The Role of Technical Standards in Enabling the Future

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Abstract: The history of civilization from hunter-gatherer, agrarian, city states, manufacturing, information age, to the internet age may be identified by the successions of technical references/standards that are developed—symbols, measurements, designs, similarity, compatibility, and adaptability. Each new succession results in a paradigm change, enabling increased value creation: bartering, counting and measuring, building, manufacturing, networks, and openness. Standards successions offer an evolutionary technology model, showing why and how market control occurs and where new value is created. By extension this evolutionary model also suggests ideas for the future.

Predicting the future using technical standards seems counterintuitive, but examining their history indicates otherwise. Six successions of technical references/standards—symbols, measurements, designs, similarity, compatibility, and adaptability (Figure 1)—are based on general set theory (Krechmer 2005b). Each succession, a paradigm change, enables a period of increasing value creation: bartering, measuring, building, manufacturing, networks, and openness. The most widely used standards from one succession may continue during the following successions.

Standards successions offer an evolutionary technology model, showing why market control occurs and where new value is created.

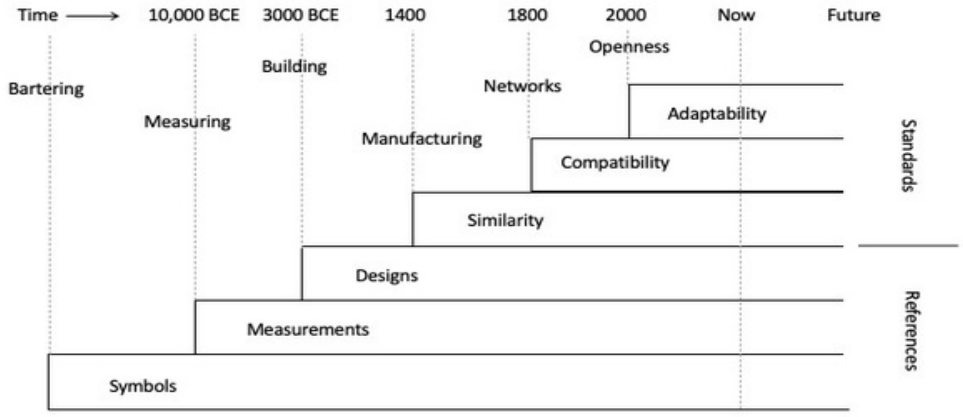

Fig. 1. Succession of references/standards codifies the history of technology.

Bartering

Human creations—such as the use of fire, tools, prepared plants, animal parts, structures—emerged before recorded history. As early humans found that they could benefit from each other's tools and resources, they learned to barter, a new value creation and one that required communication. Beginning well before 10,000 BCE, cave art includes a graphic protolanguage using symbols (Von Petzinger 2016). These symbols, the first succession, set the stage for increasing communications.

Measuring
Settled societies started about 10,000 BCE, and often developed unique products to trade (Bunch and Hellemans 1993).[1] As communities were established and expanded, counts and measures were necessary to grow enough food in an area or to barter resources with others. The Sumerians, for example, developed standard measures of weight, volume, and length. Measuring, the second succession, helped create more value.

Building
About 3000 BCE, the planning and building of larger structures, including wooden ships, began around the world. The seven wonders of the ancient world were human-built structures, and they required designs using symbols and measuring. These designs or sets of references, the third succession, predict the completed structure.

Manufacturing
The first assembly line, producing sea-going galleys, began in Venice about 1400. Repetitive assembly applies and creates similarity (David 1987), the fourth succession, and similar goods increase efficiency.

As an example, while the liter standard ensures the same measure of liquid in a barrel, a reference barrel design defines similar construction and shape among barrels. Making each barrel similar offers economic advantages to the barrel maker in manufacturing efficiencies, to the trucker in handling efficiencies, and to the bartender in use and maintenance (Krechmer 2005a). The desire for greater efficiency, a self-reinforcing effect (Arthur 1988), creates larger markets. As a market becomes larger, controlling it becomes more valuable:

- Patents and copyright—new value systems—allow market control.
- Cartels emerge, controlling industries and markets, requiring antitrust law.
- Controlling a useful standard (e.g., barrel size) is also a form of market control.

Networks
Networks began with railroads (~1800), then water and gas distribution companies, newspapers, electric power, and broadcast and communications, among others. The larger the network, the more desirable; the more desirable the network, the larger. This self-reinforcing effect often creates one dominate network.

When a network connection is complex and not standardized, only the network owner can provide a connection to it. This is another form of market control, so networks are often government regulated as a utility (new value system) to reduce different forms of market control. Additionally, when compatibility is recognized, a connection (physical) or interface (virtual) to a desired network may be standardized, reducing market control and increasing value.

Independent compatibility standards for electronic mail, the internet, the web, and wireless and cellular networks developed as these networks were created, speeding market growth. Without network compatibility standards, market control is greater and growth is often reduced. Network connections by railway gauge, pipe threads, electrical outlets, and telegraph and telephone wires were originally owner controlled, which slowed market growth and still makes multicountry travel more difficult.

The effect of later standardization on the US Public Telephone and Telegraph (US PT&T) network became clear when the Federal Communications Commission Part 68 regulations standardized compatibility (von Alven 1983), supporting divestiture of the US PT&T (reducing market control) in 1984. Over time, new companies innovated using the Part 68 compatibility standards and created large new markets for private telephone switches (PBXs), answering machines, data modems, and feature phones. Standardized compatibility, the fifth succession, makes such innovation possible.

[1] The further historic references in this essay are from this book.

Openness

The openness succession began when smartphones connected to networks in 2000. By 2020 web-based services (companies) supporting searches, mapping, electronic health records, ecommerce, social networks, and finance offered autonomous functions. The connection to these web services is via application programming interfaces (APIs).

Few web service companies are cartels, but all control their markets using APIs. The copyright control of APIs is under review by the US Supreme Court (2019). All APIs could, in theory (and should for health, safety, or antitrust law), allow competing networks to connect. The above history of networks indicates that when controlled APIs are standardized, greater value will be created and distributed.

Standardizing future compatibility may require an independently developed and maintained API and adaptability standard that defines a peer-to-peer meta-function that compares, negotiates, and selects from a menu of services from both sides of the API (Krechmer 2000) and separates API control from the network owner.

This meta-function also supports proprietary operation by transferring—in both directions—a trademarked character string (e.g., "Amazon") that identifies proprietary ownership. Trademark strings (a new value system) allow networks to control their innovations and still support standardized APIs. Similarly, specific national or regional requirements (e.g., the EU General Data Protection Regulation) could be identified.

Implementing adaptability, the sixth succession, will create new self-reinforcing effects: individual desire for specific compatibility, functionality, or security; network owner desire for proprietary value (sans monopoly); and nation-state desire for control of virtual borders. It will also significantly improve troubleshooting.

Predicting the Future

Each succession of technical references/standards—symbols, measurements, designs, similarity, compatibility, and adaptability—predicts and enables emerging future value. At this point web services companies should help develop and implement adaptability standards for APIs defined and maintained by independent standards development organizations.

Both adaptability (a new succession of standards) and openness (an emerging technology requirement) are quite likely to have significant influence on future technology development for hundreds of years. Even the impact of the 200+-year-old compatibility succession is still not understood (e.g., on patents; Krechmer 2005c) and likely to remain so for many more years. As adaptability increases, history and logic predict more innovation, expanded markets, and further openness.

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