THE BLACKWELL ENCYCLOPEDIA OF MANAGEMENT

SECOND EDITION

# MANAGEMENT INFORMATION SYSTEMS

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## SECOND EDITION

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process definition, and decision analysis and resolution.

CMMs typically have an accompanying appraisal method that allows users to have an evaluation of their progress conducted. The appraisal method currently available for use with CMMI models is the Standard CMMI Assessment Method for Process Improvement (SCAMPI$^{SM}$) Class A. To help insure that useful and credible results are obtained from SCAMPI appraisals, the SEI developed a certification and authorization process for SCAMPI Lead Appraisers$^{SM}$. To insure consistency, all appraisal methods must conform to the most current Appraisal Requirements for CMMI (ARC). Although SCAMPI Class A is the only appraisal method currently available from the SEI, the SEI also plans to support the development of additional appraisal methods that differ in cost, time to execute, and rigor.

### Process Improvement

Process improvement objectives identify the processes and outcomes that an organization wishes to improve. Successful process improvement initiatives must be driven by the business objectives of the organization. Thus, process improvement objectives are derived from business objectives.

Process improvement is a significant undertaking that, to be successful, requires senior-level management sponsorship and a firm commitment of resources. Further, it is a long-term commitment for the organization that cannot be approached and accomplished quickly.

The costs vary depending on the organization and its goals. However, the support of process improvement typically requires additions to the organizational structure, such as an engineering process group (EPG).

### Adoption Results

CMMI is being adopted worldwide, including in North America, Europe, India, Australia, and the Pacific Rim. CMMI models and associated products are designed to fit the needs of small and large organizations from a variety of different industries. There are CMMI-adopting organizations in fields such as electronics, aerospace, health services, finance, defense, insurance, and transportation.

Many benefits are reported by CMMI users, including: lower development costs, more accurate schedules, increased quality, higher customer satisfaction, and substantial return on investment.

A recently published SEI report, *Demonstrating the Impact and Benefits of CMMI: An Update and Preliminary Results*, provides more information about the benefits of CMMI. It is available at www.sei.cmu.edu/publications/documents/03.reports/03sr009.html.

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www.sei.cmu.edu/cmm/cmms/cmms.html
www.sei.cmu.edu/cmmi/

## careers in information technology

*Soon Ang and Sandra A. Slaughter*

Information technology (IT) professionals are people who acquire, develop, manage, and maintain hardware, software, and telecommunication networks, and offer computing and information services to users. There is a wide spectrum of IT professionals who play various roles in the management and development of information systems. With the advent of client–server technologies, powerful personal computers, and software languages that are easy to use, end-users have been increasingly developing and managing their own computing applications, rather than relying on the organization's IT employees. This trend has contributed to the downsizing of the IT group within organizations. It also affects the nature of IT work. Rather than providing complete information system services to the organization, IT professionals may provide support for end-user-developed systems or may concentrate on developing and managing only major, company-wide applications.

Contemporary categories of IT careers include:

1 *Chief IT executives.* These IT professionals serve as the senior executives in the IT organization. Chief information officers (CIOs) are top corporate officers responsible for the overall IT function in an organization.

CIOs offer leadership in managing the information resources of the firm, and in directing the power of information technology toward the strategic objectives of the firm. Chief technology officers (CTOs) are responsible for technology planning, new technology evaluation and selection, and setting the vision for the firm's IT architecture. Given the increasing importance of information security, some firms have created another senior-level IT position, the chief security officer or chief information security officer (CSO). CSOs oversee and coordinate information technology security; establish, communicate, and implement IT security policies that support the firm's IT objectives; and act as the primary liaison with other security professionals inside and outside of the firm.

2 *Software development/engineering professionals.* These IT professionals comprise application programmers who develop software using programming languages and software tools; systems analysts who determine user requirements and design the systems specifications; and project managers who oversee and coordinate teams of programmers and systems analysts in developing specific application systems. Positions include: applications systems programmer, software applications specialist/engineers, software architect/engineer, data modeler, operating systems designer/programmer/engineer.

3 *Web development/administration professionals.* These IT professionals design, develop, and maintain web-based applications. They analyze, design screens, develop client–server applications, and provide quality assurance and testing. Positions include webmaster, web designer, web specialist/developer.

4 *Database/data warehouse professionals.* These IT professionals design and model databases, create objects, and monitor, test, and maintain the data integrity of the databases. Positions include: database administrator, data developer/modeler, and knowledge architect.

5 *IT operations, network design, and administration professionals.* These include computer operations and network specialists who are involved in computer capacity planning, management; disaster recovery; security; hardware and systems software maintenance; and production or job scheduling. Contemporary network specialists are involved with INTERNET connectivity, intranets (*see* INTRANET), extranets (*see* EXTRANET), as well as local and wide area networks. They also analyze, install, monitor, and provide maintenance for hardware integration. Positions include network administrator, network engineer, network manager, and information systems administrator. Of increasing importance are security specialists who are responsible for protecting and recovering information resources.

6 *Technology support IT professionals.* These are responsible for the acquisition, installation, upgrade, maintenance, and help-desk support of IT use in the organization. Positions in this cluster of professionals include help-desk specialist, PC support specialist, call center support specialist, and maintenance or technical support engineer.

## Career Orientations of IT Professionals

Igbaria, Greenhaus, and Parasuraman (1991) found that IT professionals are diverse in their career orientations, i.e., in their interests, self-perceived talents, values, and motives that shape their career decisions (see also Ginzberg and Baroudi, 1988). Technical and managerial orientations are two dominant themes among IT professionals. People in technical jobs such as application programmers and systems engineers are more technically oriented, while those in managerial jobs such as systems analysts, project leaders, and managers are more managerially oriented. The study by Igbaria et al. (1991) found that the match between job type and career orientation of IT professionals is important because such a match leads to higher job satisfaction, stronger organizational commitment, and lower intentions to leave the organization. The implication of this study is that management should take into account differences in employee interests and orientations and provide job opportunities that match employee needs.

Joseph, Ang, and Slaughter (2004) tracked the

individuals with at least one year of IT work experience) for a 21-year period using a US National Youth Longitudinal Survey sample and found that IT professionals are clustered into three types of career profiles: technical IT professionals ($N = 127$) who devote a majority of their careers to technical positions; managerial IT professionals ($N = 72$) who move to managerial positions after an average of three years of technical work experience; and ad hoc IT professionals ($N = 148$) who move in and out of the IT position during their career lifespan. Studies based on IT salary data (Ang, Slaughter, and Ng, 2002; Joseph et al. 2004) found that the returns to careers for managerial IT professionals were significantly higher than those of technical or ad hoc careers, suggesting that the IT labor market recognizes and pays a premium value for managerial competence in the IT profession. The average pay for each career profile (adjusted for inflation to base years 1982–4; Bureau of Labor Statistics 2004) is $26,589 for managerial, $22,185 for technical, and $16,854 for ad hoc.

### Outsourcing and Impact on IT Careers

Traditionally, firms that require a specific skills set will employ a worker under a long-term employment contract where the worker works all year round at the employer's place of business, except for vacations and holidays. Unless they resign or have their services terminated, employees are assumed to remain with the employer until death or retirement. From the legal perspective, both parties have rights and responsibilities accorded to them by both common law and employment statutes governing the employer–employee relationship. Accordingly, it is not uncommon for IT professionals to remain attached to a single employer during their entire careers.

Careers built upon long-term employment relationships with single organizations work well in situations where the skills sets required by the firm are relatively stable over time. However, in information systems, firms are finding that alternative employment arrangements, such as contract work, are becoming more important and attractive because of the increasingly rapid evolution of technology (see Ang and Slaughter, 2001; Slaughter and Ang, 1995, 1996). Cutting-edge technologies typically enjoy lifespans of only two years. Skills of IT professionals therefore erode very rapidly. Operating in short windows of stable technological environments, IT organizations with a stable and static workforce anchored in traditional employment relationships continually face the problem of needing to upgrade the skills of the workforce. In many cases, organizations may feel that commitment to training the internal workforce is self-defeating. Because technologies move so rapidly, by the time an organization invests in and trains its IT staff in a certain technology, that technology may already have become obsolete.

Accordingly, the number of organizations using contract workers for IT work is growing dramatically, particularly with the rapid diffusion of IT OUTSOURCING and offshoring where organizations are contracting out the services of some or all of the IT organization to independent contractors or service providers (Ho, Ang, and Straub, 2003).

Consequently, IT careers no longer take place in single organizations. Rather, as contract workers, IT professionals are not attached to any single organization for a long period of time. Instead, they are independent and self-employed, hired on a fixed-term basis for a specific skill through an agreed-upon contract. The contract may provide a fixed duration of service or may operate on a job-by-job basis. From the worker's point of view, contract work provides an opportunity to establish a special expertise or professional status within an industry. In fact, it is often regarded as a way for workers to focus on the aspects of their profession they most enjoy (e.g., programming instead of managing software projects) without having to deal with corporate politics or pressures to move up the expected career ladder (see Ang and Slaughter, 2001).

The trends toward outsourcing and careers based on contract work arrangements imply an increasing inter-organizational division of IT labor in the future, as work formerly conducted within organizational boundaries and under the administrative control of a single enterprise is parceled out to more specialized individuals or organizational entities. The implication for IT professionals is that they can no longer solely rely on building careers by moving upwards in single organizations. Rather, IT professionals

themselves in light of competence-destroying technologies. They must also be cognizant of new career opportunities offered by outsourcing arrangements. For example, ideal IT professionals in outsourcing must possess a combination of not only technical and practical knowledge, skills, and abilities, but also negotiation and bargaining skills to sustain a flexible partnership that demands intense relationship building and continual recommitment from top to bottom of both client organizations and service providers.

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## CASE: computer-aided software/system engineering

*Dzenan Ridjanovic*

The term "computer-aided software/system engineering" (CASE) applies to tools that assist developers to analyze, design, and construct software applications or information systems. The objective of the tools is to automate software development. This requires an integrated set of features to support the development of models, requirements, design, and code generation. There are a large number of CASE tools, some with a very broad scope and some with limited capabilities.

CASE tools may be understood in terms of the process of developing an application using the tools. A software system is developed to provide a solution to a problem. This requires the problem domain to be analyzed before a solution is proposed and a solution to be designed before a software system is constructed. Once constructed, the system is maintained. After use, it may evolve and change. There are different approaches to the development (analysis, design, and construction) of software systems, as well as different formalisms and notations to represent requirements and design during the software life-cycle phase.

There are two broad categories of CASE tools: tools are used in both analysis and design and the construction of applications. Construction usually involves generating computer program instructions. All results of the development process using a CASE tool are stored in a repository. In this way, they can be used to maintain and evolve a software system from the analysis and design perspective, providing higher-quality software. In addition, they can be reused in other projects to increase software development productivity.

A CASE tool consists of a repository of analysis, design, and construction tools and results from using the tools in a graphical interface that presents the data in a specific notation (formalism or language). One of the important features of CASE tools is support for modeling of a problem domain and modeling information system components, such as external entities, business processes, data flows, and data stores. External entities provide specific entry and exit points to or from an organization unit being analyzed. Business processes transform, move, or store organizational data represented as data flows or data stores. A process relies on organizational resources to accomplish its tasks. If a