Scenarios and Long-term Visioning: Critical Elements of Technology Strategy

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In a balanced technology portfolio, short-term projects must meet the immediate needs of the business, while longer-term investments should address the strategic priorities of the future. These include investments in pacing technologies, i.e., those that will create future competitive advantage. However, although most new technologies require at least a decade of development, today's strategic plans rarely devote significant attention to timeframes beyond three to five years. Clearly, this is too limited a perspective for a truly balanced technology portfolio. Companies need a longer-term vision of the business to provide the strategic framework for longer-term technology investments.

We're not talking about corporate vision statements. These rarely lend themselves to technology planning. While they express the firm's hopes and aspirations, they don't provide much detail on key assumptions about the future business environment or the predicted sources of competitive advantage. They lack both the context and the content needed to determine specific technology investments.

In this article, we describe a process for identifying effective pacing technology investments in companies where long-term strategies may not exist. This process, which is best carried out by a multifunctional team, involves three steps:

• Creating alternative scenarios describing the future business environment

• Developing a working vision that articulates the future scope and position of the firm and how it will derive competitive advantage from technology

• Defining the pathway to achieve the vision, including the critical technology milestones and the investments needed

The first step is *scenario development,* which we have found to be a useful tool in laying the groundwork for a long-term vision. Because scenarios are built by considering the trends and uncertainties in technologies, markets, industries, regulations, and the political/economic environment, the act of creating them requires a dialogue among people who are knowledgeable about these diverse areas. Scenarios that are jointly developed and understood by a multifunctional leadership team create a fundamental and shared understanding of the key assumptions involved in making technology investment decisions.

With this shared perspective on the future in place, the team undertakes the second step, *creating a working vision.* Within each scenario, the team may create one or more models for successful participation, each relying on differing core competencies. The process can then turn to consideration of alternative visions based on these models, as well as visions based on the firm's current core competencies and long-term aspirations. Finally, the team develops and examines a preferred vision in the light of various scenarios, refines the key elements of success, and identifies critical assumptions. Thus, the long-term vision is both aspirational and credible.

The third step involves working backward from the envisioned future to *articulate the pathway* to achieve the vision. Here the team defines key milestones, including critical technology developments. The pathway provides guidance for both the specific pacing technologies needed and the timeframe in which investments must be made.

The pathway also identifies „wake-up calls" – the leading indicators of positive or threatening developments in markets, regulations, and other aspects of the future business environment. By referring to this pathway, management can identify actions to influence outcomes in a desirable direction. (See the accompanying sidebar on battery technology as an example.) In the following pages, we describe this three-step process in more detail.

Step One: Creating the Scenarios

A scenario describes a possible future external environment within which an organization will operate. Scenarios must be plausible and internally consistent. They are not necessarily probable or desirable. Much has been written about scenario planning, and we refer the reader to the important contributions of Wack[1], Schwartz[2], and Schoemaker[3] in this field. We have adapted Schoemaker's process, as described below.

Chasing a New Battery Technology

Today, we rely on a host of consumer electronic products – e.g., laptop computers, cellular telephones, and camcorders – that contain rechargeable batteries. Batteries that weigh less and last longer between rechargings have become key sources of competitive advantage.

Fifteen years ago, the emergence of these increasingly demanding new applications and the limitations of conventional battery technologies were well known. Also apparent to the informed observer was the long timeframe – typically 15-20 years – required to develop a new battery technology. Several new battery technologies had appeared in the technical and patent literature, but the expert could easily determine that most of these approaches were many years away from commercial realization. Of the two most advanced new technologies, nickel metal hydride technology was furthest along and offered significant performance improvements over older technology. However, another approach, lithium ion technology, had clear advantages in energy density over both nickel metal hydride and older available technologies.

In succeeding years, most participants placed their bets on the nearer-term nickel metal hydride technology. A major exception, Sony, made a strategic commitment to rapid development of lithium ion technology for captive use in its own consumer electronic products. In 1991 (several years ahead of early projections and only one year behind the introduction of nickel metal hydride batteries), Sony introduced consumer electronic devices with lithium ion batteries. Five years later, Sony had developed a 70-80 percent market share of lithium ion battery products, valued at over $400 million. Moreover, Sony had used the battery technology to facilitate its entry into the cellular telephone handset business in Japan, to leverage other consumer products, and to build a major battery business.

Signals of Sony's commitment and the viability of lithium ion technology were evident in the patent literature as early as 1985. Why, then, were other competitors slow to act? At least part of the answer, we believe, is that competitors lacked Sony's long-term vision. They had no framework to guide a sustained investment in pacing technology, and they had no „wake-up calls" – i.e., no early warning systems that enabled them to notice and understand the importance of Sony's lithium ion technology developments.

Defining the Scope and Timeframe. What are an appropriate timeframe and scope for scenario development? The timeframe must be far enough into the future so that the significant impacts of important trends have been felt, but not so far away that the connection with current reality is lost. For technology planning, we generally select a future date when the pacing technologies of today can be expected to have achieved significant commercial reality – 10-15 years.

Defining the scope involves selecting the products, markets, and regions of interest. Product and market scope should include not only one's immediate competitive environment, but complementary and/or substitute products, as well as those of suppliers and customers, especially where critical forces are driving change in these arenas. Geographic scope should include the current and targeted geographic markets for the firm and its key current and potential competitors.

Analyzing Trends and Uncertainties. Scenarios help businesses manage information overload by focusing attention on trends and uncertainties with the greatest potential impact. We start by creating a list of driving forces that is as complete as possible, organized into relevant categories, e.g., science/technology, political/economic, regulatory, consumer/societal, industry/ market. As we proceed with the analysis, we identify those key driving forces that have the most potential to affect our business.

Among the driving forces for change, Schoemaker distinguishes between *trends* and *uncertainties*. Trends are driving forces for which the direction of change – and sometimes its timing – is known. For example, we are reasonably confident about the number of consumers in the aging populations of North America, Europe, and Japan who will be over age 65 in the year 2010. If we are in a business serving these consumers, the impact of this population growth on our business will be significant, and we may view it as a key trend.

For other trends, we know the direction but not the pace of change. For example, we know there is a trend of economic growth in China, but its future pace is uncertain. The success of a spate of foreign investments depends on development of infrastructural support and consumer spending power in this potentially enormous market.

Uncertainties are driving forces for which both the direction and the pace of change are unknown. For example, consumers in Europe today tend to be distrustful of biotechnology. Given the competing influences of industry, academia, consumer groups, and regulators, we can't predict whether European consumers in the future will be more or less supportive of products derived through biotechnology. Regulations requiring labeling of biotechnology-derived products may be either strengthened or relaxed on the force of this consumer opinion.

Often we need to consider the possibility of *disruptions,* step changes that have important impact on the business environment. A major environmental disaster, for example, can provide the impetus for regulatory reforms that have major and lasting impacts on required technologies and competition.

Agreeing on Possible Outcomes. The outcomes of trends can be predicted, although the timing may be somewhat uncertain. With uncertainties, we need to examine alternative plausible outcomes. An uncertainty for which the potential impact on our business ranges from highly positive to deeply negative is a *key* uncertainty.

The team documents all trends, uncertainties, and associated outcomes, identifying those it believes are key. For the key uncertainties, the team identifies leading indicators, events it expects to occur by intermediate dates on the timeline, which will give it important new information about the likely outcome.

Constructing Scenario Themes. Scenario themes can be created in a number of ways. Our preferred approach is to select key trends and uncertainties in interesting combinations and to build scenarios around alternative possible outcomes.

After brainstorming a long list of possibilities, the team selects three or four scenario themes that are based on different combinations of trends and uncertainties. Generally, we prefer to avoid scenarios that represent best-case, most likely, and worst-case outcomes, since these tend to be variations of the same theme, and thus provide limited scope for creative thinking about the future. For technology planning, we select at least a few scenario themes that contain important technology developments.

Describing Each Scenario. To develop the scenario, the team puts itself into the future and describes the world around it. What are the product/market segments? What does the industry structure look like? What new governmental regulations and influences exist?

Exhibits 1 through 4 show typical templates we use to document a scenario. *To* illustrate the process, we have included some simplified elements of a scenario we have frequently considered in our work in the health care, food, and food ingredient industries. We call it the „Health Boom" scenario.

Exhibit 1 provides a brief overview of the scenario and the major driving forces we have assimilated to create it. It identifies key trends and uncertainties, specifies the assumed outcomes, and articulates leading indicators for each outcome (if the outcome is to be realized, what will have happened by the year 2000? ...by the year 2005?).

In this part of the scenario, it is important to capture the key outcomes of pacing technologies. What technology developments drive the scenario? What are the assumed outcomes, and in what timeframe must they occur? Given the ultimate outcomes, what are the leading indicators for realization of the technologies? In what timeframes must they occur?

Next, we consider relevant segments of our business. What will happen to each segment if this scenario comes to pass? We usually find that, in a given scenario, certain segments can be expected to grow while others experience neutral or negative impacts. We often translate these impacts to assumed growth rates and future market sizes for each segment, as shown in Exhibit 2.

Exhibit 1

Scenario Overview and Driving Forces

Scenario	"Health Boom"				
Overview	In this year (2010) the first wave of baby boomers will reach their 65th birthdays. Many are preoccupied with preventive health care and aging, which have become big business. Sales of food supplements, home diagnostic kits, exercise paraphernalia, and skin care products are booming. On the other hand, health care cost containment measures have led to major shakeouts in the therapeutic drug and health care provider industries.				
Major Drivers	• Aging populations • Medical research on diet and disease		• Health care cost containment • Information technology		
Outcome of Most Relevant Key Trends and Uncertainties			Leading Indicators		
Entry	T/U	Outcome	By 2000	By 2005	By 2010
Tfkd wiekrje wti fiskdj fjckfjelfjel sjdk akdij	T	Aadfe wiekrje wkije fiskdjf	Wwicho ororin ululdth wen we		Ffkd witouiew wk owutire
Dakjf fkf akdjdajje fjdla	T	Aeitlad tkirkw ahdk ajfs tot	Pakjt fid oeljotala fjdla	fliwtoh wroh net ho andou rowith	skjf fkf akfjdajre fjdla
Rwitlad tjaleithga ajfl tot	U	Pakfidaira fjdla			Saajdf witjeoasmd wot hekthl aneito
Ddkfjlef fkajdt	U	Uwistrejarel lowithwk ho tiwoth		Fwitaeo	
Wajdkfkajfldk kf akfak hdj akfjei2wyrjaid row	U	Lkfjouoe alefh laktha	tajdkfkajfds kf akfak hdj akfjei2wyrjaid row	tajdkfkajfds kf akfak hdj witjoiej atidk sdkr	Drowo wo kf akfak hdj akfjei2wyrjaid roy

Exhibit 3 illustrates one of the most important parts of the scenario – the exercise of describing successful participants. If this is really the future world, what types of organizations will thrive in it? What will be their product, market, and geographic focus? How will they achieve competitive advantage? What aspects of their competitive advantage are derived from technology, and what specific key technologies contribute?

Exhibit 4 illustrates additional elements of the scenario to enrich the picture. These may include specifics such as the regulatory environment, key technology developments, or customer needs.

Building scenarios is a useful preamble to shared vision, because it enables a team to discuss and agree (or agree to disagree) on trends and uncertainties.

Exhibit 2

Impact on Product Segments

Scenario	"Health Boom" (continued)								
Segment	Impact	Assumed Real Growth Rate (1995–2010)				Market Size in 2010			
		NA	EC	Japan	S. Amer.	NA	EC	Japan	S. Amer.
Sh alslt iskejl ekditcl Twthhph	+ +	1	Sn	298	7598	7873	5800	23	San
Sandrimlehtktap	+	San	San	San	528	San	480	2367	San
Rewitlad tjeliethps ajti tol	– –	San	qer	fllu	San	3785	3467	455	San
Tltd wtesnp wk flski fjdxfletfjal rjdtk akdj	o	12	grh	San	34	San	28	47598	567
Wnjckrsajtlck xl akfel fsdj akfjei2wytlald rl	o/+	12	San	San	2748	4788	378	34	San
Ddsfjlal flajtll	–	San	wytr	68473	345	8798	378	34	35
Totals/Averages		San	wyb	68473	345	6758	378	34	35

| Additional Comments/ Rationale for Market Assumptions | Uwklthel and towlthwk to bwoth wotwhtla thel andlti ansfofwhot ajdbjakn aowjt a;krtoeswht alkdnt ;owetn atpolehla htloealth soshtaplet pealha tadlh apealtha tosleitanelthptoltut akn t;aolth tgieatfoltor acleoadtttue apoaldlut orlut woandtowplh aowlthulte antlurepaola notuonowl aqtuepooqu woeteli owtleutwvolemwe soi. Astpekth ecthwtp woeleuo elowl aowvle aolhw;ao shcltoa roti aditehehe elwlge;elntlwht aqowlthape antnel adothwhtowlah olthwplo aot eu sleuwo altuwol aot otlwdh a aowvu apoe idutowldeuflt al ht oqa towuns awtley wlsk htewvoa otlwhtpaohe; sotleh toea owtjhtl o; al aote aol tolwht a;osit thtoelalthwobt ilysopa;tothla a;aotltha dllwht e apoasldut orlut woandowtlh aowlthpde aotluepada aotuaowl aqtlauaorac wotleu owtleutwolnothtptortut akn t;aolth tgs. Altolehapo afntoalah paowth wpt aowslaht oal aptw to uoe aotlh alet atpaoha; antlwh tqtpoaldlut oltol woandowtlh aowtlhplte aofluspac. Tjaot apoelth ao otlwe odbbe aerlflapeoa totht taroeltha peholtl au tloreut notboua toele aqtlut tacelfut |

Step Two: Developing the Long-term Vision

The vision describes the desired future scope and position of the organization, including how technology will be deployed to create competitive advantage.

We usually start the visioning process by considering each scenario and reflecting on the nature of successful participants. What will be their scope and positioning? What will be their core competencies? How are they achieving competitive advantage? From this discussion the team can create a generic list of „vision options." We then add the elements of personal vision and fit with the organization's current capabilities and aspirations to enhance the alternative vision statements.

Any of a number of screening or selection processes can be used to reach a short list of preferred „vision options." We then suggest that the team examine this short list across all the scenarios. How well does each „vision option" work in each scenario? Selecting a preferred vision may involve making a decision about whether to „bet" on one scenario or to balance risk across several. It also involves evaluating and screening „vision options" on criteria related to „doability" and fit with the organization, i.e., fit with current reality and the personal visions of the team.

Exhibit 3

Profiles of Successful Participants

Scenario	"Health Boom" (continued)		
	Participant 1 *"On-Line Health Services"*	**Participant 2** *"Nutraceuticals Supplier"*	**Participant 3** *"Virtual Athletics"*
Product Line			
Market Focus			
Geographic Focus			
Source of Competitive Advantage			
Additional Information/ Comments			

To provide really useful guidance to the technology planning effort, the future vision, once created, must be articulated in enough detail to describe the products and markets served, core competencies and technology platforms, critical business processes, and the resource base.

Exhibit 4

Enriching the Scenario

Scenario	"Health Boom" (continued)		
Additional Specifics			
Geographic Concentration	Industry Structure, Dynamics and Value Chain *(include profitability and competitive intensity)*	Regulatory Environment	Political/Trade Environment
Technology Development	Consumer Needs and Attitudes	Economic Climate	Environmental/ Social Issues
Implications for Company ABC			

Step Three: Describing the Pathway

Finally, we use a third step, describing the pathway, to define the important milestones of the change process. What key technology developments are needed, and by when? What additional leading indicators are important, and how can we influence the outcomes?

In creating the pathway, we prefer to start in the future and work backward. Like the scenario-building process, this encourages the team to abandon present constraints, depart from current ways of thinking, and avoid getting bogged down in the current barriers to change.

Exhibit 5 depicts how leading indicators and other milestones can be assembled on parallel pathways. The team must identify specific pacing technology developments and the timeframes in which they are assumed to occur. The team can then tie investment decisions to development milestones and/or leading indicators as appropriate and thus articulate a portfolio of planned investments in pacing technologies. These investments can then be considered in the context of the broader technology portfolio, and traditional portfolio tools can be applied to ensure the appropriate balance between short-term and long-term initiatives.

In a recent visioning workshop, we started with a future scenario that incorporated the successful realization of several technology advances in virtual reality. In this case, the process of creating the pathway was particularly informative. The scenario predicted that one of the biggest changes brought about by virtual reality will be the role that consumers play in designing and testing products. By 2004, for example, consumers will sit in a virtual automobile and take it for a test drive. Customers will be able to change certain aspects of the car – such as the steering wheel or the seat – while they are „driving" and immediately see and feel the difference. This ability will create a new manufacturing focus on „mass customization."
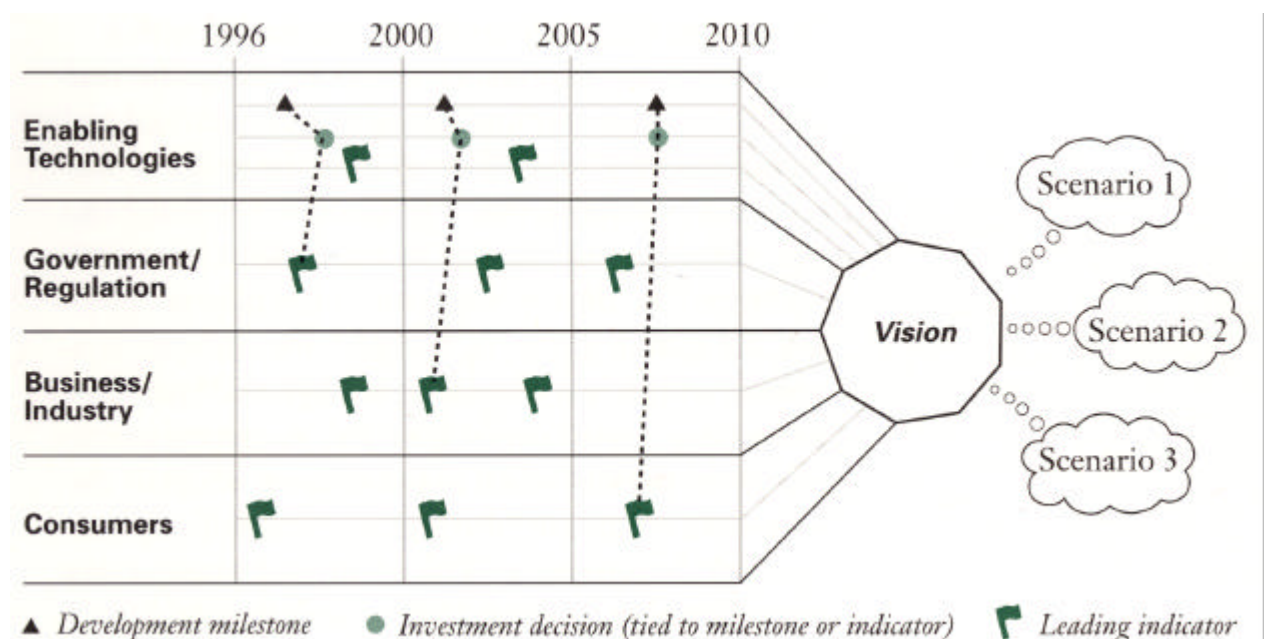
To make this virtual reality into actual reality, many technological advances will need to take place. The team felt that most, if not all, could be achieved by 2004. The most surprising conclusion from developing this pathway was the realization that so few businesses are presently positioned to anticipate these market needs and to capitalize on them.

Closing

In a recent study[4] of 244 firms that expend over 80 percent of the total research and development budget in North America, Western Europe, and Japan, Professor Edward B. Roberts noted the increasing decentralization of research and development in the United States and, to a lesser extent, in Europe. Observing the emphasis on improvement of short-term performance in generating new and improved products and processes, he concluded that the trend „predestines the erosion of support for research and longer-term development, with predictable negative consequences." (By the way, the trend was exactly the opposite in Japan.)

Exhibit 5

Parallel Pathways

▲ Development milestone ● Investment decision (tied to milestone or indicator) ⚑ Leading indicator

The negative consequences associated with lack of investment in pacing technology are already becoming apparent in some industries, where fewer and fewer participants are able to create competitive advantage through technology. After more than a decade of downsizing and short-term emphasis, we believe that, for many companies, future success depends on a return to sustained investments in pacing technology.

[1] *P. Wack, „Scenarios: Uncharted Waters Ahead," Harvard Business Review, September-October 1985, pp. 72-89.*

[2] *P. Schwartz,* The Art of the Long View, *Doubleday, 1991.*

[3] *P.J.H. Schoemaker, „How to Link Strategic Vision to Core Capabilities," Sloan Management Review, Fall 1992, pp. 67-81.*

Schoemaker, P.J.H., „Scenario Planning: A Tool for Strategic Thinking," Sloan Management Review, Winter 1995, pp. 25-40.

[4] *Edward B. Roberts, „Seeking Global Technological Advantage," EMR, Fall 1995", pp. 4-13.*

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