

5 PATTERNS OF THE CHIEF TECHNOLOGY OFFICER

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Abstract: The Chief Technology Officer position has been adopted by a wide variety of industries that are seeking to leverage technology within products and services. The position calls for an operational executive who can make important strategic decisions that impact the competitive position of the company. However, very little research has been done to define the CTO's responsibilities, methods of evaluating the person's performance, and the skills that the person should bring to the office.

In this paper we identify five dominant patterns of the CTO position. These are labeled the Genius, Administrator, Director, Executive, and Advocate. These patterns are useful in understanding the diversity within the position and in matching a CTO from a specific pattern to a business with unique issues to be addressed.

Keywords: chief technology officer, CTO, innovation, career management, technology executive

Introduction

The position of Chief Technology Officer is relatively new, emerging from the position of R&D laboratory director in the 1980's (Parker 2002). Therefore, the definition of what a CTO is and how this person should contribute to an organization varies widely. In some cases, this variation is driven by unique business needs or by the evolutionary path that created the position within a specific company. In other cases, the variation is a result of a misunderstanding of the role of the CTO or of simply mimicking the role used in other companies.

When asked what a CTO is, Nathan Myhrvold, the former CTO of Microsoft and head of its massive research organization, replied, "Hell if I know. You know, when Bill [Gates] and I were discussing my taking this job, at one point he said, Okay, what are the great examples of successful CTO's. After about five minutes we decided that, well, there must be some, but we didn't have on the tip of our tongues exactly who was a great CTO, because many of the people who actually were great CTO's didn't have that title, and at least some of the people who have that title arguably aren't great at it. My job at Microsoft is to worry about technology in the future. If you want to have a great future you have to start thinking about it in the present, because when the future's here you won't have the time." (Brockman 2003)

Though the position is new, it is being widely used in many different industries. A Google search on the term “Chief Technology Officer” returns 392,000 hits, most of which are corporate announcements of the appointment of a new CTO. These announcements span the breadth of industries, including

- IT, computer, and research organizations like SAS, Intel, and the Fraunhofer Institute;
- Heavy production companies like Siemens, ALCOA, and ChevronTexaco;
- Service providers like Federal Express, National Association of Convenience Stores, and Hewitt Associates;
- Government agencies like the CIA, Air Force Research Laboratory, and the City of Washington D.C.

Clearly each of these industries has a very different business model, customer base, internal structure, and culture. It is unlikely, if not impossible, for one definition to meet the needs of all of these organizations.

Given such a large number of CTOs in service, we would expect a solid foundation of journal, magazine, and trade book publications on the subject. Surprisingly, what we actually found from an archival database search on the term and its three-letter abbreviation were fewer than 20 published journal articles in the last 10 years (Smith 2003). It is no wonder that the position is poorly understood and unevenly applied. CTOs are not publishing their activities and academics are not researching the position.

With such a vague idea of what a CTO should do, one would expect many people in the position to be “winging it” and their superiors to be evaluating them based on trial-and-error. CTOs must define for themselves what they should do, and their bosses must largely accept that definition without a basis for comparison and evaluation. In this article we will examine some of the dominant patterns within the CTO position and the types of problems each is best suited to address.

Foundations for Filling the CTO Position

The CTO position is occupied by people with diverse backgrounds, as is common to other executive positions like the CEO, COO, and CIO. Since the CTO position is often confused or interchangeable with the CIO position, and since both are relatively new to the executive ranks, it should be no surprise that the skill and background of the CTO is at least as diverse as that found in the CIO position.

In studying the backgrounds, responsibilities, and missions of a number of CTOs we identified several distinct patterns of CTO (Figure 1). These patterns are driven by unique stages in business evolution and by the needs of specific industries. Clearly separating these categories and associating them with a business phase or industry sheds considerable light on references to the CTO in the trade press and corporate news releases.

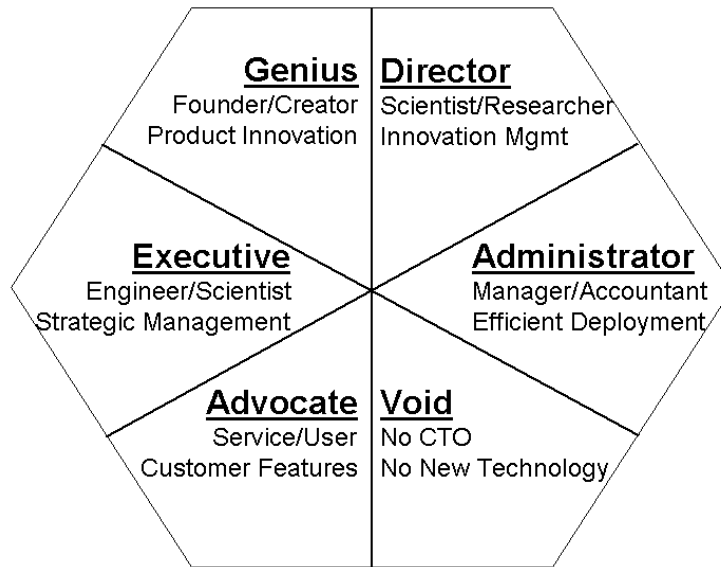


Figure 1. Dominant CTO Patterns

Genius

We are in the midst of technology revolutions in computers, information services, biotechnology, nanotechnology, medical products, and pharmaceuticals. The seeds of these industries are often traced back to a few innovators with the personal drive, talent, and opportunity to explore the unknown. People like Steve Wozniak of Apple Computer and Sergey Brin of Google have become the Thomas Edison's of this generation. They demonstrate the power of an idea championed and largely matured by single person. These are the archetypes of the Genius CTO pattern.

When a company, technology, or industry is in its formative stages, the CTO is often a technical genius about whom larger-than-life legends will be told by later generations. He or she (192 of the first 200 CTOs returned by a Google search are men) may be pulling together a number of available concepts and products in a new way, as Wozniak did with the first Apple computer. Or the CTO may be commercializing a new technology that has emerged from a university or commercial laboratory, as Sergey Brin did with the Google search engine (Boorstein and Watson 2003).

The Genius CTO is usually skilled at creating something new, possessing vision and confidence, and exploiting a unique opportunity. This ability or skill is essential to a company that is emerging from the garage or presenting its concepts before a panel of venture capitalists. Some technologies can be formed and matured largely through the efforts of a single exceptional person. When this is possible, the Genius CTO is the type of person that an emerging company needs.

However, the Genius CTO may have poor skills for managing teams of people, administering processes across an organization, or working with executives on a long-term strategy. Like Winston Churchill, their skills may be essential at a critical point in history, but they are not necessarily the best person to fill the position once the crisis is over and the company has moved on to larger problems, processes, and structures.

Administrator

In many cases, the CTO must defend the organization's budgets from overspending on technology products, services, and project labor. The CTO must be prepared to negotiate with outside vendors and service providers to insure that the company is receiving the resources it needs, but is not overpaying for these. Government offices that rely on technology-based products and services to create new products for civil, military, and intelligence applications fall into this category. Without such a person, the government buyers and users of technology are not in a position to effectively separate marketing claims for technical facts. The office then finds itself at the mercy of the vendor representatives and their claims for their products.

Jeffery Pound, the CTO of the Air Force Research Laboratory, is one example of the Administrator CTO. Pound has been involved in two major endeavors along these lines. The first was a deal in which he negotiated a favorable licensing agreement with Microsoft that saved AFRL \$9.6 million in fees. Equipped with an understanding of the laboratory's technical needs, Pound was able to identify the type and number of products that were essential and eliminate wasted licenses. He has also been working with vendors and developers to identify new ways to increase the security of the lab's networks without seriously impacting their performance (Jones 2000). These projects require an appreciation and understanding of both the technical aspects and the financial impacts of technical issues in the laboratory.

Director

As a company grows large enough to sustain and benefit from a research and development laboratory, future CTOs can emerge from that organization. He or she may be a leading scientist or researcher who has shown a talent for organization, handling exceptional people, and visioning the future. If such a person is willing to give up direct, hands-on research in order to create an environment in which others are enabled to do outstanding and valuable work, then they may become the Director of R&D and a future CTO. In some companies the title CTO is a direct substitute for Director of R&D. The organizational implications behind this are that the labs must make a direct contribution to the company's financial performance and competitive position. To encourage, enable, or enforce this, the Director is pulled into the executive ranks

and retitled the CTO. In other companies, the CTO is an additional position designed to bridge the gap between the company's strategies and its research activities.

Pat Gelsinger, the first CTO of Intel Corporation, is an excellent example of this category. Gelsinger lead Intel Labs, Intel Research, and the Intel Architecture Group. He is extremely well versed in the technical aspects of Intel's products. He is focused on the leveraging research and laboratory work into profitable products for the company. To quote from the Gelsinger's Intel bio, "As CTO, he coordinates Intel's longer-term research efforts and helps ensure consistency from Intel's emerging computing, networking and communications products and technologies." (Intel 2004)

Nathan Myhrvold also exhibited the Director CTO pattern when he created Microsoft Research. He recognized that the world's leading software developer needed to pioneer new technologies to be integrated into its world-dominating products. It needed collaborative relationships with academic researchers and a conduit for engaging those people on problems of interest to Microsoft. The result was a world-class organization that is now investigating speech and vision interfaces, machine translation, spam filtering, new Internet technologies, multimedia and dozens of other technologies that will become part of their future products.

In creating and managing such a research lab, the CTO must be able to separate ideas with great potential from those that are challenging and exciting, but lack the ability to become or contribute to great products. The actual Director of R&D will be more focused on sponsoring important research projects, while the CTO matches research ideas with the strategic plans of the company and its broader capabilities to move a new technology into the marketplace. He must consider whether great technology can be manufactured efficiently, priced competitively, delivered to the customer, and whether it will be a product that a customer will embrace.

Executive

Large corporations that use technology as a key component of their products or services have been the most aggressive at applying the CTO to their innovation process. Companies like GE Medical, ALCOA, Corning, ChevronTexaco, and IBM have all become known for their use of a CTO to assist in guiding strategic decisions and managing the innovation process. The Executive CTO is a businessperson who measures innovation, research, and experimentation by the contribution it makes the company's revenues and future competitive advantage.

This person's background may be just as scientific and research focused as the R&D Director described earlier, but their current focus and purpose are different.

They are an integrated part of the executive staff and are relied upon just as the CFO, COO, and CIO are to assist in directing and managing the business.

Dr. Malcolm O'Neill, CTO of Lockheed Martin, is an excellent example of the Executive CTO. He is responsible for the company's research projects, but is also directly tied to the company's engineering, program management, and mission execution (National Academies 2004). His role includes consideration of operations beyond the research labs. He must foster the exchange of ideas and technology between the research, manufacturing, service, and contracting operations of a 130,000 employee global company.

Advocate

Rob Carter, CTO of FedEx, has received numerous awards from the IT community for transforming the IT infrastructure of the world's leading overnight shipper. Carter and FedEx realized that over 70% of their customers used electronic transactions in shipping packages. They recognized that improving the IT experience for the customers could drastically improve the efficiency, profitability, and market share of the company. This implementation also made dramatic contributions to FedEx's expansion into international markets (Gotcher 2000).

Carter represents the Advocate CTO who is generally focused on the customer's experience of and interfaces with the company. This type of CTO is most often found in retail and service businesses, to include government organizations. These CTOs do not usually direct the creation of technology, but rather select and combine the best products for their specific business capabilities.

President Bush's plan to make all government services available electronically and to create an electronic conduit between every government office and their constituents, has challenged government CIOs and CTOs to build a modern, customer-centric computer infrastructure. Together, these two executives must identify, evaluate, deploy, and maintain IT systems that meet their customers' needs.

Organizations of this type may assign these responsibilities to the CIO since he or she has traditionally been the acquirer and integrator of IT technologies. This practice has contributed to the blurring of the responsibilities of the CIO and CTO. Most writers maintain that the CIO should be focused on the internal IT needs of the organization, while the CTO should be focused on technology as it applies to products, customers, revenues, and competitive positioning in the market (Spiers 2001). When the technology involved is strictly IT, it is feasible for this work to be combined with the CIO's traditional internal IT work. However, for companies when the technology is pharmacological research, new rocket fuels, and computer chip manufacturing, this combination would not even be considered.

Void

Finally, there are the companies that intentionally decide that they do not need a CTO. Many of these have stable sustaining businesses that incorporate very little new technology and do so only after the industry has already defined a stable solution. However, companies that are leading change in “non-technical” businesses are probably encountering issues for which a CTO would be very useful.

One could argue that a grocery chain does not need a CTO to improve sales of produce, meats, and canned goods. But, in-store computerization and automation argue otherwise. The Point of Sale (POS) terminals in most grocery stores are advanced computing systems. To the degree that they collect accurate data, manage inventory, and allow a store to predict future sales, these POS systems can be seen as part of the CIO's mission. But, when they are specifically designed to improve the speed at which customers are served or the systems are strategically located to provide information in the aisles, they are becoming an application of technology aimed at the customer. Recognizing that service lines form at the deli counter, Stop and Shop grocery has installed tablet PCs in the aisles to allow customers to place deli orders to be picked up later in their shopping trip. These types of systems are competitive tools just as fresh produce, baked goods, and meats are. They allow the store to differentiate itself from competitors, attracting additional revenue. Computerized control of lighting, refrigeration, in-store advertising, bakery and deli cooking systems, and a host of others are part of the store's competitive advantage (Patton 2002). These represent a domain of the business for which a CTO can be used to identify the best solutions and implement them in the most efficient manner. Some of these responsibilities can be handled by the CIO, as has been done in other industries. But that is a misfit of function and mission. Reaching in-store customers and convincing them that the store should be their shopping site of choice requires a different focus, mindset, and talent base from those traditionally found in the CIO's organization.

The CTO and associated staff are not necessary for every business. But they are probably not being used in many businesses that could benefit from their contributions. Just as modern corporations have developed the need for a CFO, and more recently a CIO, the continued evolution of business, technology, and society will broaden the industrial base for which a CTO is needed.

Conclusion

Twenty years is a very short period in which to evolve a new executive position. In this time we have seen the rapid emergence and adoption of both the CIO and CTO positions. The urgent need for information systems and common ways of applying them have driven the maturation process for the CIO much faster than

that of the CTO. Since the role of the CTO is much more dependent upon the type and phase of the business, it is difficult to set a common definition for the position. We have identified several common patterns of CTO as they are found in major industries and have discussed the most appropriate application of each of these patterns. These patterns are not exhaustive, but they are very useful in guiding new CTOs and assisting them in anticipating conflicts and changes that will arise in the position.

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