

COMMENTARY

The Evolution of the Knowledge Professional

Robert K. Elliott and Peter D. Jacobson

Robert K. Elliott and Peter D. Jacobson are members of the Office of the Chairman of KPMG LLP in New York.

INTRODUCTION

Wealth creation depends on knowledge work as never before, a change full of implications for those who provide information services. We argue that a new economic model has created a need for a new type of information professional.

Types of information professionals wax and wane with the information needs of the prevailing economic paradigm. This is another way of saying that market demand influences the supply of information services. Moreover, it suggests that CPAs can learn about their present situation by considering it in light of prior relationships between economic paradigms and types of information professionals. We identify four economic paradigms of the past and present, the characteristic information professionals in each paradigm, and how the academic branch of the profession can help practitioners adapt to the current paradigm as it matures.

FOUR ECONOMIC PARADIGMS

Mankind's evolution is a tiny proportion of the earth's past, which is measured in the billions of years. Before humanity appeared, the earth's geology had a long history. Biological evolution began with geological evolution underway, and the process led to our forbears. They were both poorly and well equipped—poorly in muscle mass and defensive equipment, remarkably well in brain power. Over time brain power enabled our species to turn nature to its advantage.

That story is called cultural evolution. It starts in prehistoric times, and continues to today. Economic development is central to cultural evolution. Looking back at the ways in which wealth was created, we can identify four economic paradigms. Each is an overarching, pervasively influential economic form, within which there can be great variety. As we shall see, each economic paradigm had a characteristic information professional to meet its needs, and therein lies our argument.

Hunting and Gathering

The first economic paradigm was the hunting and gathering way of life. There was technical knowledge. Hunter-gatherers knew how to make tools (axes, spears, bows, fish-nets), which roots and berries to gather, how to hunt, and how to control fire. But their lives depended on the abundance of game and vegetable sustenance. When local supplies declined, they wandered in search of more bounteous landscapes. The hunter-gatherers lived at survival levels, much at the mercy of the environment, without the surpluses in food that permit increasing differentiation of labor and cultural development.

Agriculture

The agricultural economic paradigm, beginning with the Neolithic (New Stone Age) revolution, enormously reduced dependency on the whims of nature. Farming probably first began in hill country where wild-growing grain was harvested. When farming arrived in the lower Tigris-Euphrates valley, flood-watered crops and technological advances led to early civilization. Knowledge of the seasons, based on the movements of the sun, the moon, and the stars, reduced the risk of sowing seed at the wrong time. Canals and dikes extended the reach of flood waters. Urban centers concentrated different forms of labor and experience. Writing enabled "prehistory" to come to an end, at least in places like Sumer. Forms of artisanry multiplied. Social organization became more complex and more ordered by governing institutions. Other riverine civilizations, such as along the Nile and the Indus, showed many striking similarities. Again agriculture, by generating a surplus of food, enabled crafts, governance, and commerce to advance.

Industry

The agricultural paradigm dominated from ancient through medieval times, the Renaissance, and Reformation, and until the industrial revolution (the source of the third paradigm) made manufacturing the key enabler of economic progress. Machines increased output, and the division of labor added efficiencies. Steam drove machines with power and endurance beyond the capabilities of unaided humans or harnessed animals. In England, first to undergo the transition to the industrial paradigm, manufacturing put raw materials to use in new quantities, created new dimensions for trade and finance, and supplied jobs both for surplus farm labor and an increasing population. Relations between owners and employees changed as enterprises grew in size, took on a characteristic corporate form, and eventually became complicated by a separation of owners (off-site stockholder investors) from management. Iron and steel were produced and supplied in new abundance. Railroads moved more goods and people faster. Advances in machine tools, new sources of power, and applied science made new products possible, from dyes and other industrial chemicals to the internal combustion engine and electrical appliances.

Manufacturing became the pervasively influential economic form, the new economic paradigm. It influenced the way people thought about the human condition and the future. For example, in the mid-nineteenth century Karl Marx linked factory-driven industry to the dominance of social classes, generalizing about stages in history that would arrive at the rule of the proletariat and communism.

The Information Economy

Now we have entered the era of a fourth economic paradigm, the information economy. Knowledge work is the key source of growth in the most developed countries. Services play a huge role in advanced economies, and many, such as advertising, are pure knowledge work. But even in manufacturing, knowledge work is essential—for

example, design, marketing, quality control, planning, strategy, and identifying customers' needs and tastes. Knowledge work does more to differentiate competitors' products than the physical inputs that are fashioned or fabricated. Production also differentiates, but it embeds knowledge and is best continually improved by assessment, insight, teamwork, and research. Books are written on how to stimulate and structure ongoing learning within corporations.

Computers and telecommunications are at the center of the new paradigm. They raise the productivity and potential of knowledge work and effectively condense time and space by degrees once unimaginable. Firms are networked within and connected to customers and suppliers. Orders, purchases, financial commitments, appointments, and creative ideas are transmitted and shared at a pace that makes the conduct of business and exchange of knowledge a century ago seem torpid in comparison. International markets are far more interdependent than ever before. Arbitrage in some securities is international, and new financial instruments proliferate. Globalization is celebrated by some and demonized by others. The potential for freer trade in a world so networked tantalizes the forward looking and terrorizes newfangled Luddites.

Companies that develop and sell knowledge must be added to professional knowledge workers, such as accountants and attorneys, when considering the breadth of the information economy. There are precedents. Textbook companies sell knowledge. Marketing information developed from computerized transactions offers clues to what is possible in the information era, but Celera Genomics's February 2000 prospectus provides a company-wide example:

Since its formation, Celera Genomics has become a recognized leader in the generation, sale and support of genomic information and enabling data management and analysis software. Celera Genomics' customers use the information for commercial applications in the pharmaceutical and life sciences industries. The specific applications include target identification, drug discovery, and drug development.

Celera Genomics' mission is to become the definitive source of genomic and related medical and biological information.

The information economy is in its infancy, but it is identifiable and is already much cited and described. It takes its place alongside the hunter-gatherer, agricultural, and industrial paradigms. Control over nature has made another quantum jump, and a new economic form again dominates wealth creation and cultural change.

The Four Paradigms in Perspective

The dominance of an economic paradigm is partly indicated by employment. In pre-historic times almost everyone was engaged in hunting and gathering, and then agricultural employment dominated for thousands of years. However, in 1997 less than 2 percent of the U.S. workforce worked in farming, and only 16 percent in manufacturing, with less than 10 percent being directly engaged in making things (*Statistical Abstract*, U.S. Bureau of the Census 1998, 417-419, 421).¹ Porat (1977, 119-123) estimated that information workers increased from less than 10 percent of the workforce in 1860 to the single largest group of workers in 1975, well over 40 percent of the total, followed in order by

¹ "Employed in farming" means included in the figures for "farm operators and managers" and "farm workers." "Directly engaged in making things" means included in the figures for "machine operators, assemblers, and inspectors" and "precision production occupations." The percentages pertain to the civilian workforce.

service, industry, and agricultural workers. Porat (1977, 8) also estimated that information activity accounted for 46 percent of U.S. Gross National Product in 1967.

The sketch above is intended only to identify the four economic paradigms. It is not intended as a mini-economic history of the world. Other themes, such as trade, the use of capital, urban development, and the growth of services, are vitally important to understanding economic change. The history as currently understood is available from scholars. For now, bear in mind these qualifiers. The paradigms developed and took hold in different places at different times with different levels of intensity. Even when deeply rooted, the course of an economic driver could be uneven. War, disease, economic imbalances, and the vicissitudes of social organization led to ups and downs. Countries favored by geography, sources of capital, key natural resources, skilled workers, entrepreneurial mores, and ethical approval of diligence were more likely to progress in industrial development than those not so favored. Hunter-gatherer societies resided on the same globe as countries undergoing industrial development. Cloth manufacture and trading were active for hundreds of years before England's steam-driven factories won their fame. Advances in agricultural productivity helped achieve England's industrial revolution. Without modern agriculture we could not survive in the information era, much less prosper. And without manufacturing, we could neither live as we want to live nor fuel the information economy, which runs on computers and telecommunications as much as on brain power. Dominant economic forms were never the sole economic form. That said, what is the meaning for the information professional?

FOUR INFORMATION PROFESSIONALS

Each economic paradigm can be associated with the information professional who met its need for information services, as summarized in Table 1.

The information professional of the hunter-gatherer economy was the shaman. He was responsible for the relationship between the hunter-gatherer band and the spiritual world. He was believed to be able to heal the sick and communicate with the world of spirits. He directed the group's sacrifices to the spirits, explained the untoward, and was responsible to escort the dead to another world. The shaman held an honored, full-time job. His material needs were met by the other members of the band or tribe.

The hunter-gatherer economy was not dependent on high volumes of information for decision making. One can imagine that knowledge of the hunt was passed down from parents or from new peers when a youth came of age. On the other hand, prehistoric bands that lived on the boundary between subsistence and disaster, with relatively little control over nature, were prey to fears and found the natural world, life, and death inexplicable. They therefore had a great need for the shaman's certainties.

TABLE 1
Characteristic Information Professionals

<u>Economic Paradigm</u>	<u>Information Professional</u>
Hunting and gathering	Shaman
Agriculture	Scribe (and other designations)
Industry	Accountant
Information economy	The new information professional

Scribes, Agents, and So Forth

The agricultural economy depended much more on information. Measurements were necessary to ration grain until the next harvest. Orderly taxation to maintain evolving religious and governing institutions was impossible without records, and since agriculture made crafts and trade possible, there were barter and monetary transactions. In ancient Egypt, Greece, and Rome and later in the medieval church, economic events were recorded. Large organizations cannot be run for long periods of time without information on the acquisition and disposition of resources. The medieval manorial estate called for records because of the obligations between the lord and those who tilled the soil. These created varied information needs.

The professional who met the information needs of the period dominated by agriculture was variously called a scribe, clerk, agent, secretary, or steward. Sometimes the role was combined with administrative functions. In ancient Babylon, Hammurabi's Code required the agent selling goods for a merchant to give the merchant a sealed memorandum quoting the price. Only then was the agreement enforceable (Chatfield 1974, 5). Religion was important to the economy in post-hunter-gatherer years. In Sumerian civilization, "The priests alone possessed the skills of calculating the seasons, laying out canals, and keeping accounts..." (McNeill 1963, 34). The temple directed the economy. But a secularization of economics and account keeping characterized later agricultural societies.

To a great extent the nongovernmental estate accounts were needed to ensure that the owner was not robbed or inefficiently served by the manager. Manorial stewards' accounts were evidence, assuming all went well, of competence and good faith. On larger English manors the lord and his domestic council examined the accounts each year, and often appointed an audit official (Chatfield 1974, 24-27).

These few examples do not capture the variety of the information professionals in the agricultural era, the kinds of records they produced, and increases in their skills and technology over time. This phase includes data recording for banking and trading in Renaissance Italy and encompasses the development of double-entry bookkeeping, codified by Luca Pacioli in 1494. It is arguable that the bookkeeper should be added to the list of information professionals between the scribe-steward and the accountant. Double-entry bookkeeping, *by itself*, is an elegant, controlled technique of recording events.

Accountants

With the maturing industrial paradigm, corporations funded by capital markets became the dominant business form. This had a great effect on information needs. The corporations were continuing enterprises with obligations to investors to calculate proper dividends and were therefore concerned with periodic net profit. Viewing businesses as ongoing operations differed from the accounting perspective applied to the mercantile ventures that terminated after one or more voyages. The duration of these ventures limited the merchants' accounting needs. The corporate perspective was different as well because long-lived factories and machinery were essential to the typical industrial-model enterprise. Merchants typically invested in inventory, not fixed assets. Periodic revenue became based on the event of delivering goods, not payment for those goods, and periodic depreciation was charged against revenue. Financial accounting for purposes of reporting to investors, creditors, and potential suppliers of capital, though owing much to its antecedents, was a creature of the industrial era.

The professionals responsible for financial reporting, and for the systems that enabled and audited it, were, and are, accountants. Over the years they expanded the scope of their traditional work. Financial statements, financial reporting systems, and audit reports are far from being their only products. Accountants apply their information, control, and reporting skills to all types of information, not just financial information and not just information pertinent to financial statements. The information might pertain to quality assessments, for example. In recent times managerial accounting has created a variety of performance measurements of great use to business executives.

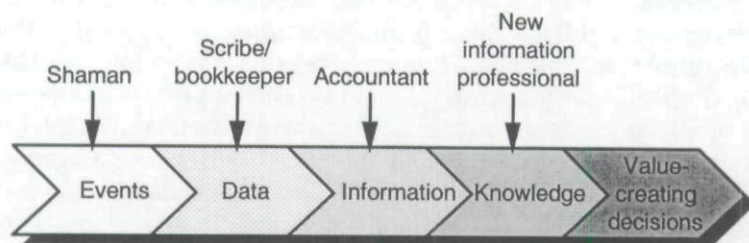
The New Information Professional

The variety of information work currently performed by accountants and those in other knowledge work professions does not define the information professional who meets the needs of the information economy. The information economy is too young to define fully this professional's role. It will evolve, just as the role of the accountant has evolved. Work to reform accounting education has moved in the direction of the new information professional, as have the efforts to define a new information credential undertaken by the accountancy institutions in several countries. But we cannot know how these initiatives will play out. Nor can we at this time foresee whether other professions will take related initiatives or how they will otherwise react to the opportunities presented by the evolving information economy. The outcomes will rest on how the environment shapes and is shaped by individual and group choices and the will power and adaptability of those in the marketplace. But we can relate the value of the new information professional's services to the driving economic paradigm.

THE INFORMATION PROFESSIONAL'S SERVICE VALUE

Figure 1 illustrates, from left to right, the increasing value of information services to business and the associated information professionals. The five-segment arrow is called the value chain. Except for the first, its segments are not mutually exclusive. Each more valuable service captures what it needs from the less valuable service to its left, and, except in the case of the shaman's relationship to "events," that segment corresponds to a service, as described below.

FIGURE 1
Information Services Value Chain



Business events—In the shaman's times events and transactions were not exploited to create information services. Where there is nothing but unrecorded events and no economic need for records, we are in the prehistoric time of the hunter-gatherer. The shaman's information services assisted the hunter-gatherer's work by explaining life's and the economy's uncertainties. These explanations relied on the supernatural, calling upon direct knowledge of the spirits. The shaman's services were valuable because they sustained the society, not because they contributed to economic decisions that create value.

Data services—The data service refers to recording the events and transactions. The scribe is typical of those who performed this service in circumstances where there were no other business information services. The service includes summing, recording, and eventually using the double-entry system.² Recorded data are essential to the conduct of business—that is, to effective business decisions. But this professional—called scribe or going by other designations—often had other responsibilities, such as administrative, legal, or managerial responsibilities.

Information services—The accountant was (and is) a full-time information professional, whose qualifications, if sufficient, are authoritatively recognized by a license. Financial statements and modern managerial accounting deliver greater value than data services alone, and far greater skills are required. Accountants' competencies include making estimates and assumptions, selecting appropriate presentation formats and measurement principles, and knowing how to apply them.³ Associating costs with revenues and timing revenue recognition are much more demanding matters than entering data into columns.

Knowledge services—The services of the new information professional will contribute more to business decision making than any of the other information professionals in the value chain. The required competencies will be broader, covering not only all types of information that might be relevant to a business problem, but also all types of decisions. It will not matter whether the decision pertains to personnel, regulatory issues of all variety, public relations, or profit opportunities. The challenge of the new information professional will be to formulate the strategy to align or mesh the right information with particular and generic problems requiring decisions. This professional's unique skills and knowledge will enable the fruitful conjunction of the decision maker, the problem, and the information needed to solve the problem. This focus will apply both to unique problems, where information germane to a decision is not *by itself* systematically related to other decisions, and to recurring decisions, like compensation and promotion, where the needed information is systematically related to other decision-making events.

INFORMATION PROFESSIONALS AND THE FUTURE

The value chain just described indicates the types of services needed by the four successive economic paradigms and the relative value the services provide. As society becomes more dependent on information, information services most in demand receive a higher premium. It is therefore important to relate the effect of the changing economic

² The invention of paper and movable-type printing facilitated the spread of literacy and numeracy, reducing demand for scribe/bookkeepers. In these situations, literate people became their own scribes/bookkeepers.

³ The development of increasingly intuitive accounting software has effectively empowered many computer-literate people with accounting skills. They can then both record data and create useful reports on demand.

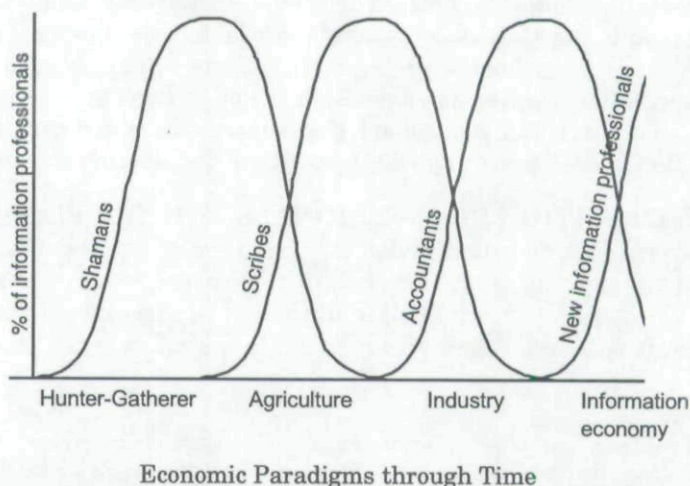
paradigms not only to opportunities for new information services, but also to demand for services originating in earlier economic eras.

Figure 2 relates the population of information professionals to the economic paradigm giving rise to the services each provides or provided. At the peak of each economic paradigm's dominance, demand for the related information service also peaks, as does the volume of related information services supplied and number of information service providers in the workforce. As the economic paradigm changed, information needs changed, and the information professionals typical of the passing era either lost their positions or transformed themselves into information professionals serving the needs of the newly dominant economic paradigm.⁴ The accounting profession has a vital interest in understanding the transition to the new information professionals' peak usefulness as we move toward the peak of the information economy.

Figure 2 illustrates that the accountant is at risk of becoming a lesser or perhaps even a marginal player in providing business information services. Unlike the shaman and the scribe, extinction is not on the horizon. Financial accounting, audits, tax advisory services, and related work will continue. Nevertheless, accountancy as we know it today will not be the core of the information services satisfying the needs of the dominant economic model.

⁴ A professional has perceived value only when operating higher on the information-services value chain than customers/clients. The ancient scribe, for example, possessed more abstract information skills than contemporary farmers, but less than later manufacturers. The accountant possessed more abstract information skills than the manufacturer.

FIGURE 2
Information Professional by Heyday



Today's and Tomorrow's Information Professionals

Evidence abounds of the information economy's effects on information services. Types and sources of services proliferated, fragmenting the former unity of business information services. Within accounting firms and among industry CPAs, new services multiplied. CPA consultants perform systems work, information risk analysis, and electronic commerce advisory services, all while in competition with non-CPA consultants. Computer hardware and software makers provide information services to their customers well beyond what is necessary to use the hardware and software they sell—for example, the consulting services of IBM and Unisys. Data processing houses are enormously successful, and the term "outsourcing" applies to information services available from different types of competitors. Internet companies provide technical information and educational services. Software is increasingly available to perform data gathering, tax, and accounting tasks.

These events and conditions indicate that the transition to the new economic paradigm is well under way. Some information services appear headed for extinction or marginalization. Just as there is no economic role for a shaman in modern industry, there seems less and less of a role for a professional who records data. Computers with the right software are linked by telecommunications to record data on business events and transactions as a by-product of the events and transactions themselves. They also generate reports for those needing the information. Tax and accounting software do work once performed manually by accountants. Much of the laborious preparatory work in financial-statement audits is eliminated by automated workpapers.

The descending slope of accounting services and the ascending slope of the new information professional's services in Figure 2 correspond to the rapid increase in new types of information services and the threatened redundancy of types of accountants' work. This process must be put in the perspective of time. The agricultural era was vastly longer than the industrial era. The dominance of the information economy came upon us suddenly. Its progress has been rapid; and it promises to continue at the same pace. It seems likely to peak in many fewer years than the industrial era that came before. Its duration cannot be defensibly estimated, but no competing economic paradigm is imminent. There might be variations within this paradigm ahead of us, rather than a root replacement. For example, biotechnology might replace the computer-telecommunications element generating the most growth. The information economy captures what is differentiating about mankind, the ability to apply brain power to transform the environment in a desired way. In any case, it seems reasonable to conclude that accountants must adapt if they are to control their destinies.

Nothing is assured. It may be that the fragmentation of services and providers that has begun, with competition in different markets by groups offering different mixes of business information services, is fated to continue or increase as the information economy matures. That event would serve no particular profession, though it would certainly remove accountants' business-information services from their past mainstream position. On the other hand, the pell-mell reinvention and proliferation of information services might sort itself out without the initiative of the accounting profession, concluding with some other group controlling the mainstream of business information services. And, finally, the information-service-sector might become characterized by various specialties without a single type of service professional at its core.

The Body of Knowledge Is a Determinant

The presence or absence of a single type of professional providing core business information services will largely be determined by whether that professional has a distinctive body of knowledge. A profession is defined more by its body of knowledge than by anything else. There are plenty of other possible identifying criteria. One scholar writing in 1964 found 23 elements included by other scholars in definitions of a profession. He found the six most frequently mentioned characteristics to be possession of a skill based on theoretical knowledge, provision of training and education, competency testing, organization, adherence to a code of conduct, and altruistic service. Later scholars focused on control of work, an idea linked to monopolization (Waddington 1996, 677). Other possible criteria include governmental licensing or other credentials, but common usages of "professional" and "professionalism" ignore formal criteria. For example, paid baseball and football players as well as career military personnel are called professionals. Exemplary service at a restaurant is sometimes described as "very professional."

Why, given the different usages and definitions of a profession, focus so exclusively on the body of knowledge? Partly because a service provider's body of knowledge creates advantages and vulnerabilities in the marketplace. The competition between psychiatrists, psychologists, and social-worker therapists is an example. The psychiatrist who has studied general medicine (the M.D. program) is differentiated from the others in the set and has typically commanded higher fees. However, this advantage has varied depending on changes in knowledge of mental illness and the corresponding therapies. Attention to the chemistry of mental illness and corresponding pharmacological remedies has given psychiatrists an advantage that had eroded in the provision of psychotherapy.

The knowledge needed for most professions changes and typically overlaps with the knowledge needed for other professions. This is clear in an academic setting, where accounting has claims to being both a separate discipline and part of a business curriculum. The sciences incorporate mathematics in their knowledge sets, but mathematics is a discipline in itself. The porous boundaries among bodies of knowledge are even clearer in the case of interdisciplinary courses at universities. Such courses take advantage of the interrelatedness of bodies of knowledge and the usefulness of their overlaps. The courses bring different perspectives to bear, but the notion that all of them can contribute to a single problem or theme nevertheless suggests interrelatedness and overlaps.

It might be said that the body of knowledge itself is not defining, but society's recognition of exclusive rights to apply that knowledge, typically by licensing, is defining. However, the audit license would probably have lost its meaning if audit technology did not radically change over the past century. Sampling, the audit risk model, and computerized audit techniques, for example, all bespoke a revised body of knowledge. The body of knowledge leads to the license and gives it meaning, not vice versa. Licenses indicate expertise; they do not create it. The license that does not signify unique knowledge does not signify a profession in any useful sense.

In addition, the exclusive right to perform audits is limited to financial statements, not to the broader notions now defined as assurance work. Auditors count the votes at the annual motion picture Academy Awards, but attorneys count ballots in proxy votes, and there are all sorts of measurements by nonauditors that back performance claims, from the reports of the Audit Bureau of Circulation to Neilson's television ratings and Standard & Poor's bond ratings. Some might argue that the attest or assurance models

do not bear in some particular a one-to-one relationship to these other services. But even if considered derivative or allied or cousins, they are nevertheless business information services that auditors might perform by virtue of their reputation for objectivity and integrity and their measurement skills. Other groups provide services based on a body of knowledge that could have been claimed by accountants, but was not.

These examples show the competition for information services related to the body of knowledge that has been or could be claimed by auditors. Analogous competitions await the entire accounting profession, because needs for information services are growing. It is fair to ask whether the profession is going to adjust its body of knowledge to establish a wider claim to those service markets.

The Accounting Professoriate's Opportunity

The academic community can play a great role in the accounting profession's coming evolution. It can define a body of knowledge more suited to the realities of the marketplace, to the needs of decision makers, and to the future prospects of both. A new synthesis, including theory, techniques, and service concepts, could be captured in teaching materials, articles, and monographs and refined through debate. In the process, the lines between disciplines would be sharpened or relaxed. Academic or practicing professionals must adapt accountancy's body of knowledge to the modern information economy, or accounting's place in it will decline.

If the professoriate is to take this on successfully, it must generate fresh ideas and be willing to defend them. Only when academics take ownership of ideas are they likely to stimulate debate, research, and institutional change. They cannot rely solely on the notion that practitioners are customers for accounting departments. Customers typically focus on current needs; the body of knowledge for the new information professional must be based on projections into the future as well as analysis of the present—pioneering as well as rooted in the accountancy tradition.

One view of the general direction in which these efforts might proceed is based on the challenge facing the new information professional stated earlier: the challenge to formulate strategies to align or mesh the right information with particular and generic problems requiring decisions, to enable the fruitful conjunction of the decision maker, the problem, and the information needed to solve it.

Preparation for this challenge implies control of a considerable and varied body of knowledge. Business and organizational knowledge is needed to understand problems and the kinds of information needed to solve them. Knowledge of information technology, information systems, and decision science is needed in order to structure the conjunction of the decision maker, the problem, and the information. Measurement skills are needed to create decision-useful information from events, and analytical skills are needed to put information into a form that serves decision makers in different circumstances and to distill from information what is germane to the decision. The new information professional must be prepared to identify and create decision-useful information, arrange its availability when needed for decisions, and design feedback loops to ensure the continued readiness and effectiveness of the systems.

The skills and knowledge needed by the new information professional will become clearer as the information economy unfolds. But the task of defining the body of knowledge must begin now. The body of knowledge must achieve a level sufficient to put the new information professional on the map and provide a base for continued evolution of the body of knowledge itself.

The economic-paradigm analysis above suggests that the academic group with the most obvious claim to defining the body of knowledge for the new information professional is the accounting professoriate. Accountants inherited the scribe-steward role. They inherited and developed double-entry bookkeeping, transforming it into financial accounting. They developed audit and attest technologies. The profession has been giving advice on business information systems and controls for centuries. It harbors the information professionals best prepared to carry the accountancy tradition to the next generation of services. It has contributed to economic growth with its standing body of knowledge and can do much more by adapting that body of knowledge to meet new needs generated by the information economy.

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