Executive Summary

As new technologies proliferate, CIOs increasingly face the challenge of selecting which to invest in and how to do so successfully. The full article focuses on how to make informed choices by separating signal from noise. Signal refers to indicators of an emerging technology's value to a firm's core business, and noise refers to factoids, assertions and beliefs that drown out the meaningful signal. A low signal-to-noise ratio means that information about an emerging technology is difficult to interpret, leads observers down multiple blind alleys and requires great cognitive effort and expense to discern meaningful insights.

We use three emerging technologies—additive manufacturing (also known as 3D printing), the internet-of-things and technology-based, biologically inspired organizations such as platform ecosystems—to illustrate the challenge of filtering out the noise (hype) during the early lifecycle of a technology.

Separating Signal from Noise

There are two sources of noise when evaluating an emerging technology—the evaluator's cognitive biases and the assumptions, and frameworks (or cognitive lenses) that CIOs are trained to use and that have historically served them well. The penalties of not separating signal from noise are intensified by two factors: “Red Queen” competition and envelopment.

Red Queen Effect. Named after the anecdote in Lewis Carroll’s Through the Looking Glass, the Red Queen effect describes the increased pressure to adapt faster just to survive in the face of the increasing pace of rival technology solutions. If the pace of adaptation of a competing solution increases, it puts much greater pressure on its rivals to increase their pace of adaption just to remain in the game.

Envelopment. Envelopment is where a business platform offers the functionality of another platform in an adjacent market in addition to its existing bundle of functionality. Adjacency can be in the product or service, location in the industry value chain or in customer bases. Examples include the iOS platform successfully adding gaming functionality, effectively swallowing the functionality of hand-held gaming platforms, and smartphones adding digital photography capabilities and thus enveloping the adjacent digital camera market.

Three Sources of Noise in Emerging Technology Evaluation

Illusion of Joint Probabilities. Partitioning innovation work across multiple firms decreases the likelihood of a successful outcome, even if the likelihood of each firm’s success in its role is greater than a single firm attempting the project. This occurs because the overall probability of success is the product of each partner’s likelihood of success. Thus if a firm has a 60% likelihood of success, outsourcing the work to three partners each with an 80% likelihood of success will result in an overall likelihood of success of 51%.

Confusing Different Types of Uncertainties. It is important to distinguish between technical (supply-side) uncertainty and market (demand-side) uncertainty. The former requires reversible experimentation and trial-and-error learning whereas the latter requires watching and waiting.

Timing Misjudgment. Errors of timing result from: attempting to introduce an emerging technology-based application before the arrival of complements (complementary products, services or technologies that are critical

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1 The full article is published in the March 2014 issue of MIS Quarterly Executive, available online at www.misqe.org.
to the successful business application of an emerging technology; introducing the application before the mainstream market is ready for it; or misjudging which incumbent solution it must outshine.

Three Frameworks for Amplifying Emerging Technology Signals

**Innovation Mode Framework.** A business process, product or service can be envisioned as a system of components that are assembled to produce the whole application. An emerging technology can impact the components themselves, the linkages among the components or both. Depending on the dimension that is altered, an innovation can be classified into one of four possible modes—Modular, Incremental, Architectural or Radical. (These modes are described in the full article.)

**Cube Shifting Framework.** Any product or service can be physical or digital along three dimensions: the product or service itself, how it is delivered to a consumer and how it is purchased. Disruptive emerging technologies have the potential to transform any one of these three dimensions from physical to digital, or from digital to physical. CIOs are familiar with physical-to-digital shifts but may overlook digital-to-physical shifts that are becoming increasingly feasible with the advent of additive manufacturing technologies. The cube defined by these three dimensions can be subdivided into eight cells. The current cell for a focal product, service or process must first be identified, together with the new cell to which an emerging technology can potentially shift the focal element. This shift can help identify how an emerging technology might alter the business model of a firm or its individual products or services.

**Emerging Technology Governance Framework.** Firms face a classic tradeoff between synergy and opportunity-spotting in deciding where to locate the activity of scanning emerging technologies and making subsequent investment decisions. Synergy requires centralization; opportunity-spotting is best decentralized. The solution is to partition emerging technology decisions into two distinct classes—those related to infrastructural emerging technologies and those related to emerging technology applications. These two types of decision can then respectively be independently centralized and decentralized.

In summary, the low signal-to-noise ratio in the early lifecycle of an emerging technology is a key challenge when trying to assess the potential of the technology. Confusing signal for noise results in a failure to make timely investments in emerging technologies that turn out to be disruptive in an industry, whereas confusing noise for signal can result in squandering resources on emerging technologies that were more hype than substance. Improving the signal-to-noise ratio requires filtering the noise and amplifying the signal to reliably recognize potentially disruptive emerging technologies.

By asking the following nine questions, CIOs can provide themselves with a starting point for probing the disruptive potential of an emerging technology in their industries.

1. Have you considered the risks of involving outside partners in developing a solution?
2. Are you clearly separating technology uncertainty from market uncertainty?
3. Are you realistically assessing uncertainties and your firm’s ability to cope with them?
4. Are you setting realistic investment hurdle rates to ensure you don’t underinvest in emerging technologies?
5. What upstream and downstream complements are critical in your firm’s value chain?
6. What is the incumbent solution that this application must meet or exceed?
7. Can the technology alter the components or their linkages in core business processes, products or services?
8. Can it transform a product service or business processes, how it is delivered or how it is purchased either from physical to digital or from digital to physical?
9. Is the governance of emerging technologies aligned to better spot opportunities to exploit them without sacrificing firm-wide synergies?