With an "aggregate project plan," companies map out and manage a set

Creating Project Plans to Focus

By Steven C. Wheelwright
and Kim B. Clark

The long-term competitiveness of any manufacturing company depends ultimately on the success of its product development capabilities. New product development holds hope for improving market

> **Like many companies, PreQuip had no formal process for choosing and managing its development projects.**

position and financial performance, creating new industry standards and new niche markets, and even renewing the organization. Yet few development projects fully deliver on their early promises. The fact is, much can and does go wrong during development. In some instances, poor leadership or the absence of essential skills is to blame. But often problems arise from the way companies approach

the development process. They lack what we call an "aggregate project plan."

Consider the case of a large scientific instruments company we will call PreQuip. In mid-1989, senior management became alarmed about a rash of late product development projects. For some months, the development budget had been rising even as the number of completed projects declined. And many of the projects in the development pipeline no longer seemed to reflect the needs of the market. Management was especially troubled because it had believed its annual business plan provided the guidance that the marketing and engineering departments needed to generate and schedule projects.

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DRAWING BY MARK STEELE

of strategic development projects.
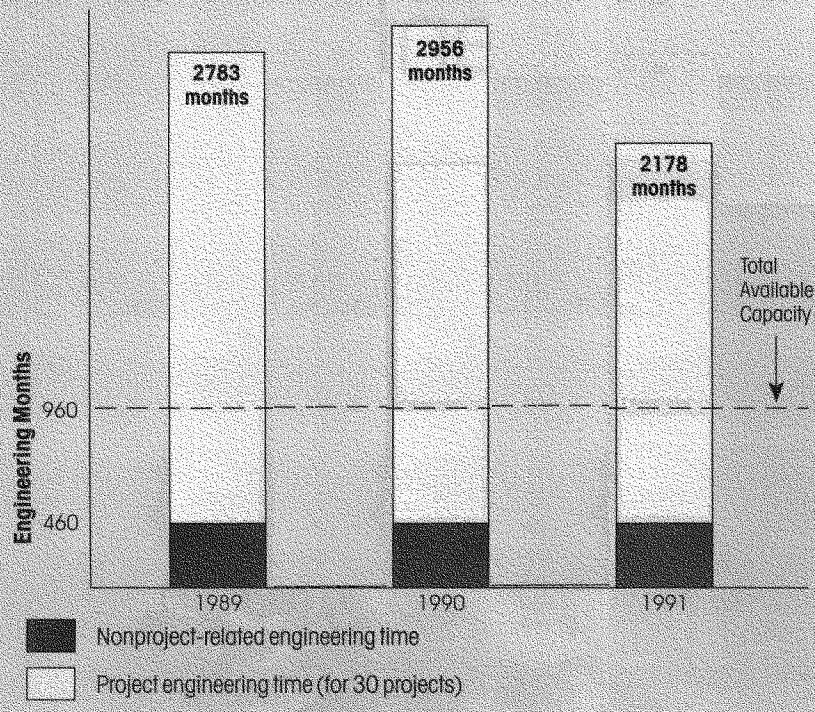
Product Development

To get to the root of the problem, the chief executive first asked senior managers to compile a list of all the current development projects. They discovered that 30 projects were under way – far more than anticipated, and, they suspected, far more than the organization could support. Further analysis revealed that the company had two to three times more development work than it was capable of completing over its three-year development planning horizon. (See the chart "PreQuip's Development Predicament: Overcommitted Resources.")

With such a strain on resources, delays were inevitable. When a project ran into trouble, engineers from other projects were reassigned or, more commonly, asked to add the crisis project to their already long list of active projects. The more projects they added, the more their productivity dropped. The reshuffling caused delays in other projects, and the effects cascaded. Furthermore, as deadlines slipped and development costs rose, project managers faced pressure to cut corners and compromise quality just to keep their projects moving forward.

The senior management team also discovered that the majority of PreQuip's development resources – primarily engineers and support staff – was not focused on the projects most critical to the business. When questioned, project leaders admitted that the strategic objectives outlined in the annual business plan had little bearing on project selection. Instead, they chose projects because engineers found the technical problems challenging or because customers or the marketing department requested them. PreQuip had no formal process for choosing among development projects. As long as there was money in the budget or the person making the request had sufficient clout, the head of the development department had no option but to accept additional project requests.

Many engineers were not only working on noncritical projects but also spending as much as 50% of their time on nonproject-related work. They responded to requests from manufacturing for help with problems on previous products, from field sales for help with customer problems, from quality as-

PreQuip's Development Predicament: Overcommitted Resources

PreQuip had 960 engineering months each year to allocate to development work. But combining the time it would take to keep its current 30 projects on schedule with the time engineers spent doing nonproject development work, the company found it had overcommitted its development resources for the next three years by a factor of three.

the set and mix of projects. In particular, they should focus on how resources are allocated between projects. Management must plan how the project set evolves over time, which new projects get added when, and what role each project should play in the overall development effort.

The aggregate project plan addresses all of these issues. To create a plan, management categorizes projects based on the amount of resources they consume and on how they will contribute to the company's product line. Then, by mapping the project types, management can see where gaps exist in the development strategy and make more informed decisions about what types of projects to add and when to add them. Sequencing projects carefully, in turn, gives management greater control of resource allocation and utilization. The project map also reveals where development capabilities need to be strong. Over time, companies can focus on adding critical resources and on developing the skills of individual contributors, project leaders, and teams.

Finally, an aggregate plan will enable management to improve the way it manages the development function. Simply adding projects to the active list – a common practice at many companies – endangers the long-term health of the development process. Management needs to create a set of projects that is consistent with the company's development strategies rather than selecting individual projects from a long list of ad hoc proposals. And management must become involved in the development process *before* projects get started, even before they are fully defined. It is not appropriate to give one department – say, engineering or marketing – sole responsibility for initiating all projects because it is usually not in a position to determine every project's strategic worth.

Indeed, most companies – including PreQuip – should start the reformation process by eliminating or postponing the lion's share of their existing projects, eventually supplanting them with a new set of projects that fits the business strategy and the

surance for help with reliability problems, and from purchasing for help with qualifying vendors. In addition to spending considerable time fixing problems on previously introduced products, engineers spent many hours in "information" and "update" meetings. In short, they spent too little time developing the right new products, experimenting with new technologies, or addressing new markets.

PreQuip's story is hardly unique. Most organizations we are familiar with spend their time putting out fires and pursuing projects aimed at catching up to their competitors. They have far too many projects going at once and all too often seriously overcommit their development resources. They spend too much time dealing with short-term pressures and not enough time on the strategic mission of product development.

Indeed, in most organizations, management directs all its attention to individual projects – it micromanages project development. But no single project defines a company's future or its market growth over time; the "set" of projects does. Companies need to devote more attention to managing

capacity constraints. The aggregate project plan provides a framework for addressing this difficult task.

How to Map Projects

The first step in creating an aggregate project plan is to define and map the different types of development projects; defining projects by type provides useful information about how resources should be allocated. The two dimensions we have found most useful for classifying are the degree of change in the product and the degree of change in the manufacturing process. The greater the change along either dimension, the more resources are needed.

Using this construct, we have divided projects into five types. The first three – derivative, breakthrough, and platform – are commercial development projects. The remaining two categories are research and development, which is the precursor to commercial development, and alliances and partnerships, which can be either commercial or basic research. (See the chart "Mapping the Five Types of Development Projects.")

Each of the five project types requires a unique combination of development resources and management styles. Understanding how the categories differ helps managers predict the distribution of resources accurately and allows for better planning and sequencing of projects over time. Here is a brief description of each category:

Derivative projects range from cost-reduced versions of existing products to add-ons or enhancements for an existing production process. For example, Kodak's wide-angle, single-use 35mm camera, the Stretch, was derived from the no-frills Fun Saver introduced in 1990. Designing the Stretch was primarily a matter of changing the lens.

Development work on derivative projects typically falls into three categories: incremental product changes, say, new packaging or a new feature, with little or no manufacturing process change; incremental process changes, like a lower cost manufacturing process, improved reliability, or a minor change in materials used, with little or no product change; and incremental changes on both dimensions. Because design changes are usually minor, incremental projects typically are more clearly bounded and require substantially fewer development resources than the other categories. And because derivative projects are completed in a few months, ongoing management involvement is minimal.

Breakthrough projects are at the other end of the development spectrum because they involve signifi-cant changes to existing products and processes. Successful breakthrough projects establish core products and processes that differ fundamentally from previous generations. Like compact disks and fiber-optics cable, they create a whole new product category that can define a new market.

Because breakthrough products often incorporate revolutionary new technologies or materials, they usually require revolutionary manufacturing processes. Management should give development teams considerable latitude in designing new processes, rather than force them to work with existing plant and equipment, operating techniques, or supplier networks.

Platform projects are in the middle of the development spectrum and are thus harder to define. They entail more product and/or process changes than derivatives do, but they don't introduce the untried new technologies or materials that breakthrough products do. Honda's 1990 Accord line is an example of a new platform in the auto industry: Honda introduced a number of manufacturing process and product changes but no fundamentally new technologies. In the computer market, IBM's PS/2 is a personal computer platform; in consumer products, Procter & Gamble's Liquid Tide is the platform for a whole line of Tide brand products.
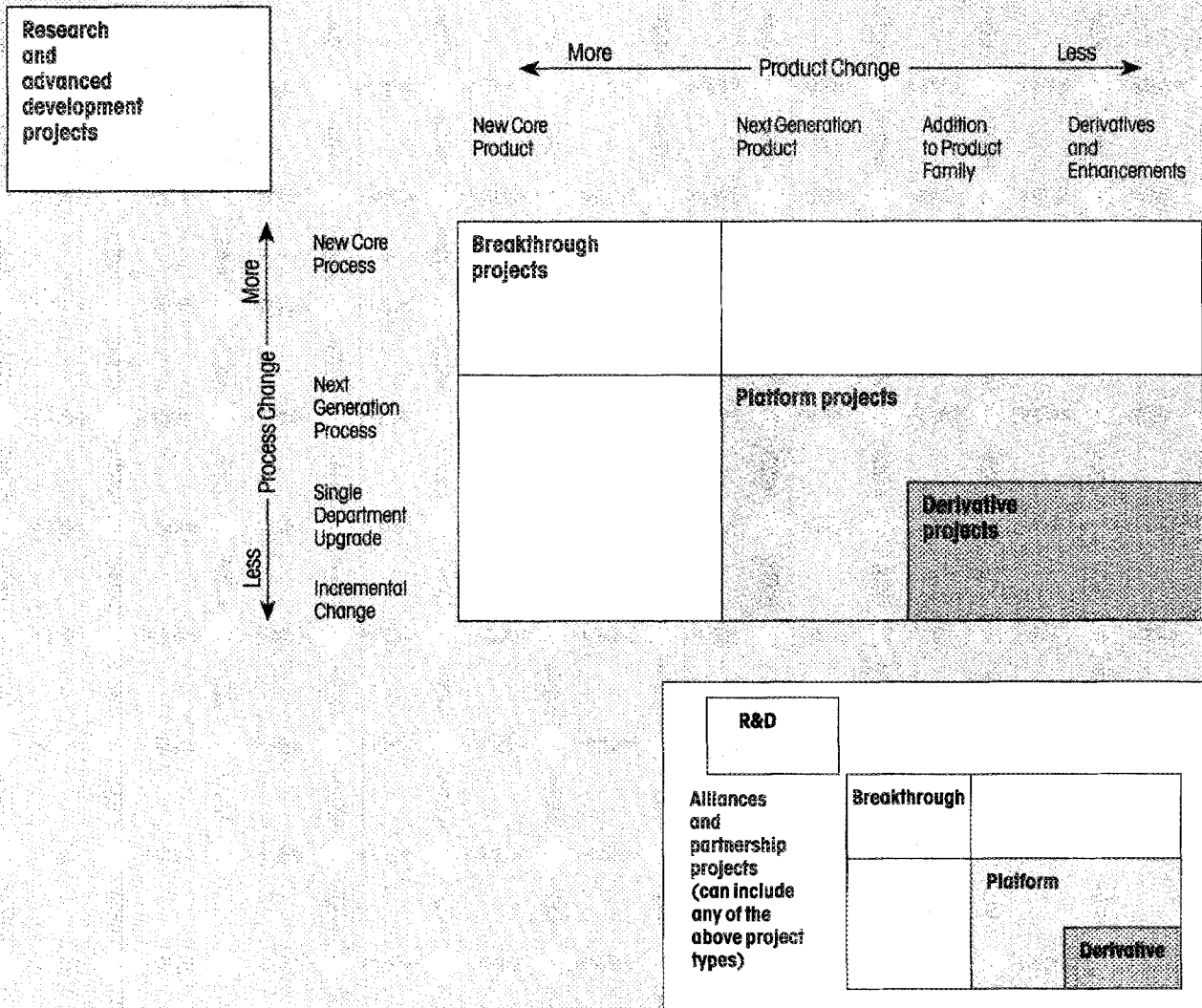
Well-planned and well-executed platform products typically offer fundamental improvements in cost, quality, and performance over preceding generations. They introduce improvements across a range of performance dimensions – speed, functionality, size, weight. (Derivatives, on the other hand, usually introduce changes along only one or two dimensions.) Platforms also represent a significantly better system solution for the customer. Because of the

> **Most companies should start reforming their development process by eliminating the lion's share of existing projects.**

extent of changes involved, successful platforms require considerable up-front planning and the involvement of not only engineering but also marketing, manufacturing, and senior management.

Companies target new platforms to meet the needs of a core group of customers but design them for easy modification into derivatives through the addition, substitution, or removal of features. Well-designed platforms also provide a smooth migration path between generations so neither the customer nor the distribution channel is disrupted.

Mapping the Five Types of Development Projects

Research
and
advanced
development
projects

More ◄——— Product Change ———► Less

New Core	Next Generation	Addition	Derivatives
Product	Product	to Product	and
		Family	Enhancements

More ↑ Process Change ↓ Less

New Core
Process

Breakthrough projects

Next
Generation
Process

Platform projects

Single
Department
Upgrade

Derivative projects

Incremental
Change

R&D

Alliances
and
partnership
projects
(can include
any of the
above project
types)

Breakthrough

Platform

Derivative

Consider Intel's 80486 microprocessor, the fourth in a series. The 486 introduced a number of performance improvements; it targeted a core customer group – the high-end PC/workstation user – but variations addressed the needs of other users; and with software compatibility between the 386 and the 486, the 486 provided an easy migration path for existing customers. Over the life of the 486 platform, Intel will introduce a host of derivative products, each offering some variation in speed, cost, and performance and each able to leverage the process and product innovations of the original platform.

Platforms offer considerable competitive leverage and the potential to increase market penetration, yet many companies systematically underinvest in them. The reasons vary, but the most common is that management lacks an awareness of the strategic value of platforms and fails to create well-thought-out platform projects. To address the problem, companies should recognize explicitly the need for platforms and develop guidelines for making them a central part of the aggregate project plan.

Research and development is the creation of the know-how and know-why of new materials and technologies that eventually translate into commercial development. Even though R&D lies outside the boundaries of commercial development, we include it here for two reasons: it is the precursor to product and process development; and, in terms of future resource allocation, employees move between basic research and commercial development. Thus R&D projects compete with commercial development proj-

ects for resources. Because R&D is a creative, high-risk process, companies have different expectations about results and different strategies for funding and managing it than they do for commercial development. These differences can indeed be great, but a close relationship between R&D and commercial development is essential to ensure an appropriate balance and a smooth conversion of ideas into products.

Alliances and partnerships, which also lie outside the boundaries of the development map, can be formed to pursue any type of project – R&D, breakthrough, platform, or derivative. As such, the amount and type of development resources and management attention needed for projects in this category can vary widely.

Even though partnerships are an integral part of the project development process, many companies fail to include them in their project planning. They often separate the management of partnerships from the rest of the development organization and fail to provide them with enough development resources. Even when the partner company takes full responsibility for a project, the acquiring company must devote in-house resources to monitor the project, capture the new knowledge being created, and prepare for the manufacturing and sales of the new product.

All five development categories are vital for creating a development organization that is responsive to the market. Each type of project plays a different role; each requires different levels and mixes of resources; and each generates very different results. Relying on only one or two categories for the bulk of the development work invariably leads to suboptimal use of resources, an unbalanced product offering, and eventually, a less than competitive market position.

PreQuip's Project Map

Using these five project types, PreQuip set about changing its project mix as the first step toward reforming the product development process. It started by matching its existing project list to the five categories. PreQuip's product line consisted of four kinds of analytic instruments – mass spectrometers, gas and liquid chromatographs, and data handling and processing equipment – that identified and isolated chemical compounds, gases, and liquids. Its customers included scientific laboratories, chemical companies, and oil refineries – users that needed to measure and test accurately the purity of raw materials, intermediate by-products, and finished products. PreQuip's management asked some very basic questions in its attempt to delineate the categories.

What exactly was a breakthrough product? Would a three-dimensional graphics display constitute a breakthrough? How was a platform defined? Was a full-featured mass spectrometer considered a platform? How about a derivative? Was a mass spectrometer with additional software a derivative?

None of these questions was easy to answer. But after much analysis and debate, the management

> ## When the dust had settled, PreQuip had reduced the number of development projects from 30 to 11.

team agreed on the major characteristics for each project type and assigned most of PreQuip's 30 projects to one of the five categories. The map revealed just how uneven the distribution of projects had become – for instance, less than 20% of the company's projects were classified as platforms. (See the chart "Before: PreQuip's Development Process Was Chaotic....")

Management then turned its attention to those development projects that did not fit into any category. Some projects required substantial resources but did not represent breakthroughs. Others were more complicated than derivative projects but did not fall into PreQuip's definition of platforms. While frustrating, these dilemmas opened managers' eyes to the fact that some projects made little strategic sense. Why spend huge amounts of money developing products that at best would produce only incremental sales? The realization triggered a reexamination of PreQuip's customer needs in *all* product categories.
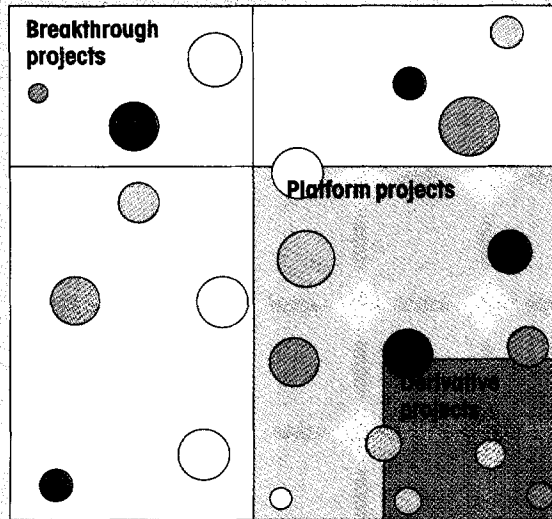
Consider mass spectrometers, instruments that identify the chemical composition of a compound. PreQuip was a top-of-the-line producer of mass spectrometers, offering a whole series of high-performance equipment with all the latest features but at a significant price premium. While this strategy had worked in the past, it no longer made sense in a maturing market; the evolution of mass spectrometer technology was predictable and well defined, and many competitors were able to offer the same capabilities, often at lower prices.

Increasingly, customers were putting greater emphasis on price in the purchasing decision. Some customers also wanted mass spectrometers that were easier to use and modular so they could be integrated into their own systems. Others demanded units with casings that could withstand harsh industrial environments. Still others required faster

Before: PreQuip's Development Process Was Chaotic...
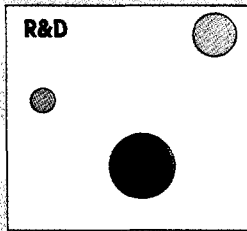
Each circle represents a PreQuip development project; the size correlates to the amount of development resources the project requires.

R&D

Breakthrough projects

Platform projects

Derivative projects

Alliances and Partnership Projects

R&D

Breakthrough

Platform

● Mass spectrometers
◐ Liquid chromatographs
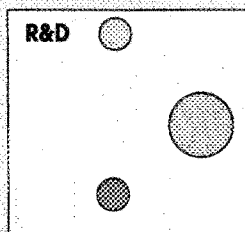○ Gas chromatographs
◓ Data processing and handling products
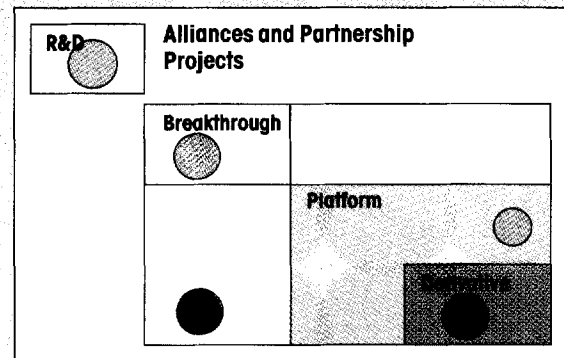
operating speeds, additional data storage, or self-diagnostic capabilities.

Taking all these customer requirements into account, PreQuip used the project map to rethink its mass spectrometer line. It envisaged a single platform complemented with a series of derivative products, each with a different set of options and each serving a different customer niche. By combining some new product design ideas – modularity and simplicity – with some features that were currently under development, PreQuip created the concept of the C-101 platform, a low-priced, general-purpose mass spectrometer. In part because of its modularity,

the product was designed to be simpler and cheaper to manufacture, which also helped to improve its overall quality and reliability. By adding software and a few new features, PreQuip could easily create derivatives, all of which could be assembled and tested on a single production line. In one case, a variant of the C-101 was planned for the high-end laboratory market. By strengthening the casing and eliminating some features, PreQuip also created a product for the industrial market.

Mapping out the new mass spectrometer line and the three other product lines was not painless. It took a number of months and involved a reconcep-

...After: PreQuip's Development Process Was Manageable

R&D

By mid-1990, PreQuip had reduced the number of development projects, including R&D, from 30 to 11, all well defined and strategically positioned within the 5 project types.
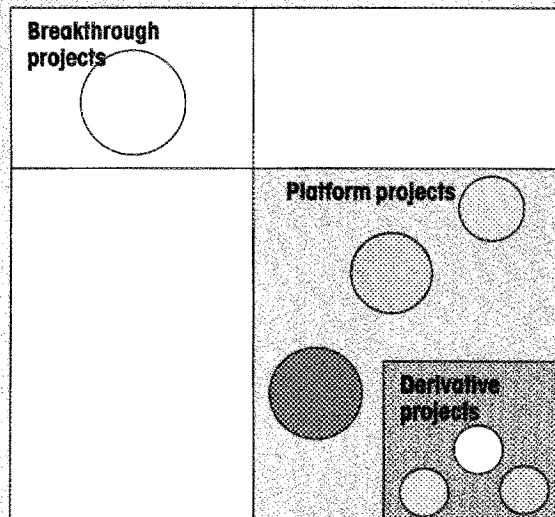
Breakthrough projects

Platform projects

Derivative projects

R&D

Alliances and Partnership Projects

Breakthrough

Platform

Derivative

○ Mass spectrometers
○ Liquid chromatographs
○ Gas chromatographs
○ Data processing and handling products
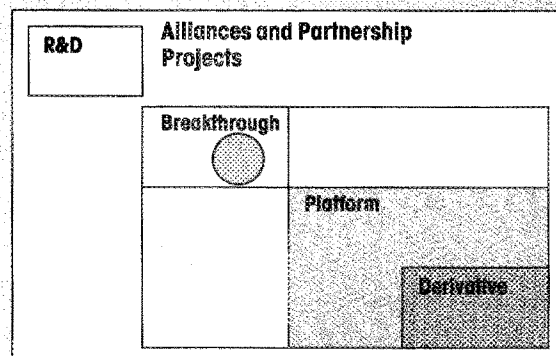
tualization of the product lines, close management, and considerable customer involvement. To provide additional focus, PreQuip separated the engineering resources into three categories: basic R&D projects; existing products and customers, now a part of the manufacturing organization; and commercial product development.

To determine the number of breakthrough, platform, derivative, and partnered projects that could be sustained at any time, the company first estimated the average number of engineering months for each type of project based on past experience. It then allocated available engineering resources ac-

cording to its desired mix of projects; about 50% to platform projects, 20% to derivative projects, and 10% each to breakthrough projects and partnerships. PreQuip then selected specific projects, confident that it would not overallocate its resources.

In the end, PreQuip canceled more than two-thirds of its development projects, including some high-profile pet projects of senior managers. When the dust had settled in mid-1990, PreQuip had just eleven projects: three platforms, one breakthrough, three derivatives, one partnership, and three projects in basic R&D. (See the chart "...After: PreQuip's Development Process Was Manageable.")

The changes led to some impressive gains: between 1989 and 1991, PreQuip's commercial development productivity improved by a factor of three. Fewer projects meant more actual work got done, and more work meant more products. To avoid overcommitting resources and to improve productivity further, the company built a "capacity cushion" into its plan. It assigned only 75 full-time-equivalent engineers out of a possible 80 to the 8 commercial development projects. By leaving a small percent of development capacity uncommitted, PreQuip was better prepared to take advantage of unexpected opportunities and to deal with crises when they arose.

Focus on the Platform

PreQuip's development map served as a basis for reallocating resources and for rethinking the mix of projects. Just as important, however, PreQuip no longer thought about projects in isolation; breakthrough projects shaped the new platforms, which defined the derivatives. In all four product lines, platforms played a particularly important role in the development strategy. This was not surprising considering the maturity of PreQuip's industry. For many companies, the more mature the industry, the more important it is to focus on platform projects.

Consider the typical industry life cycle. In the early stages of growth, innovative, dynamic companies gain market position with products that have dramatically superior performance along one or two dimensions. Whether they know it or not, these companies employ a breakthrough-platform strategy. But as the industry develops and the opportunity

> Sony pioneered the "hyper-variety" strategy – its 200 Walkman models are based on only three platforms.

for breakthrough products decreases – often because the technology is shared more broadly – competitors try to satisfy increasingly sophisticated customers by rapidly making incremental improvements to existing products. Consciously or not, they adopt a strategy based on derivative projects. As happened with PreQuip, this approach ultimately leads to a proliferation of product lines and overcommitment of development resources. The solution lies in developing a few well-designed platform products, on each of which a generation of products can be built.

In the hospital bed industry, for example, companies that design, manufacture, sell, and service electric beds have faced a mature market for years. They are constantly under pressure to help their customers constrain capital expenditures and operating costs. Technologies are stable and many design changes are minor. Each generation of product typically lasts 8 to 12 years, and companies spend most of their time and energy developing derivative products. As a result, companies find themselves with large and unwieldy product lines.

In the 1980s, Hill-Rom, a leading electric-bed manufacturer, sought a new product strategy to help contain costs and maintain market share. Like other bed makers, its product development process was reactive and mired in too many low-payoff derivative projects. The company would design whatever the customer – a single hospital or nursing home – wanted, even if it meant significant commitments of development resources.

The new strategy involved a dramatic shift toward leveraging development and manufacturing resources. Hill-Rom decided to focus on hospitals and largely withdraw from the nursing home segment, as well as limit the product line by developing two new platform products – the Centra and the Century. The Centra was a high-priced product with built-in electronic controls, including communications capabilities. The Century was a simpler, less complex design with fewer features. The products built off each platform shared common parts and manufacturing processes and provided the customer with a number of add-on options. By focusing development efforts on two platforms, Hill-Rom was able to introduce new technologies and new product features into the market faster and more systematically, directly affecting patient recovery and hospital staff productivity. This strategy led to a less chaotic development cycle as well as lower unit cost, higher product quality, and more satisfied customers.

For companies that must react to constant changes in fashion and consumer tastes, a different relationship between platform and derivative projects makes sense. For example, Sony has pioneered its "hyper-variety" strategy in developing the Walkman: it directs the bulk of its Walkman development efforts at creating derivatives, enhancements, hybrids, and line extensions that offer something tailored to every niche, distribution channel, and competitor's product. As a result, in 1990, Sony dominated the personal audio system market with over 200 models based on just three platforms.

Platforms are critical to any product development effort, but there is no one ideal mix of projects that fits all companies. Every company must pursue the

projects that match its opportunities, business strategy, and available resources. Of course, the mix evolves over time as projects move out of development into production, as business strategies change, as new markets emerge, and as resources are enhanced. Management needs to revisit the project mix on a regular basis – in some cases every six months, in others, every year or so.

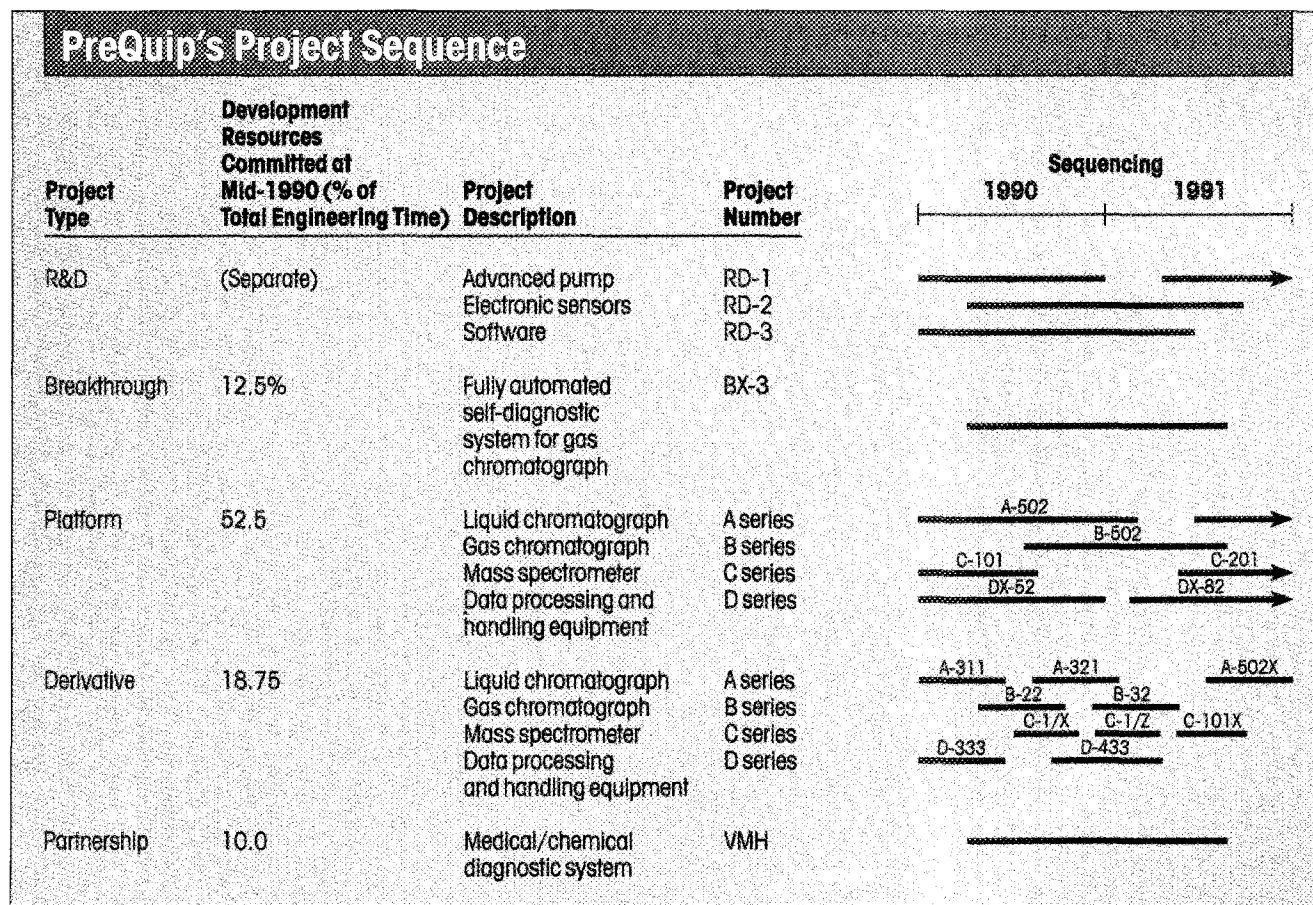## Steady Stream Sequencing: PreQuip Plans Future Development

Periodically evaluating the product mix keeps development activities on the right track. Companies must decide how to sequence projects over time, how the set of projects should evolve with the business strategy, and how to build development capabilities through such projects. The decisions about changing the mix are neither easy nor straightforward. Without an aggregate project plan, most companies cannot even begin to formulate a strategy for making those decisions.

PreQuip was no different. Before adopting an aggregate project plan, the company had no concept of project mix and no understanding of sequencing. Whenever someone with authority had an idea worth pursuing, the development department added the project to its active list. With the evolution of a project plan, PreQuip developed an initial mix and elevated the sequencing decision to a strategic responsibility of senior management. Management scheduled projects at evenly spaced intervals to ensure a "steady stream" of development projects. (See the chart "PreQuip's Project Sequence.")

A representative example of PreQuip's new strategy for sequencing projects is its new mass spectrometer, or C series. Introduced into the development cycle in late-1989, the C-101 was the first platform conceived as a system built around the new modular design. Aimed at the middle to upper end of the market, it was a versatile, modular unit for the laboratory that incorporated many of the existing electromechanical features into the new software. The C-101 was scheduled to enter manufacturing prototyping in the third quarter of 1990.

PreQuip positioned the C-1/X, the first derivative of the C-101, for the industrial market. It had a rugged casing designed for extreme environments and fewer software features than the C-101. It entered the development process about the time the

PreQuip's Project Sequence

Project Type	Development Resources Committed at Mid-1990 (% of Total Engineering Time)	Project Description	Project Number	Sequencing 1990 — 1991
R&D	(Separate)	Advanced pump	RD-1	—————— ⟶
		Electronic sensors	RD-2	————————
		Software	RD-3	———
Breakthrough	12.5%	Fully automated self-diagnostic system for gas chromatograph	BX-3	————
Platform	52.5	Liquid chromatograph	A series	A-502 ⟶
		Gas chromatograph	B series	B-502
		Mass spectrometer	C series	C-101 C-201 ⟶
		Data processing and handling equipment	D series	DX-52 DX-82 ⟶
Derivative	18.75	Liquid chromatograph	A series	A-311 A-321 A-502X
		Gas chromatograph	B series	B-22 B-32
		Mass spectrometer	C series	C-1/X C-1/Z C-101X
		Data processing and handling equipment	D series	D-333 D-433
Partnership	10.0	Medical/chemical diagnostic system	VMH	————————

C-101 moved into manufacturing prototyping and was staffed initially with two designers whose activities on the C-101 were drawing to a close.

Very similar to the C-1/X was the C-1/Z, a unit designed for the European market; the C-1/X team was expanded to work on both the C-1/X and the C-1/Z. The C-1/Z had some unique software and a different display and packaging but the same modular design. PreQuip's marketing department scheduled the C-101 to be introduced about 6 months before the C-1/X and the C-1/Z, thus permitting the company to reach a number of markets quickly with new products.

To leverage accumulated knowledge and experience, senior management assigned the team that worked on the C-1/X and the C-1/Z to the C-201 project, the next-generation spectrometer scheduled to replace the C-101. It too was of a modular design but with more computer power and greater software functionality. The C-201 also incorporated a number of manufacturing process improvements gleaned from manufacturing the C-101.

To provide a smooth market transition from the C-101 to the C-201, management assigned the remainder of the C-101 team to develop the C-101X, a follow-on derivative project. The C-101X was positioned as an improvement over the C-101 to attract customers who were in the market for a low-end mass spectrometer but were unwilling to settle for the aging technology of the C-101. Just as important, the project was an ideal way to gather market data that could be used to develop the C-201.

PreQuip applied this same strategy across the other three product categories. Every other year it planned a new platform, followed by two or three derivatives spaced at appropriate intervals. Typically, when a team finished work on a platform, management assigned part of the team to derivative projects and part to other projects. A year or so later, a new team would form to work on the next platform, with some members having worked on the preceding generation and others not. This steady stream sequencing strategy worked to improve the company's overall market position while encouraging knowledge transfer and more rapid, systematic resource development.

An Alternative: Secondary Wave Planning

While the steady stream approach served PreQuip well, companies in different industries might consider alternative strategies. For instance, a "secondary wave" strategy may be more appropriate for companies that, like Hill-Rom, have multiple product lines, each with their own base platforms but with more time between succeeding generations of a particular platform.

The strategy works like this. A development team begins work on a next-generation platform. Once the company completes that project, the key people from the team start work on another platform for a different product family. Management leaves the recently introduced platform on the market for a couple of years with few derivatives introduced. As that platform begins to age and competitors' newer platforms challenge it, the company refocuses development resources on a set of derivatives in order to strengthen and extend the viability of the product line's existing platform. The wave of derivative projects extends the platform life and upgrades product offerings, but it also provides experience and feedback to the people working on the product line and prepares them for the next-generation platform development. They receive feedback from the market on the previous platform, information on competitors' platform offerings, and information on emerging market needs. Key people then bring that information together to define the next platform and the cycle begins again, built around a team, many of whose members have just completed the wave of derivative products.

A variation on the secondary wave strategy, one used with considerable success by Kodak, involves compressing the time between market introduction of major platforms. Rather than going off to work on another product family's platform following one platform's introduction, the majority of the development team goes to work immediately on a set of derivative products. This requires a more compressed and careful assessment of the market's response to the just-introduced platform and much shorter feedback loops regarding competitors' products. If done right, however, companies can build momentum and capture significant incremental market share. Once the flurry of derivative products has passed, the team goes to work on the next-generation platform project for the same product family.

Before 1987, Kodak conducted a series of advanced development projects to explore alternative single-use 35mm cameras – a roll of film packaged in an inexpensive camera. Once used, the film is processed and the camera discarded or recycled. During 1987, a group of Kodak development engineers worked on the first platform project which resulted in the market introduction and volume production of the Fling 35mm camera in January 1988. (The product was later renamed the Fun Saver.) As the platform neared completion, management reassigned the front-end

Eight Steps of an Aggregate Project Plan

1. Define project types as either breakthrough, platform, derivative, R&D, or partnered projects.

2. Identify existing projects and classify by project type.

3. Estimate the average time and resources needed for each project type based on past experience.

4. Identify existing resource capacity.

5. Determine the desired mix of projects.

6. Estimate the number of projects that existing resources can support.

7. Decide which specific projects to pursue.

8. Work to improve development capabilities.

development staff to two derivative projects: the Stretch, a panoramic, double-wide image version of the Fling, and the Weekend, a waterproof version.

By the end of 1988, Kodak had introduced both derivative cameras and was shipping them in volume. True to the definition of a derivative, both the Stretch and the Weekend took far fewer development resources and far less time than the Fling. They also required less new tooling and process engineering since they leveraged the existing automation and manufacturing process. The development team then went to work on the next-generation platform product – a Fun Saver with a built-in flash.

No matter which strategy a company uses to plan its platform-derivative mix – steady stream or secondary wave – it must have well-defined platforms. The most advanced companies further improve their competitive position by speeding up the rate at which they introduce new platforms. Indeed, in a number of industries we've studied, the companies that introduced new platforms at the fastest rate were usually able to capture the greatest market share over time.

In the auto industry, for example, different companies follow quite different sequencing schedules, with markedly different results. According to data collected in the late 1980s, European car companies changed the platform for a given product, on average, every 12 years, U.S. companies every 8 years, and Japanese companies every 4 years. A number of factors explain the differences in platform development cycles – historical and cultural differences, longer development lead times, and differences in development productivity.[1]

In both Europe and the United States, the engineering hours and tooling costs of new products

1. Based on research by Kim B. Clark and Takahiro Fujimoto. See their article, "The Power of Product Integrity," HBR November-December 1990, p. 107.

were much higher than in Japan. This translated into lower development costs for Japanese car makers, which allowed faster payback and shorter economic lives for all models. As a consequence, the Japanese could profitably conduct more projects and make more frequent and more extensive changes than both their European and U.S. competitors and thus were better positioned to satisfy customers' needs and capture market share.

The Long-Term Goal: Building Critical Capabilities

Possibly the greatest value of an aggregate project plan over the long-term is its ability to shape and build development capabilities, both individual and organizational. It provides a vehicle for training development engineers, marketers, and manufacturing people in the different skill sets needed by the company. For instance, some less experienced engineers initially may be better suited to work on derivative projects, while others might have technical skills more suited for breakthrough projects. The aggregate project plan lets companies play to employees' strengths and broaden their careers and abilities over time.

Thinking about skill development in terms of the aggregate project plan is most important for developing competent team leaders. Take, for instance, an engineer with five years of experience moving to become a project leader. Management might assign her to lead a derivative project first. It is an ideal training ground because derivative projects are the best defined, the least complex, and usually the shortest in duration of all project types. After the project is completed successfully, she might get promoted to lead a larger derivative project and then a platform project. And if she distinguishes herself there and has the other required skills, she might be given the opportunity to work on a breakthrough project.

In addition to creating a formal career path within the sphere of development activities, companies should also focus on moving key engineers and other development participants between advanced research and commercial development. This is necessary to keep the transfer of technology fresh and creative and to reward engineers who keep their R&D efforts focused on commercial developments.

Honda is one company that delineates clearly between advanced research and product development – the two kinds of projects are managed and organized differently and are approached with very different expectations. Development engineers tend to have

broader skills, while researchers' are usually more specialized. However, Honda encourages its engineers to move from one type of project to another if they demonstrate an idea that management believes may result in a commercially viable innovation. For example, Honda's new lean-burning engine, introduced in the 1992 Civic, began as an advanced research project headed by Hideyo Miyano. As the project moved from research to commercial development, Miyano moved too, playing the role of project champion throughout the entire development process.

Besides improving people's skills, the aggregate project plan can be used to identify weaknesses in capabilities, improve development processes, and incorporate new tools and techniques into the development environment. The project plan helps identify where companies need to make changes and how those changes are connected to product and process development.

As PreQuip developed an aggregate project plan, for example, it identified a number of gaps in its capabilities. In the case of the mass spectrometer, the demand for more software functionality meant PreQuip had to develop an expertise in software development. And with an emphasis on cost, modularity, and reliability, PreQuip also had to focus on improving its industrial design skills.

As part of its strategy to improve design skills, the company introduced a new computer-aided design system into its engineering department, using the aggregate project plan as its guide. Management knew that one of the platform project teams was particularly adept with computer applications, so it chose that project as the pilot for the new CAD system. Over the life of the project, the team's proficiency with the new system grew. When the project ended, management dispersed team members to other projects so they could train other engineers in using the new CAD system.

As PreQuip discovered, developing an aggregate project plan involves a relatively simple and straightforward procedure. But carrying it out—moving from a poorly managed collection of ad hoc projects to a robust set that matches and reinforces the business strategy—requires hard choices and discipline.

At all the companies we have studied, the difficulty of those choices makes imperative strong leadership and early involvement from senior management. Without management's active participation and direction, organizations find it next to impossible to kill or postpone projects and to resist the short-term pressures that drive them to spend most of their time and resources fighting fires.

Getting to an aggregate project plan is not easy, but working through the process is a crucial part of creating a sustainable development strategy. Indeed, while the specific plan is extremely important, the planning process itself is even more so. The plan will change as events unfold and managers make adjustments. But choosing the mix, determining the number of projects the resources can support, defining the sequence, and picking the right projects raise crucial questions about how product and process development ought to be linked to the company's competitive opportunities. Creating an aggregate project plan gives direction and clarity to the overall development effort and helps lay the foundation for outstanding performance. ▽

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