping must be encouraged and provided with easy-to-access resources upfront to support learning, not just later to verify results.
- Performance measurements must be expanded beyond plan conformance to include the quality and timeliness of mid-project decisions.
- Status reviews must become more timely and frequent than the go/kill reviews common to phase-gate "best practices."

Conclusions

New product developers and their managers know that mid-project changes can be costly, so firms seek to overcome change with better planning and more structured processes. But paradoxically, avoiding change makes a firm less competitive by hindering innovation and responsiveness in dynamic markets.

Flexible product development (FPD) softens this change/innovation paradox, not by seeking to reduce change, but by reducing its cost with tools and methods to anticipate and prepare for change. But flexibility adds costs to projects and programs, so it's important for company leaders to understand FPD's costs and benefits in order to strike an effective balance between flexibility and structure in new product processes.

This study uncovers important principles and useful tools to shed light on FPD's costs and benefits based on analysis of actual experiences of new product leaders in different positions at a variety of companies.

The common thinking that structured processes can eliminate product development waste obscures a true understanding of FPD's costs. The cost of flexibility is not the cost of a mid-project change, but rather it is a (usually small) "insurance premium" to reduce the potential cost of changes that may become necessary. The excessive cost that companies associate with mid-project change actually results from *not preparing* for change and thus from sinking development investment into unproductive design alternatives.

In a parallel finding, the common thinking that more process structure improves project predictability (reduces variance in project outcomes) is wrong. A typical example from participants' experience shows how FPD methods can reduce the potential variance in project cost and schedule compared to structured methods.

In addition to these surprising findings, the study found that some individuals—typically, those imposing the change—liked flexibility, while others in the same organization—those upon whom the change was imposed—thought the organization was already too flexible. This suggests the need for better up-down communication about situations of change.

Finally, the study reveals some useful tools and ideas for firms to balance FPD costs and benefits in individual situations and to lower organizational barriers to adopting FPD practices.

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