

# Emerging Technologies: A Novel Approach to Envisioning Their Development

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Just beyond the typical business time horizon are significant new technologies that will change our lives. These emerging technologies, not yet fully realized and still outside the arena of competition, will create enormous opportunities – and huge threats. Each of these technologies tends to be 10 to 15 years from full implementation and to involve multiple, sometimes competing, constituent technologies. Typically, some parts of the technology have been demonstrated, while others are still very much in the research stage. Current examples include virtual reality, micromachines, smart materials, moldless forming of parts, wireless power transmission, electric vehicles, and nutraceuticals.

A basic characteristic of emerging technologies is that they are not sufficiently developed to be amenable to conventional business analysis. In the absence of a good technique for really understanding the impact and possible strategic importance of technologies in this category, many businesses settle for „monitoring“ the evolution of related scientific and engineering disciplines. Unfortunately, this approach does not provide the kind of insight and vision needed to make informed business decisions about if, when, and how to get involved with emerging technologies that could have a very large impact on the business in the future.

In this article we describe a new process for evaluating an emerging technology that yields clear pictures of both its potential impact and the likely pathway to its implementation. This process, called „The Emerging Technologies Workshop,“ involves four key steps:

- Describing a desirable future involving the technology
- Writing the „history“ of that future
- Developing a time line of key milestones in the history
- Delineating near-term opportunities that may provide the incentives required to kindle the development process

Conducting the evaluation typically involves a group of 10 to 15 „stakeholders“ representing different technical and business disciplines. After substantial preparation by a core team, the evaluation process itself takes only two days. *Yet* it represents a uniquely focused and productive look at an emerging technology that is still years from commercial realization. Most importantly, it provides an informed basis for management decisions about that technology.

## Thinking About the Future

There are two very different ways to think about the future. The first and most common way is to extrapolate the present. For example, the usual entry points for examining a new technology are discussions of (a) whether or not the technology will ever succeed, and (b) which one of a number of proposed technical approaches will turn out to be successful.

For any technology of real commercial potential, lively discussions of these questions are common at technical conferences. Every conceivable answer is heatedly presented and supported with extensive data. While the views of the future that arise from these debates can be quite different, they all share the characteristic of having been developed by extrapolating the present. And they all depend in one way or another on the current technological state of the art, current market estimates, and current financial estimates. Therefore, they are all equally biased. Furthermore, they are all relatively unlikely, since the future almost never turns out to be a direct extrapolation of the present. Instead, unpredicted inventions and discoveries introduce discontinuous jumps in the gradual unfolding of present technology. Only by identifying and delineating these abrupt changes as far as possible can we arrive at a specific vision of the future. This identification and delineation is the key feature of our process.

In developing the Emerging Technologies Workshop, we recognized that extrapolating the present is fundamentally unproductive because it generates too many alternative futures and focuses attention on the wrong discussions. Instead, we chose to use the second major way to think about the future: by starting in the future and working back to the present. This approach more closely mimics – albeit in reverse – the creative forces that shape the successful development of the technology itself.

Basically, the driving force behind any successful new technology must include a vision of a future in which the technology has been successfully implemented and is filling an important need profitably. It could be argued that this factor has more to do with the success of the technology than anything else, i.e., the sharper the vision of the future, the more likely that the developers will be able to find a way to make it happen. As a familiar example, consider the vision of the late U.S. President John F. Kennedy in 1960, when he called for putting people on the moon within 10 years. Only with this vision firmly in mind was it possible to develop the many technologies

needed for this extraordinary scientific feat. Extrapolation of the capabilities available in 1960 would almost certainly not have led to the same outcome.

The starting point for a meaningful evaluation of an emerging technology, then, is the creation of a vision of a desirable future in which the technology is successfully achieving its full potential. In a sense, this is the only kind of a future that is worth evaluating, because this is the condition for which we must completely understand the opportunity or the threat. Thus, we are not asking whether or not the technology will win or which variation will win, but rather what the world will be like if it does win.

Our posing of this question should not be misconstrued as advocating the technology in question, nor does our workshop process result in a „self-fulfilling prophecy“ regarding the technology. As the workshop evaluation process unfolds, various aspects of the initially proposed future are found to be more or less credible, and on this basis we craft a more robust vision of the future. This process is outlined below.

### **Describing a Desirable Future**

The key to the success of the workshop process is to start the discussion in the future and keep it in the future long enough for the participants to shed the constraints dictated by the present status of the technology. The objective is to create a new reference point that illustrates the status of the technology at some future time when it has been successfully implemented. The most powerful way we have found to do this is through the use of video technology. For example, to begin a recent workshop on virtual reality (VR) as a tool in new product development, we created a 12-minute videotape of a newscast in the year 2004, reporting on the rapid adoption of VR as a business tool. The newscast highlighted a medical products company using VR to custom-design surgical instruments, a consumer products company using VR to design and consumer-test a new package design, a clothing store using a „virtual mirror“ to allow customers to select and size suit fabrics and styles without actually trying on the suits, a toy store where children could design their own toys, and several related scenarios. By providing a high-impact vision of technology success, the video allows participants to suspend disbelief and enter the discussion on a common basis.

Following the video introduction, the workshop discussion focuses on creating a broader view of the future. Working in small groups, the participants are asked to stay in the future and „report on what they see,“ i.e., to identify the direct consequences of the technology’s successful implementation. Consequences could include new products, new companies, new regulations or laws, new ways of doing business, new political or social trends, new infrastructure, etc. At the same time, participants report on aspects of present-day reality that have been supplanted.

Keeping the discussion in the future helps the participants quickly create an enhanced vision of the technology’s impact on the world and a good understanding of its business implications. Obviously, the future thus described is neither unique nor inevitable. Nonetheless, it is both credible and surprisingly convincing, because it is built up from a broad set of interrelated outcomes. Interestingly, the process effectively neutralizes one of the major barriers to predicting the future of emerging technologies, namely, the myriad reasons why the technology can’t or won’t work. Because our approach recasts these barriers as former problems that have been solved along the way to the future, workshop participants tend to look at them as opportunities for creative solutions rather than insurmountable barriers.

### **Writing the History**

The next step in the process is to write the history of the future that we have envisioned. We take a milestone approach to this task, identifying the major events that must have taken place in order to reach our future. We look at a number of categories of events: technology developments, new products, new processes, government regulations, infrastructure, global changes, investment, education, and others. Many of the milestones turn out to be events that enable the further development of the technology in one way or another. Some, of course, represent the solving of key technical challenges. Others might relate to capital creation, infrastructure development, facilitating laws or policy, or the development of important business alliances.

The milestones identified in this step are each assigned an approximate date and then arrayed on a time line that illustrates the overall pathway to the implementation of the technology.

The timeline represents the participants’ best estimate of the way the new technology will evolve. Although the elapsed time may not be correct, and individual milestones may or may not occur as shown, we generally have a high degree of agreement that for the technology to be successful, the major milestones must be met in one way or another. This process is especially effective in identifying with sharp clarity the one or several absolutely critical issues that must be resolved for the technology to succeed. Often these are not technology issues. For example, in our Emerging Technologies Workshop on wireless power transmission, it became very clear that the success of the technology would rely on the outcomes of studies to determine the environmental consequences of exposure to microwaves.

## Near-Term Opportunities

With a credible time line and milestones in hand, the workshop focuses on the first three to five years of the evolution of the technology. The important issue here is to begin to understand any near-term opportunities. If the early milestones can generate successful products or services, then clearly these will enhance the incentives for ongoing development, reduce the amount of risk capital required, and increase the likelihood that the technology will realize its full potential.

In our experience, the discussion of near-term opportunities is highly productive. By effectively closing the loop back to the present, it allows the participants to create a link between the current business situation and the future situation they have envisioned. Once this link is created, the participants immediately begin to identify real, viable commercial opportunities associated with the first steps of the technology evolution. For example, in one workshop we examined near-term opportunities on the pathway to implementing mold-less forming technology. It became clear that early milestones associated with the modeling of materials properties could easily lead to software packages with considerable stand-alone value.

Each workshop concludes with a discussion of next steps and agreement on the format of a formal report documenting the proceedings. In several cases, the workshops have led to ongoing professional alliances among some of the companies, government agencies, and academic institutions participating. In every case, the group has expressed a desire to see the technology realize its potential and to have a role in „making it happen.“

## Benefits

Participants derive several major benefits from the workshop experience. Foremost among these is a wellcrafted understanding of the changes the technology will bring if it succeeds. This understanding allows each participant to assess the degree to which his or her business may be affected by the technology and therefore whether or not to get involved in its development.

The second major benefit is the insight provided by the time line. By providing „signposts“ for advantageous entry points, the time line helps participants determine when to get involved in the technology.

And third, the near-term milestones can alert participants to business opportunities that, unlike the long-term technology itself, are amenable to more traditional business analysis and can be acted on at once.

Finally, it's worth noting that although the process described in this article was developed for evaluating emerging technologies, it has clear application to more general business-planning exercises. For example, we recently used it in planning a technology-intensive new business activity and found it very helpful in clarifying key issues and identifying critical milestones. In both applications, the Emerging Technologies Workshop methodology allows planners to break out of the confines of a gradualist planning paradigm and consider longer-term scenarios involving radical change with the prudence normally associated with near-term analyses.

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