# The CTO and Innovation

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## Innovation

Deborah Wince-Smith, President of the U.S. Council on Competitiveness, has said that, "The only driver for productivity growth for the U.S. is our innovation capacity. We're not going to compete on standardized products and services." Though this is clearly true of industries in developed nations, it also applies directly to every company that is attempting to grow its business, to direct its own future. Those who do not innovate remain static and accept the position they are handed by the market – usually a position that other companies or countries do not want.

Webster's dictionary defines innovation very succinctly as, "a new idea, method, or device." Business innovators may enhance this definition to read, "a new idea, method, or device that meets the needs of a targeted customer-base and that is accessible to them." In business, it is important that innovations create something that has a financial value to the company. This may be in the form of a product or service that can be sold, an internal process that reduces costs, or anything that improves a company's competitive position. "Value" is the key attribute of business innovations.

Every company that enjoys a dominant position in their market space has achieved that position through at least one successful innovation. At one time, large players like IBM, Apple, Hewlett-Packard, and Compaq dominated the personal computer market. But, the innovation of selling PCs via mail order lifted tiny Dell Computer into the major leagues. Michael Dell continued to push his way to the top by pushing additional innovations like online sales, custom-made computers, an integrated supply line, service agreements with major customers, and low-cost peripherals.

Wal-Mart overtook industry leaders like Woolworth and K-mart through innovations like the "Buy America" campaign, tight relationships with suppliers, daily data delivery on store sales, and rapid inventory turn-over at lower profit margins.

General Electric is turning to innovation and invention to deliver revenue growth of $9 billion per year. Jeffery Immelt, GE CEO, sees new products in energy, medical equipment, aircraft engines, and security systems as the source of his company's future growth.

## Disruptive Innovation

Clayton Christensen has presented a distinct flavor of innovation that he calls "disruptive innovation". He explains the power of an innovation that attacks an industry where it is the least profitable. For example, a steel mill has a number of different product lines. Sheet steel and structural steel are some of its most profitable lines. But, an integrated

mill also produces rebar, angle iron, and various rods at much lower profit margins. A traditional steel producer will guard its market share in sheet steel very aggressively, but be less interested in competitors for rebar. This mindset creates an environment that is ripe for an innovator to enter the rebar market.

In the 1980's the steel industry had a new competitor, the mini-mill. The name mini-mill came from the fact that these facilities were much smaller than a traditional steel plant and were able to create a very limited number of products – perhaps just one. These mills also used electric power to drive their process and often limited themselves to recycling existing steel, rather than producing it from raw materials as the large mills had always done.

The limited capabilities of the mini-mills made them appear to be no threat to the major steel industry. Therefore, when mini-mills began turning recycled steel into rebar, the large integrated mills did not make any attempts to protect that market area. In fact, they viewed the new rebar makers as a blessing. Since, customers could get their rebar from the mini-mills, the integrated mills could cut back on rebar production and redirect those resources toward the more profitable sheet and structural steel.

However, the mini-mills were applying disruptive innovation to the steel industry. They established themselves as a reliable supplier of high-quality rebar and then began to look for ways to grow their business. They found that decades of steel production and usage had placed millions of tons of steel in society and much of that was working its way through the recycling chain. Therefore, there was an abundance of the materials necessary to produce new steel. The only thing missing was the technology to turn old steel into high quality, high profit products like sheet metal. Innovations in manufacturing techniques allowed these mini-mills to begin moving up-market and to capture additional product lines from the integrated steel mills. With their lower overhead, recycled metals, and smaller batch sizes, the mini-mills were able to compete for rods and angle iron - products that generated higher profit margins.

This disruption of the established market structure illustrates the power of innovation. Christensen's major point is that growth of technology or a shift in the market can create an environment that allows an upstart to enter an industry successfully. The world is changing continuously and established companies need keep up with that change or risk losing their position and perhaps their entire business.

**Ten Types of Innovation**

Because innovation is so powerful, it has become the topic of a huge amount of academic and industrial research and is the basis for a huge business publishing market. Today, innovation, along with leadership and ethics, is one of the leading topics of business books and seminars by business consultants.

Innovation is something that occurs across all business functions. Creating new products, improving existing products, reducing production costs, eliminating internal process

costs, improving employee morale, and eliminating unproductive resources – all of these have the power to move a company from a margin player to an industry leader. Dell, Wal-mart, Sony, Research in Motion, and dozens of others have ridden to the top of their industry through the successful implementation of innovative ideas.

To some degree all executive officers are innovation officers. The CTO is responsible to shareholders for the innovative use of technology. That technology may change the product or service, create an entirely new market for the company, significantly change the production process, change the method of delivery, or improve the way that a company operates internally.

In 1981, Jay Doblin, professor of design at the Illinois Institute of Technology, established Doblin Inc. The company "is an innovation strategy firm focused on inventing a comprehensive, reliable, and repeatable approach to innovation." This mission has led them to study the process of innovation and search for patterns that have emerged from hundreds of successes. Doblin has created and promotes its "10 Types of Innovation". These organize all innovation into ten types within four categories.

In this chapter we will use this structure to illustrate how and where a CTO may contribute to innovation within the company. As stated earlier, innovation is not limited to the CTO office, nor is it limited to the application of technology. Simple processes for disposing of production waste or rapidly meeting government regulations may involve no technology, but represent innovations that have a significant impact on company operations, profitability, and competitiveness.

Doblin organizes his ten types of innovation into four categories:

- Finance,
- Process,
- Offerings, and
- Delivery.

He is pointing out that there is opportunity for improvement and profitable change in the company's use of its *finances*, the *processes* that define its practice of doing business internally and with suppliers, the *offered* product or service itself, and the way it *delivers* those products to its customers. It is clear that these categories apply innovation across all functions of the company. The CTO is just one player in the larger game of improvement through innovation.

**The CTO's Contribution to Innovation**

We will explain each of Doblin's ten types of innovation in this section and then extend them to the contribution that a CTO can make in that category. We do not mean to imply that every CTO should be involved in all ten of these. Rather, we are illustrating that in every type of company there is a place for the CTO to innovate. Companies that create products will most likely expect the CTO to innovate in the "offerings" category, while a retailer may focus their CTO's attention in the "delivery" category.

*Finance*

In the finance category, there are two types of innovation in Doblin's model. The first is in the structure of the Business Model – the engine that makes money for the company. The second is in the Networks and Alliances that the company uses to work with other companies for the benefit of both.

**Business Model.** As mentioned above, Dell computer used innovation in a number of areas to become the leading provider of personal computers in the world. In particular, they created a unique financial business model in which the buyer pays for the computer before the product is even created. After the computer is paid for, Dell spends several days creating the product and then ships it. The result is that the company has the customer's money seven to eight days before the customer has the product.

This situation is similar to the business model of catalog companies and online retailers. Sears & Roebuck, the pioneer in catalog shopping, created this model in 1888 and has used it profitably for over 100 years. In that time, they and others have discovered the advantages of delaying their own purchases of products until customers order them. If possible, a company would prefer to maintain zero inventory and purchase from its suppliers only after a customer had purchased the item from the catalog or website. As a practical matter that is possible with some products, but not others. Dell applies this model to its computers and components, but with a twist - the finished computer does not exist until someone has purchased it. This means that there are no surplus machines with undesirable configurations to be written off or returned to a supplier. There are no leftover machines sitting around when Intel releases a new CPU or NVIDIA a new graphics card. But the competition at Best Buy, Circuit City, and other retailers find themselves in possession of "old technology" every time this occurs. They must incur the cost of returning the products to a supplier or discounting them for rapid sale.

In this type of innovation, the CTO can assist by finding or creating technology that can make it possible to achieve zero-inventory in support of real-time production as Dell has done. The relatively new book print-on-demand industry has created just such a model. Printing technology has made it possible to create a book only after someone has purchased it. The practice of printing tens of thousands of volumes based on an estimate of future sales can be replaced with real-time printing. For specialty books, this can significantly reduce their costs and improve their availability. In effect, all books are available at all times – and in paper form, not just as a digital Internet document. Textbooks that are used for college classes and ordered by an academic and professional audience can be completely produced in this manner. Very few sales of these books are made to people who are browsing the shelves of the local bookstore. Therefore, there is no need for the book to exist in a paper form to facilitate the sale.

The CTO that can enable this type of business can do for print-on-demand textbooks what Dell did for computer retailing, making the company a significant competitor in the high-profit-margin textbook industry.

**Networks and Alliances.** Information technologies make it much easier to create companies that just add value by bringing together other companies that do all of the production. These act like a sports agents that insure that the relationship between a team franchise and a player is profitable to both parties. The agent does not operate a football team or block an opposing player on the field. His value comes from his ability to bring a player together with a team in a profitable manner. The Sara Lee brand is well known among grocery shoppers for its pies and frozen dinners. However, the company no longer produces a single edible product in its own facilities. After creating a successful business in frozen foods, Sara Lee recognized that they were really outstanding at recognizing what consumers want, marketing to that desire, and creating a brand with meaning. A number of other companies could create equally delicious food. Therefore, the company redesigned itself to be a brand builder and marketer, and outsourced nearly all of its food production.

Sara Lee's Chief Information Officer (CIO) plays a big role in holding the network of suppliers, marketers, and product delivery together. IT systems make these relationships much more efficient and allow the company to remain in contact with near-real-time consumer preferences. What the CIO does for information systems across the alliances of companies, the CTO can do for manufacturing technology. The CTO will work with apple pie manufactures to enable them to create each pie more efficiently. This may mean improving machinery for mixing and baking the ingredients. It may mean changing the processes for the mixing and baking. The CTO may work with the container partner to customize a box that fits into the baking company's machinery.

In a company that relies on networks and alliances, the CTO of the brand company will work across many company boundaries. He or she will act as a multi-company resource to insure that the product found in a Sara Lee box is unique from the product found in a competitors box. This uniqueness may take the form of superior taste, texture, cost, shelf life, or a number of other desirable features. This cross company operation is the uniqueness of the CTO in this type of innovation.

### *Process*

Jay Doblin defines two kinds of processes within a company. The Core Processes are those involved directly in supplying a product or service. These include the methods used to load passengers on aircraft or the Subway sandwich assembly line. Enabling Processes are those that support, enhance, or hinder the people and systems behind the core products and services. The process for scheduling flight attendants to staff each airline flight is a good example, or the process for handling a complaint when a customer is unhappy with her sandwich is another.

**Enabling Process**. Information Technology has had a huge impact on the enabling processes of companies around the world. These systems have made it possible for a company to deliver better service and real-time information about that service to customers and to their own employees. Internally, employees know more about their

income, benefits, and status with the company than ever before. They can access their 401(K) plans via the Internet, enter their work time via the cash register, request a schedule change via web form, and a hundred other operations. These efficiencies reduce internal costs, improve employee morale, and empower managers. They have had a significant impact on company performance. These systems are also used by customers to track packages at Federal Express, shop for books at Amazon.com, and supply auto parts to General Motors.

However, the movement of this information is often just the tip of the iceberg. Other technologies in shipping, tracking, and forecasting have been improving right behind these to insure that the physical delivery of overnight packages, textbooks, and auto parts matches the delivery of the information about those products.

**Core Processes.** At every McDonalds there is a complex layout of equipment and processes designed to provide uniform hamburgers and fries to customers as fast as possible. The design of efficient processes is a research field known as "operations research". It was pioneered in World War II to improve Allied defenses against German submarine warfare. It is now used to improve processes for doing everything imaginable – bank operations, fast food delivery, military strategy, and political decision-making.

The CTO usually oversees research operations, including operations research. Decades of experience in this field have shown that OR can improve product delivery times by an order of magnitude. The application of OR to fast food restaurants is one reason that a customer can place an order at the drive-through speaker and have their food handed to them almost at the instant that they pull up to the service window. This speed and efficiency has a significant impact on the core business of the company. It creates a company that a customer can depend upon for outstanding service.

"Process" defines how something gets done. It is not specific to the product being created or the tools for creating that product. It is an intangible set of relationships between people, equipment, information, and customers. These relationships can become very complex and develop hidden bottlenecks that are extremely difficult to identify, but not so difficult to remedy. Scientist and mathematicians understand the tools required to identify and measure these relationships.

### *Offerings*

**Product Performance.** Innovation in product performance is targeted directly at the product that is used by the consumer. It is the search for opportunities to make the product better in ways that exceed the capabilities of your competitors and that meet the needs of your customer. R&D labs are usually targeted at this form of innovation. In the pharmaceuticals industry, hundreds of millions of dollars are invested in the search for new medicines or improvements to existing products. The CTO oversees R&D activities to insure that it is targeted at the primary mission of the company and does not become diffused as scientists uncover interesting opportunities to explore. At Blue Ridge Numerics, CTO Rita Schnipke describes her role as keeping the engineers and

programmers focused on the vision and mission that executives have set for their company and product. CFdesign is a computational fluid dynamics software package that it targeted at the designers of aircraft components, automobile engines, and NACSAR automobiles. The CFdesign product is meant to be simple enough to allow non-CFD experts to apply it to their problems. Like all creative people, Blue Ridge engineers and programmers have a tendency to recast the product to match their own notions of how it should work. The CTO keeps everyone focused on the same goal and the same standards for the product.

Remaining focused on the product design market has allowed Blue Ridge Numerics to capture a customer base that had been ignored by earlier CFD software companies. Blue Ridge built the software to operate on the Microsoft Windows platform, rather than the more traditional scientific workstations running Unix. This created a very unique position for them in the market. Dr. Schnipke works diligently to insure that their product remains ahead of the competitors in usability, accuracy, and flexibility. These features cannot be lost if they are going to remain an industry leader.

**Product System.** Pat Gelsinger, CTO of Intel Corporation, faces a different challenge. As head of R&D and future products for this huge company, he is not involved in the design of any single product. Rather he must direct the company's entire line toward their future goals for the company. That goal is to dominate devices that are bringing together computing and communications. Gelsinger must direct multiple research efforts and new product development toward this focused goal. He must convert the business concept into technical direction that can be applied to the company's chip, networking, and device businesses. Each of these previously independent domains must see themselves as a complementary part of a new future for the company. Gelsinger must repeatedly preach a future in which Intel stands for the merger of computing and communications, not just the CPU domain that it holds today.

Similarly, Scott Donnelly, the head of GE's global research and development efforts, must keep his eye on a number of different industries and products across GE. He must get the entire company to respond with technical innovation to the CEO's demands for an internal growth rate of 7% - much of that from new products currently in the research phase. Donnelly presses against very diverse business units and research labs to get them all aligned toward this goal. Though some labs may claim that they cannot make 7% revenue contributions by the CEO's deadlines, they must be reminded that the company is spending its R&D money on targets that have such potential. Funding and support can always be redirected if the labs cannot make significant contributions to GE's revenue goals. This perspective is very different from that of a research scientist. Such tracking by business goals does not come natural to them, which is what makes Donnelly's technology executive position so important.

**Service.** The world has been inundated with information technology and the services that these make possible. The CTO at any Web-based service company can vouch for the demands that the competition and the public are placing on their capabilities. At Monster.com they have continued to expand their service offerings to meet a much

broader set of customer needs than just matching potential employees and employers. Recognizing that both parties need assistance with locating the right person and making the right impression, Monster.com has added resume and cover letter writing services for different specialties. They have also added a business networking service that introduces people who hold similar responsibilities and positions around the country. People looking for jobs can leverage an online network to assist them in contacting the right person in potential companies. Neither of these services is absolutely essential to match candidates. But the richness and ease of use of these services ensure that recruiters and job hunters both prefer the Monster.com web site to many alternatives. Technology-driven services act like a magnet to attract customers on both sides of the employment process. Other online job services may match this capability, but that is not sufficient to overtake the industry leader. Copying the leader just makes them an also-ran in the industry. If they want to become the leader, they must provide a better service that is easier to use and then hold that position long enough for word to spread. This is how Google overtook Alta Vista and Yahoo. Unique technology is what makes Google better, not their logo, not their quirky name, and not their advertising.

*Delivery*

**Channel.** In most businesses the channel of delivery is not a domain for the CTO. But, in the software industry, the delivery channel can be a purely technical solution. One of the most widely used product channels in the world is the Microsoft Windows Update. This feature allows any desktop computer that is connected to the Internet to communicate with Microsoft servers to automatically determine whether new updates to the operating system are available. These updates include functional fixes to the operating system, Internet browser, multi-media player, and foreign language capabilities. This channel is a purely technical solution to the delivery and customer connection problem. It eliminates the need for the purchase and delivery of software updates on CD-ROM. It can also be deployed from within a client company to allow them to automatically update all of their computers and maintain a common baseline of software. Because these data communications are secure, there has been no issue of corruption or hacking of this capability. In fact, the automatic update is the method that Microsoft has chosen to deliver patches to security flaws in their operating system and applications.

Anti-virus software companies and computer game developers have used this same method of delivering product updates. Updated versions of these applications are delivered to the computer by allowing the software itself to communicate with corporate servers. It essentially opens up a direct channel from the product supplier to the customer. Some early adopters of this technology unwisely chose to use this opportunity to collect personal data on their customers without their permission. This led to such an outcry against the practice that they have retreated from the practice and now allow customers to voluntarily provide the information.

In a sense, the Internet and various private networks are technology-specific delivery channels. The New York Times Online and hundreds of other newspapers had to decide what business they were in and develop a strategy for providing their product via the

Internet or risk obsolescence. Physical product delivery involves some degree of technology, but never in such a pure form as is possible when the product is information. Newspapers, magazines, journal archives, weather forecasts, financial data, and lottery results are just a few of the products that have been completely changed by the introduction of technologies like the Internet. The CTO plays a core role in strategic decisions to participate in this revolution.

**Brand.** The product or company brand is its identity or flavor in the minds of customers. Tightly tied to advertising, public relations, and product design, it would appear that there is little place in this area for a CTO to innovate. However, some brands are founded on the expertise of their in-house technical wizards. Apple Computer built on the legend of founder Steve Wozniak, while Sun Microsystems set themselves apart from the competition by hiring Bill Joy, the primary creator of BSD UNIX at the University of California at Berkley. Sun repeated this tactic when they introduced the Java programming language and promoted its inventor, Jim Gosling, as a revolutionary in the computer language field. These company and product brands were founded on the personality, image, and genius of their senior technician. This person is sometimes the effective CTO of a young company, such as Steve Wozniak, or they may be part of a more elaborate branding plan led by senior executives. In the latter case, a CTO would play a major role in aligning business objectives with the brand development. If a company is going to build a brand around a personality, it carries very similar risks to a political campaign. The candidate must be unassailable in the areas that matter to the customer. It is important to use a person that can be counted on to remain with the company and reflect the attributes that they want to be associated with their brand. Internally this person should also be someone that other employees accept as "brand worthy". He or she must not be a marketing-created facade for the position. This would generate too much internal dissention and cynicism and damage the company internally.

Symantec built part of their brand as a leading anti-virus provider on their CTO, Ron Moritz. He was a co-founder of the company and was invested enough to be expected to stay with the company. Moritz was a wizard at communications security, but had always played the part of a student to leading university researchers in the field. The Symantec CEO saw this as an opportunity to create an industry expert out of his CTO and use the exposure with the trade press to overshadow competitors like Computer Associates, Norton, and MacAfee.

**Customer Experience.** Leading computer game developer, Valve Software, the creators of Half-Life, recognized that a customer's experience with their game did not begin when he or she got it home and installed it. Since bugs are repaired and modifications are made to the game after it is mass-produced and shipped to stores, when a customer installs the game on their home computer, they must first download all bug fixes and upgrades before they are ready to play. Through a modem connection, this process often required an additional four to six hours to download, install, and restart. Valve recognized that this was a very alienating relationship with a customer and they searched for ways to change that customer experience. Their solution came in a unique variation of the Microsoft Windows Update product.

In an attempt to build a much tighter relationship with customers, Valve designed an online game service engine that could deliver game updates and even entire game content via a broadband connection. This meant that the customer always received the most current version of the game when they were ready to play it. The concept and the change in business strategy required significant technology investment. Their Steam Engine product created an entirely new relationship between a game developer and the game player. For one, it cut out several middlemen – specifically the game publisher and distributor. This removed significant product costs and allowed Valve to sell games at lower prices directly to customers. It also opened a market for mini-games that could be sold for five to ten dollars and distributed without printing, and distribution costs.

CTOs are also wrestling with new forms of online expression – such as Blogging. This Internet application emerged as a tool to allow anyone to become a digital journalist. Tens of thousands of people adopted the tools to create online journals and diaries to express their thoughts and experiences daily. The software creates a web site that can change minute-by-minute, motivating people to return to the site every day to peer into the life of the journalist. This returning traffic is a customer relationship gold mine that has been eagerly sought since the commercialization of the Internet. Online magazines and television-related web sites want their readers to return as often as possible and Blogging provides a reason for customers to return, but eliminates some of the formalism that slows communication with the public.

Teams of CTOs, CIOs, and Marketing directors are now looking for ways to create the right online experience to draw customers to web sites for all sorts of products. Companies from manufacturing, services, media, and professional societies are all seeking the right recipe for attracting repeat visitors to their site – and more importantly, to the advertisements and product education on their web sites. Software researchers are working on browser-based tools for interaction, combining the traditional web page with some of the features of instant messaging. The goal is to build a customer experience with the company that is unique and reinforcing, and to do so at a price that is orders-of-magnitude lower than that achieved with television and print advertising.

**Table 1. CTO Contributions in Doblin's 10 Types of Innovation**

| Innovation Category | Innovation Type | Description of Type | CTO Contribution |
|---|---|---|---|
| **Finance** | **1. Business Model** | How you make money. | Apply or create the technology necessary to enable a new form of business. Eliminating inventory at Dell Computer or in the print-on-demand textbook industry provides a significant business advantage. |
| | **2. Networks and Alliances** | How you join forces with other companies for mutual benefit. | Improve production or service delivery across a network of companies without being limited to a single corporate entity. |
| **Process** | **3. Enabling Process** | How you support the company's core processes and workers. | Enable technology-pull by including suppliers, production, and sales personnel in the R&D process. Employ these people and their unique perspectives in creating a new product. |
| | **4. Core Processes** | How you create and add value to your offerings. | Apply operations research techniques to improve internal process performance by an order of magnitude. |
| **Offerings** | **5. Product Performance** | How you design your core offerings. | Move products into new customer spaces and future business environments. Bet the company on where the market will be in the future. |
| | **6. Product System** | How you link and/or provide a platform for multiple products. | Build the necessary technical capabilities to support the entire future strategy of multiple lines of business. |
| | **7. Service** | How you provide value to customers and consumers beyond and around your products. | Provide customers with technology-based services that are new, unique, and powerful. Empower customers beyond the imaginations of competitors. |
| **Delivery** | **8. Channel** | How you get your offerings to market. | Deliver information-based products through technology-driven channels. Do not sell computer software in the same way that you sell shampoo. |
| | **9. Brand** | How you communicate your offerings. | Build a brand around the technical wizardry and image of a CTO, Chief Scientist, or other industry leader. Make your own Wozniak, Joy, and Gosling products. |
| | **10. Customer Experience** | How your customers feel when they interact with your company and its offerings. | Create tools to build repetitive relationships with your customers. Give them a reason to think about your product every day. |

**Source:** Doblin.com Web Site. Copyright 2002, Doblin Inc.

## Conclusion

The responsibility for innovation does not rest solely with the CTO. Innovation is the search for unique products, services, features, and processes that will propel the company into a leadership position in its industry. This responsibility is a core part of all executive positions and extends into production, research, personnel, and administrative functions. In one sense, innovation is the job of everyone that is striving to become the best in their field and to meet the future needs of their customers.

As the leader of technology issues, the CTO carries the weight of internal and external technology improvements. If a CTO cannot accomplish this, then he or she is not contributing enough. In this chapter we have demonstrated that the CTO can potentially contribute to all of Doblin's ten types of innovation, depending upon the structure of the company. The CTOs organization must be a major driver in innovation if the rest of the company is to take the call to innovation seriously.

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