Peter J. Denning and Robert Dunham

The Core of the Third-Wave Professional

The IT profession is the first profession in the third wave of civilization.

For some time, IT professionals have been grappling with four dilemmas. They are: skills, breadth versus depth, design, and licensing.

The IT skills dilemma. Employers say that IT graduates lack important skills needed in the workplace, notably knowledge of current IT and various "soft" skills, including presentation, customer relations, leadership, and team work. At the same time, employers tell university departments they value the general, principles-based education universities offer; and they snap up every graduate. Should we change the curriculum or not?

The breadth versus depth dilemma. The market seems to demand graduates with great depth in a technical specialty and at the same time a broad grasp of the IT field. Educators see no clear path to a response. There are so many specialties that any given academic department can cover only a few. There is already too much to cover in the 60 credit hours allocated for major courses within a BS degree. Moreover, depth and breadth appear to be individual choices—in what areas does a person seek depth? Across what spectrum does a person seek breadth?

The design dilemma. Our current software design processes consistently yield systems with a wide range of flaws, making them unreliable and difficult to use. Michael Dertouzos documents these flaws and argues that the complexities of IT cannot be successfully hidden from users without a fundamental change in the design process [3]. Dertouzos is the most recent of a long lineage who for over 20 years have exhorted us to move from technology-centered to human-centered design. Our inability to consistently develop software that meets specifications and satisfies customers has led not only to widespread dissatisfaction with commercial-off-the-shelf (COTS) software, but to the licensing dilemma discussed next. Makers of COTS software packages keep encountering users who find the systems hopelessly complex, overloaded with unneeded features, missing useful features, and backed with surly, thin technical support. These software makers deny any liability for malfunction and refuse to offer a warranty. No other industry takes so little responsibility for its products. Through the Uniform Computer Information Technology Acts (UCITA) movement, software makers entreated state legislatures to exempt them from liability. Why is it so difficult to move toward a new system of software development?

The licensing dilemma. Among software engineers there is contentious disagreement over the value of licensing software engineers who work on critical systems. Software engineers consulted by ACM are split nearly 50/50. Consensus is currently impossible, and no licensing system will work without a consensus. Those who favor licensing point to other fields where licensing has produced value

JASON SCHNEIDER

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by giving assurances that professions meet minimum standards of competence and understand their responsibilities. In those fields, most professionals themselves see the license as a mark of distinction conferring credibility. These software engineers believe licensing would strengthen the field, channel the most experienced talent to critical systems, improve the safety of systems, and demonstrate that software engineers take their responsibilities seriously. Those who oppose licensing believe the field is immature—no license would distinguish the competent software engineers from the others. Indeed, they believe a license would give false assurances that a software engineer is capable of producing safe systems. These software engineers also believe licensing would diminish diversity and stifle creativity of software developers; they do not see a license as a mark of distinction, and they view certification and licensing in other professions (such as medicine) with great suspicion and cynicism. Should we advocate for or against licensing?

IT IS SO OFTEN THE CASE THAT dilemmas are matters of perception rather than objective reality. When we broaden our perception, we can reinterpret the world in a way that resolves the dilemma. What is the larger phenomenon of which these four dilemmas are manifestations?

Our belief is this: We are in a transition from the second wave of civilization (the Industrial Age) to the third wave (the Network Age). The IT profession is the first profession of the Network Age. Our traditions for understanding professions are rooted in the Industrial Age and do not adequately inform us about coping with the new realities of the Network Age.

The Third Wave

In 1970 Alvin Toffler published an influential book, *Future Shock*, in which he interpreted the history of our civilization in three waves: the Agrarian Age, the Industrial Age, and the Information Age. He characterized the essence of the second wave as production through muscle power, and of the third wave production through brain power. In 1990 Toffler followed up with *The Third Wave*, a thorough investigation of the changes by then well under way.

Toffler's premise is that our emerging information society is not just digital and electronically networked. We are experiencing difficult cultural, social, institutional, and moral changes in society. The third wave is why we suffer simultaneous crises in so many institutions at once, including education, research, health, justice, family, and politics—institutions with traditions rooted in a mass-production industrial society. Because it makes communication fast, global, and cheap, IT has been facilitating changes in business, commerce, and education. Once people experience the benefits from the changes, they don't want to turn back. We are creating a new civilization that will coexist with agrarian and industrial components. Some agrarian societies, such as Western China, will enter the third wave directly without passing through an industrial age.

In the Information Age, distance becomes less important as the cost and speed of communication drops. A host of new, intangible digital products such as e-books, music, video, shrink-wrapped software, and other intellectual property are widely available for sale. Because making new copies costs almost nothing, most of the cost of these products is in their development. Time appears to compress as the Internet brings us requests and offers at an increasing rate; potential competitors, who may now number in the thousands, can appear quickly and unexpectedly. More people are falling prey to stress induced by information overload.

One of the deeper changes is the system of wealth creation. In the second wave, wealth was created through production; capital was based in tangible assets. In the third

wave, wealth is created through transactions that bring value to the customer, for which the customer is willing to pay the provider; capital is in the form of electronic marks on hard disks. Much wealth is created by transactions that do not involve intangible goods. Taiwan techno-entrepreneur Sayling Wen believes that wealth created through value-generating transactions is the essence of e-commerce, which is a new dimension of commerce that could not be realized in the Industrial Age [9]. He puts the start of the third wave in 2000, the year in which e-business reached a critical mass. He refers to the third wave as the Network Age.

The IT profession is forming along the wavefront; it is a new profession addressing the concern for the advancement and the health of the IT enabling the third-wave society. It is the first profession of the third wave.

The wave interpretation gets us to the same place as the chasm interpretation offered in [2]. To cross the chasm separating inventors and visionaries from the multitudes of pragmatists, IT professionals must connect with the pragmatic customers' concerns. To function effectively in the third wave, every professional, whether in IT or not, must deal with customers through value-generating relationships. *In the third wave, value-generating skills will distinguish professionals from technicians.*

Customer-Centric

The term *network* in "Network Age" is an apt play on words. It can refer to the technology that interconnects computers. It can also refer to the social webs of relationships among people. Relationships are at the center of the third wave's system of wealth creation. In the third wave, the customer, not the producer, becomes the driving force in business; and value, not the amount produced, becomes the measure of wealth. Value comes in a variety of forms depending on the interests of the customer—for example, sales of tangible and intangible products, services, cost savings, increased identity, personal convenience, reduction of complexity, and increased personal creativity. These new ways of creating value are stimulating innovations in e-commerce technologies.

Who is the customer of an IT professional? We say the customer is anyone to whom the professional makes a value-producing promise. This definition applies not only to the ordinary notion of someone purchasing a product or a service, but also to users of software systems, to clients of IT professionals, to students of IT teachers, and team members with each other and their team leaders.

Human-centered design, a two-decades-old concept now gaining in favor among software developers, is an excellent example of customer-centric practice. It refers to a new kind of relationship between the software developer and the customer (or user). Many models of software development are technology-centered. They emphasize a formal process beginning with a specification and ending with customer acceptance of a system meeting the specification. They usually iterate through several versions of the system, each reviewed by the customer. Despite years of experience with these models, many software projects are cancelled or late, many others leave their customers complaining "It does what I said but not what I want."And many systems have chronic flaws of the kind Dertouzos documents. The problem is that technology-centered models are not attuned to customer value and do not acknowledge that most developers work in teams. In a human-centric design process, the developer creates a succession of system versions (beginning with prototypes) and their specifications; but the developer's focus is on working as an effective team that understands how the evolving system shows up in the customers' world, what breakdowns it causes, and what value it brings. The developer listens skillfully and co-designs each improvement with the customer. This process ends with a system meeting the specifications *and* with a satisfied customer.

Value Skills

To create value for customers, the network-age professional needs two kinds of knowledge. One is deep *technical skills*, which is at the core of any promise to a customer. The other we call *value skills*, which enables the professional to connect with the customer and successfully

deliver the promise. Without both, the professional will be ineffective. With technical skills alone, a person will be seen as a "nerd," a low-value technician, not a professional. Value skills are part of the core skills of an IT professional.

In industrial-age thinking, knowledge is interpreted as an asset—structured information that can be managed in databases. In the Network Age, knowledge is interpreted as the capacity to perform effectively. Value skills connect a professional's technical performance with the customer. In other words, without value skills, customers will not assess you as knowledgeable.

In delivering their technical expertise to customers, IT professionals manage commitments; build trust; sell products and services; write and present proposals; organize, manage, and serve on project teams; manage commitments to multiple customers; stay current with the technology; and start and run businesses [4]. The critical skills involved in doing this are listed in six categories in the accompanying table.

Value skills

Value Skill Sets	Examples
Coordination	Request, offer, promise, negotiate counteroffer, defer, decline, insist
Customer Relations	Listen for customer concerns, articulate a value proposition, make declarations, co-design value propositions with customers
Commitment Management	Maintain commitment records, allocate time and resources to each commitment, adjust load to one's capacity, communicate with customers about progress, build trust through a history of kept commitments
Teams	Declare a mission, invite members, make commitments to the team leader, manage commitments together, measure progress, share assessments within the team, raise and resolve red flags
Lifelong Learning	Understand levels of professional competency, seek situations and mentors for advancement, obtain certifications of professional competence from recognized authorities
Business and Entrepreneurship	Listen for widely held concerns, follow and interpret trends the world, identify innovative practices that can solve central problems, build an offer, a business plan, and a team, practice within a code of ethics

Many engineers and developers use the term "soft skills" for the value skills. This terminology comes from industrial-age thinking, in which production-line workers did not interact with customers. The soft skills were of little value to production. This is not so in the Network Age, where every technical professional must be minimally competent in relationships with customers, internal and external.

Soft skills also suggests that technical skills are difficult to learn and value skills easy. In fact, the value skills are every bit as difficult to learn as the conceptual skills our IT curricula specialize in. One does not learn value skills by studying them in a book or a lecture hall; one learns them by practice, often under the watchful eye of a competent coach [5].

Value skills make good business. If every action within a business transaction brings value to the customer, there is no waste. With no waste, the customer gets results as quickly as possible and at the lowest cost.

Value skills are good for engineering as well. Each value skill set adds to the quality of the result by connecting the engineer's expertise to what is delivered to the customer.

The Dilemmas Answered

Let's see how customer-centric orientation and value skills address the four dilemmas.

The IT skills dilemma can be resolved by recognizing that the missing skills are embodied skills—those learned only by extensive practice and demonstrated only in performance. Embodied value skills enable the professional to make embodied technical knowledge available to customers. Technical skills can be embodied through hands-on projects in university courses or through intensive training courses from private vendors and corporate education departments. Value skills can be embodied through ongoing leadership and professional mastery workshops adjoined to regular curricula or corporate training programs, and through coaching on the job. The increasingly popular

senior capstone project courses in universities offer excellent settings for teaching value skills.

The breadth-depth dilemma can be resolved if every professional is deep in at least one technical specialty and is competent in the team skills. A team's composition can be adjusted to achieve the required breadth and technical depth as needed for its mission. In effect, designing the team offers a way to customize technical expertise to the satisfaction of the team's customer.

The design dilemma can be resolved by human-centered development processes. The developer learns the customer's environment as a framework for the customer's actions. The developer then evolves a system (and its specification) through a series of refinements of rapidly produced versions evaluated by the customer, all the while listening skillfully for what is of value and concern to the customer. This process continues after the system is delivered, helping the customer adapt changing markets and experience with the system. Extreme programming is an excellent example of a technology that supports and encourages adaptive software development of this kind [1].

The licensing dilemma is more difficult to resolve, given the strong feelings on all sides of the issue. Let us suggest some distinctions from the third-wave interpretation that may shed light on the sources of the dilemma. Many software engineers view established, customer-oriented professions such as medicine, law, and some branches of engineering—formed in the Industrial Age—as dinosaurs that are inappropriate models for software engineering in the Network Age.

Is this skepticism well-placed? In those professions, certification and licensing are accepted as two sides of the same issue—raising public confidence in the competence of professionals and giving assurances that professionals understand their responsibilities. Licensing is a state requirement; a professional cannot practice without it. Certification is a service offered by professional societies and is often used to satisfy components of state licensing requirements. Medical professionals developed their system of certification because of pressure from governments to minimize quackery; doctors have since found patients want them to be board-certified. Law and engineering are similar. No one believes doctors will cure every disease, that lawyers will win every case, or that engineers will build bridges that never collapse. Certification and licensing raise confidence but do not guarantee certainty of the outcome [7].

Many software engineers hold the view that the software development process is ultimately a formal derivation of a correct system from specifications. This view inclines its adherents to believe certification is a *promise* that any system produced by a certified software engineer must be safe and reliable. No design process, customer-centric or otherwise, can guarantee every system is 100% safe and reliable. A customer-centric design process can, however, reduce misunderstandings about the safety and reliability of a system.

Although it is characteristic of the third wave that technologies change rapidly, the rate of change is limited by human willingness to adopt and adapt [6]. Many professions are beset with rapid changes in technologies and knowledge, but they nonetheless keep their certifications up to date. We do not agree that rate of technological change make meaningful certification impossible.

These potential answers to vexatious dilemmas demonstrate power in the third-wave, customer-centric interpretation of the world. The third-wave perspective reveals the importance of value skills for successful professionals. C

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Peter Denning (pjd@cs.gmu.edu) is the past president of ACM and the chair of the ACM Education Board.

Robert Dunham (bdunham@enterprise-design.com) is the president of Enterprise Design.