Techniques that enable waveform images to be incorporated into a corporation's processed documentation.

Creating a Document Management System

Ming-Yueh Tarng and Han-Yuh Liu

Industrial Management & Data Systems, Vol. 94 No. 9, 1994, pp. 9-15

Corporate Image

The Industrial Development Bureau (IDB) of the Republic of China has been ranked first in the Taiwanese Government in two leading surveys of administrative performance[1,2]. The IDB's staff and clients recognize that its computer-based document management system (DMS) is one of corporate image identities[3]. As a pioneer in computer-based document management for government, the IDB has enhanced its reputation owing to a high level of performance and user satisfaction at low cost to the DMS system.

In 1983, the IDB implemented the first DMS for the Taiwanese Government, using a Wang VS85 minicomputer. In 1986, IDB added a microfilm retrieval device (the first Kodak IMT350 in Taiwan) to the system. This system classifies, groups, indexes, and microfilms documents, with the IMT350 emulating a Wang workstation to retrieve and copy documents within minutes. It also provides useful management reports. This article will describe some key concepts and practical experiences in our case on creating a successful DMS. All of these issues are also suitable for a PC-based DMS.

Corporate Fixed Asset

Little thought is given to the value of documents with regard to their immediate user performance and the people whose work they affect, as we have no established way of placing a value on response time or on their accuracy and validity. There is the practice of placing documents in file folders with serial numbers; thus the liability of managing them is generated. The increasing volume of documents, the credibility and source of which are difficult to verify, can conceal the real factors and interests involved, leading to bad decisions.

Time studies indicate that as much as 25 per cent of all managerial or professional time is spent on document retrieval. The document control function exists not only for the document manager and his clerks, but also for the document users, most of whom qualify for the designation of information workers. We may try to shrink the space and minimize the labour of document keeping, but the performance of information workers and the people beyond will improve significantly only if we think of the documentation as a corporate fixed asset.

Subjective and Proliferous Value of Information

When considering automation, we often ignore its power as a communication device between the person who created it and future users of the data that it contains, particularly in government organizations. Many people who work in offices fear the advance of information technology into their work, because it is often perceived as a mystery and a threat, frequently leading to boring jobs after it has been introduced. This attitude is derived from the misunderstanding of the nature of information, which is not really known by systems engineers and users.

Information can be defined as the stimuli capable of altering an individual's perceptions, expectations, and evaluations in decision making. DMS is an information system, and provides information services. The value of information must be determined by its users. Information is not a consumer good and thus using it is different from using material objects. The use of everyday objects diminishes in value, but information gains value when it is attended to, exchanged or distributed. The more people who share information, the greater its worth. These fundamental differences between information and goods suggest that different disciplines are needed for the creation, measurement and evaluation of a DMS. If these differences are not understood, problems will be encountered in deciding how best to use computer-based information. A critical component of the successful creation and usage of a DMS is the ability to decide "what to do". This is far more important than deciding "how to do it".

Value-added Design

Although information technology has been instrumental in solving performance problems for production and clerical work, it has not been applied to offices on a large enough scale to have a great impact. There are some determining features of new information technology – changes which will almost always occur when such technology is introduced. Consequences differ in work methods, people and organizations and this will result in different disciplines being involved regarding the design of a DMS. Inadequate DMS design can cause many staff problems.

DMS is more than a tool to lighten the document management workload. It is a socio-technical system, not merely an information technology. Curley pointed out that the successful introduction of information systems to an organization is tied to achievable and desirable organizational goals[4]; in other words, the DMS should be an integral part of the organization. This perspective is essential in gaining an understanding of the conflicting influences which shape the use of DMS at every step of its evolution. Each system design element must be examined in the light of its productive allocation of resources and the performance of people at each level in the productivity chain. The DMS should meet a variety of tasks performed by document managers, clerks and document users with different requirements. Setting organizational, personal and social objectives from the outset and integrating them with technical requirements are vitally important.

When considering an investment in a DMS, there is a tendency, as with other investment decisions, to emphasize the relationship between the project's initial capital cost and its net operating savings. This translates into cost displacement – a DMS that will do the same work cheaper, faster, and with fewer errors. This implies that the DMS is a facility to be routinized and streamlined. Executives placing the primary emphasis on short-term economic impact will not provide a system that is flexible enough to adapt to change[5]. As mentioned above, we should think of the documentation as a corporate fixed asset, and concentrate our decisions on value added over cost substitution. This approach focuses on augmenting employees' abilities and supporting, rather than automating, their activities.

After the awareness of the relationship between innovative use of document management technology (e.g. Wang VS85 and Kodak IMT350) and organizational context, we used an information-processing model of decision processes[6,7] to identify the requirements of decision makers at each level (executive, managerial, and/or clerical) for a DMS, because data to be collected and information to be processed are related to changes in an individual's cognition of a decision problem. It is reasonable to assume that different decision makers at different levels may not have a uniform cognitive status of the same decision problem at a specific time. Also, the decision maker may skip over something which is clearly trivial to him to reduce the decision processes. The steps for guiding decision-making success of a DMS are shown in Appendix 1. After taking these steps, the decision maker's cognition gradually improves, from problem-sensing to alternative-finding to choice-behaviour. Then the decision maker's intention can be clarified and the function of a DMS will be defined the correct way, and the questions of the five Ws and one H (why, who, what, when, where, and how) can be clearly answered. In this case:

- Why do we need to change our present method of document management?
- Why should we install a DMS?
- Who will be the DMS's users, and what must the DMS provide to increase satisfaction?
- When will the DMS be used?
- What problems can be overcome or opportunities gained by doing so?
- What are the key objectives and tasks of the areas that will be affected by the DMS?
- What information will the DMS need to provide for successful operation in this organization?
- How well is that information being supplied today and what future changes are likely to occur in the environment of the DMS to which it must be able to respond in the future?
- What functions of a DMS are appropriate for this organization and where do the most critical needs lie?
- What underlying data need to be defined and shared consistently across organizational boundaries to ensure that information needs are met?
- What types and arrangement of data management computing and communication technologies are best for this organization?
- How should the DMS services be organized and conducted?
- What migration plan should we initiate to achieve these goals?

The features offered by competing products can be weighed and evaluated against the resulting identified requirements.

The system that we ultimately designed was carefully matched to the answers we found to the questions above. For friendly access, document (serial) number, receiver, sender, reference number cited by sender, subject or certificate code (which records subject, action division,

and allowed working days), processing status codes (i.e. 0, transfer; 1, pre-process; 2, process; 3, co-process; 4, submit; 5, ratify; 6, word process; 7, complete; 8, catalogue; 9, microfilm), keywords of subject, allowed working days, receiving and sending (or filing) dates, drafter and ID, ratifier (final decision maker) and level (i.e. 0, director general; 1, first deputy director general; 2, second deputy director general; 3, chief secretary; 4, division directors; 5, section chiefs), related document number(s), archive number, frame number, and access privilege (security class) of document have been recorded on the DMS's database. For efficient and economical use, every microfilmed document is subcatalogued into three parts – abstract and signature page, body pages, and enclosures – by different subframe numbers. This arrangement meets various needs; with Boolean logic (employing logical operations such as And, Or, Not, Except, etc.), users can retrieve and copy documents from the database in part, whole, or by groups with maximum efficiency and friendliness. The document number and the user ID are recorded for every access for audit purposes. The DMS's process flow chart is displayed in Appendix 2 for reference.

This DMS can provide extremely useful management information: for example, who holds or delays a document, staff workload and efficiency, extent of delegation of authority, process bottlenecks, and the major concerns of industries (known from the summing up of certificate codes or keywords). With this information, managers can apply the method of work simplification[8, pp. 174-7], developed by Allan H. Mogensen, to eliminate, combine, rearrange or simplify work because every job or every system involving a human factor is subject to improvement. This approach can produce improved motivation and teamwork between employees and their managers, thus increasing work satisfaction and system performance.

Integrated Measurement

Many DMSs have been perceived as problematical. Some of them can be implemented quickly, but may not be welcomed by staff. They can be efficient but highly ineffective, and thus of little or no value. Others may be implemented only after overcoming difficulties, but users judge them to be good. They can be effective and valuable but grossly inefficient. Users are sensitive only to overall DMS response as they get precisely what they are after in an acceptable time period. They use the DMS to enhance the quality of their work. They really do not care how or where the information is stored, whether it be on soft (digital storage) or hard media (microfilm, OD, paper). With less efficiency, the limited resource will be abused and will definitely affect the organization's survival and growth. With less effectiveness, this valuable resource will be misused, which will mean the organization never reaches its ultimate goals. Therefore, the performance of a DMS should be measured by examining both its efficiency and its effectiveness.

Measuring efficiency is not difficult; we obtain this from the physical output and physical consumption. Effectiveness can be traced by measuring user information satisfaction (UIS) in a manner developed and validated by scholars[9,10], whose theories are based on the integral acceptance of system outputs. When making a complementary measurement on the DMS's efficiency and effectiveness, we must consider three issues necessary in keeping the DMS's functionality in the lead. They are: implementing new ways of doing something which could not be done before, eliminating the redundant or repetitive operations in different work units, and extending its influence or control over external forces, such as customers, suppliers and competitors.

Justification of Stepping

Productivity refers to a comparison between the quantity of goods and services produced and the quantity of resources employed in turning out these goods or services[11, p. 3]. It is a systems concept and a combination of effectiveness and efficiency. Many productivity calculations can be made. In order to establish a rationale for selecting appropriate calculations, it is useful to look at the properties of the system itself and see what they imply[12].

When we design a DMS, the considerations are the system's objectives and purposes, resources committed and allocated, and environmental factors (fixed constraints) and these are therefore the basis for performance justification. The objectives and purposes define the functional class of outputs and specify the numerator of the productivity ratio. The resources allocated tell us about the means employed in producing the output, and are reflected in the denominator. The basis on which inputs and outputs are measured, however, depends on the assumptions made about the system's environment and management's perceived relation to it. It is important to point out that reorganization, new technology, new management, new materials, new work attitude and relationships, and changes in labour skills may account for increases or decreases in this ratio. According to these considerations, three kinds of productivity calculation can be used to justify a DMS for various concerns:

(1) *Process productivity* – This is evaluated by calculating the ratio of what is produced by the system (output) to what the system consumes in producing it (resource input). The output to input ratio reflects the system's ability to cope with scarcity and efficiency, in the sense that as output per unit of input increases, the system's

performance is improving. Process productivity tells us how the system is doing, but not what its potential is.

(2) *Bounded productivity* – This is assuming that the system's output is dictated by its capacity. Measurement is relative to both input and output. Bounded output productivity is the ratio of actual output to the maximum output the system *could* produce given current resources, labour, supplies, knowledge, etc. Bounded input productivity is measured as a ratio of the minimum input resources that should be required by this configuration to produce a given level of output to the input resources actually required to produce this output. This measurement tells the manager how well the system is doing compared with its achievable goal, given existing resources and configurations. Bounded productivity addresses the question of potential, and deals explicitly with the system's performance in relation to its capacity and capability. Whenever a system is achieving less than its bounded productivity, some unspecified constraints must be operating. This sort of calculation is especially useful in detecting bottlenecks in a DMS and spurs the research for limiting factors.

(3) *Systemic productivity* – Both process productivity and bounded productivity take the existing system as a given. They are measurements of how well the system is doing with the resources available. Systemic productivity is an indicator of the long-run survival and viability of a DMS. It questions the design of the system itself. Strategic planning is the information base for this approach. This is calculated as the ratio of actual output to the maximum output that *could* be produced by any system of the same functional class. Analysis of systemic productivity might result in a computerized DMS reverting to a manual system, redesigning the system, or suggesting the use of a third party to reduce the information service workload.

Summary

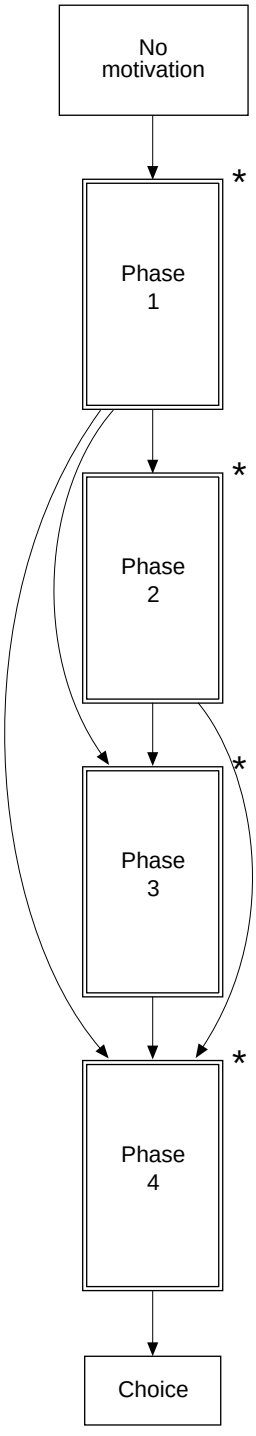
Innovative use of information technology has indicated and underlined the variety of opportunities and problems that exist. Management is required to learn not only from advertised successes, but also from misuses and abuses, how an information technology project has actually failed to achieve its objectives. Information technology influences the philosophy of information system design and development, but the system impacts on the users who directly affect the organization's performance and reputation. Concentrating solely on efficiency in evaluating the system's performance is tempting, but we must also keep in mind organizational and social factors. The failure to give complementary attention to organizational activities as well as technical aspects is likely to mean that there is a poor match between the characteristics of the system and the needs of the employees and organizations who use it.

A DMS is an information system embedded in a human social system. Throughout the process of computerizing a DMS, managers should be aware that information technology is part of the organizational culture. Technology must be accepted and accommodated by its users. Otherwise, users' dissatisfaction, suppliers' complaints, conflicting opinions and waste of scarce resources will continue to plague management. We hope that our experience in the creation of a DMS at IDB will help others develop and manage a healthy working relationship.

References

1. Yu, P.L., "The Industrial Development Bureau Succeeds in Facilitating the Businesses and the Benefit of the People", *Excellence Business Magazine*, August 1991, pp. 46-8.
2. "A Stumbling Block of Taiwan's Economic Development – From the Businessmen's Viewpoint", *Business Weekly,* 10 November 1991, pp. 53-6.
3. "The Industrial Development Bureau's Corporate Identity System", *IDB Project Report Series*, China Productivity Center, Taiwan, December 1991.
4. Curley, K.F., "Are There Any Real Benefits from Office Automation?", *Business Horizons*, Vol. 27 No. 4, 1984, pp. 37-42.
5. Hopwood, A.G., "Evaluating the Real Benefits", in Otway, H.J. and Peltu, M. (Eds), *New Office Technology: Human and Organizational Aspects*, Frances Pinter, London, 1983, pp. 27-50.
6. Tarng, M.Y. and Chen, H.M., "A Framework of Problem from the Concept of Cognitive Attributes", *Chiao Ta Management Review*, Vol. 6 No. 1, 1986, pp. 121-38.
7. Tarng, M.Y. and Chen, H.M., "A Study of the Cognitive Attributes of Decision-makers in the Decision Processes", *Public Budgeting and Financial Management*, Vol. 2 No. 3, 1990, pp. 531-50.
8. Uris, A., *101 of the Greatest Ideas in Management,* John Wiley, Chichester and New York, NY, 1986.
9. Baroudi, J.J. and Orlikowski, W.J., "A Short-form Measure of User Information Satisfaction: A Psychometric Evaluation and Notes on Use", *Journal of Management Information Systems,* Vol. 4 No. 4, 1988, pp. 44-59.
10. Ives, B., Olson, M. and Baroudi, J.J., "The Measurement of User Information Satisfaction", *Communications of the ACM*, Vol. 26 No. 10, 1983, pp. 785-93.
11. Fabricant, S.A., *A Primer on Productivity*, Random House, New York, NY, 1969.
12. Mason, R.O., "A Theory of the Productivity of Systems Which Produce and Distribute Information", *Information Systems Working Paper Nos. 2-80*, Graduate School of Management, University of California, Los Angeles, CA, 1979.

Appendix 1: The Steps for Guiding Decision-making Success of a Document Management System



No grounds for anxiety that something is wrong with document management

Bound the problem of document management:

- *Futurity*: Have a motivation to find solutions
- *Restrictiveness*: Define the scope of persons, events and materials to conduct the effective DMS operation within a specific period in broad terms
- *Idiosyncrasy*: Screen out the irrelevant factors from the scope under the decision maker's specific rating system

Establish the scope of future manipulation in document management:

- *Connectedness:* Determine the set of persons, events and materials related to the deciding activities
- *Directedness*: Observe and describe the set from some viewpoint
- *Manipulability*: Have influence in dealing with matters related to deciding activities

Formulate the structure of a DMS:

- *Executiveness:* Comprehend a variety of future executive actions and environmental factors
- *Integratedness*: Construct the relationship between the decision problem and its related environmental factors
- *Measurability*: Know and explain the results produced from various changes in the decision problem from past events or using certain observations

Generate competitive alternatives for creating a DMS:

- *Exclusiveness:* Generate the alternatives available to solve the problem and know only one alternative can be chosen
- *Evaluativeness*: Convert the various results produced from different environmental situations under each alternative to a measurable value space, such as mathematical or statistical functions
- *Competitiveness*: Recognize the gain or loss in terms of the results of each alternative and eliminate the non-competitive ones

Select an alternative and implement it (DMS)

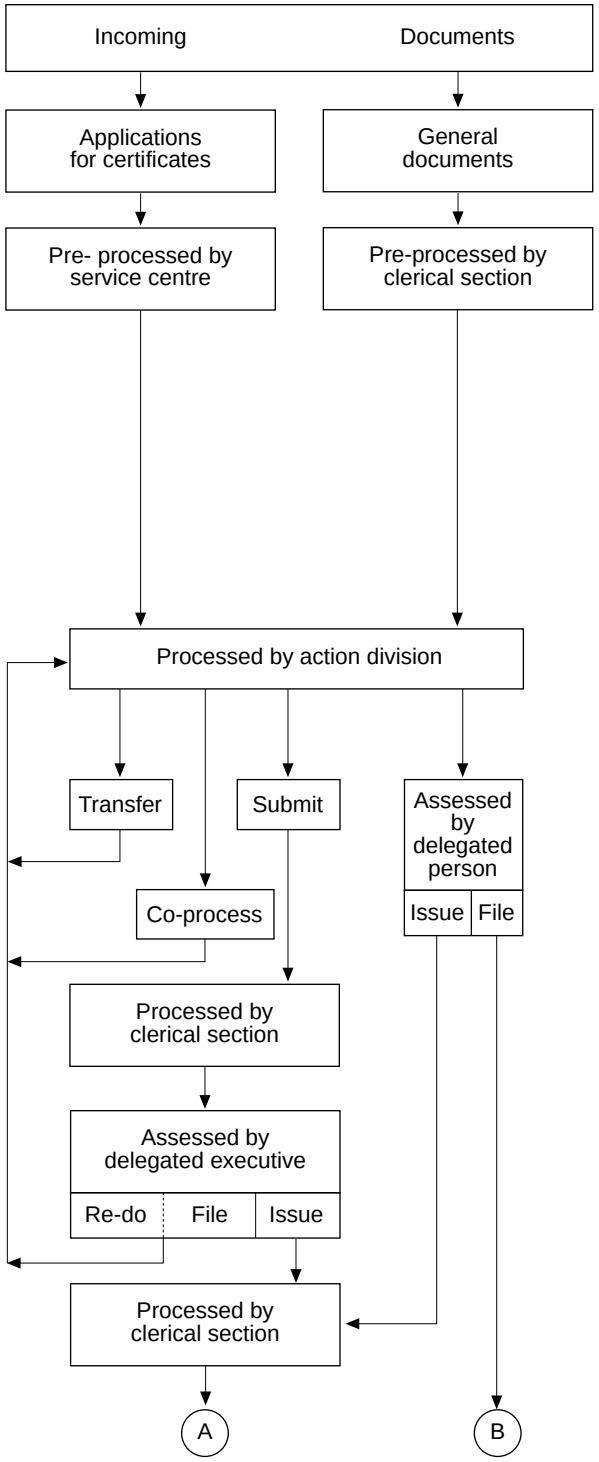
Key:

* : Possible starting- or ending-point in the complete decision process for different decision makers

↓ : Possible thinking process for different decision makers

▯ : Phase of decision processes covering particular attributes

Appendix 2: The Process Flow Chart of the IDB's Document Management System



E : Service centre/clerical section pre-process

D : Applications case
Sender/sender's document issue number/sender's issue date/certificate code (which records subject, action division and allowed process (working) days)

General case
Sender/sender's document issue number/sender's issue date/subject/ action division/allowed process days

- Document serial number, process due date, and process (incoming or outgoing) time for each step are recorded by system or keyed in by operator

R : Document abstract, assignment and signature slip (attached on document) /incoming documents lists (one for action division, one for clerical section and one for archival section) /receipt for applicant

P : 1

E : Action division process

D : Assigned staff's (drafter's) ID (document's keywords are written on abstract slip by drafter)

P : 2

E : Action division outgoing

D : 0 (transfer) /3 (co-process) /4 (submit) /5 (issue) /7 (file)

P : 0, 3, 4, 5, 7

E : Action division process

D : 4 (submitted)

P : 4

E : Action division process

D : 2 (re-do) /5 (issue) /7 (file)

P : 2, 5, 7

E : Action division process

D : 6 (issue)

P : 6

Key:

E – System entering (updating/inquiring) point

D – Data key-in

R – Reports

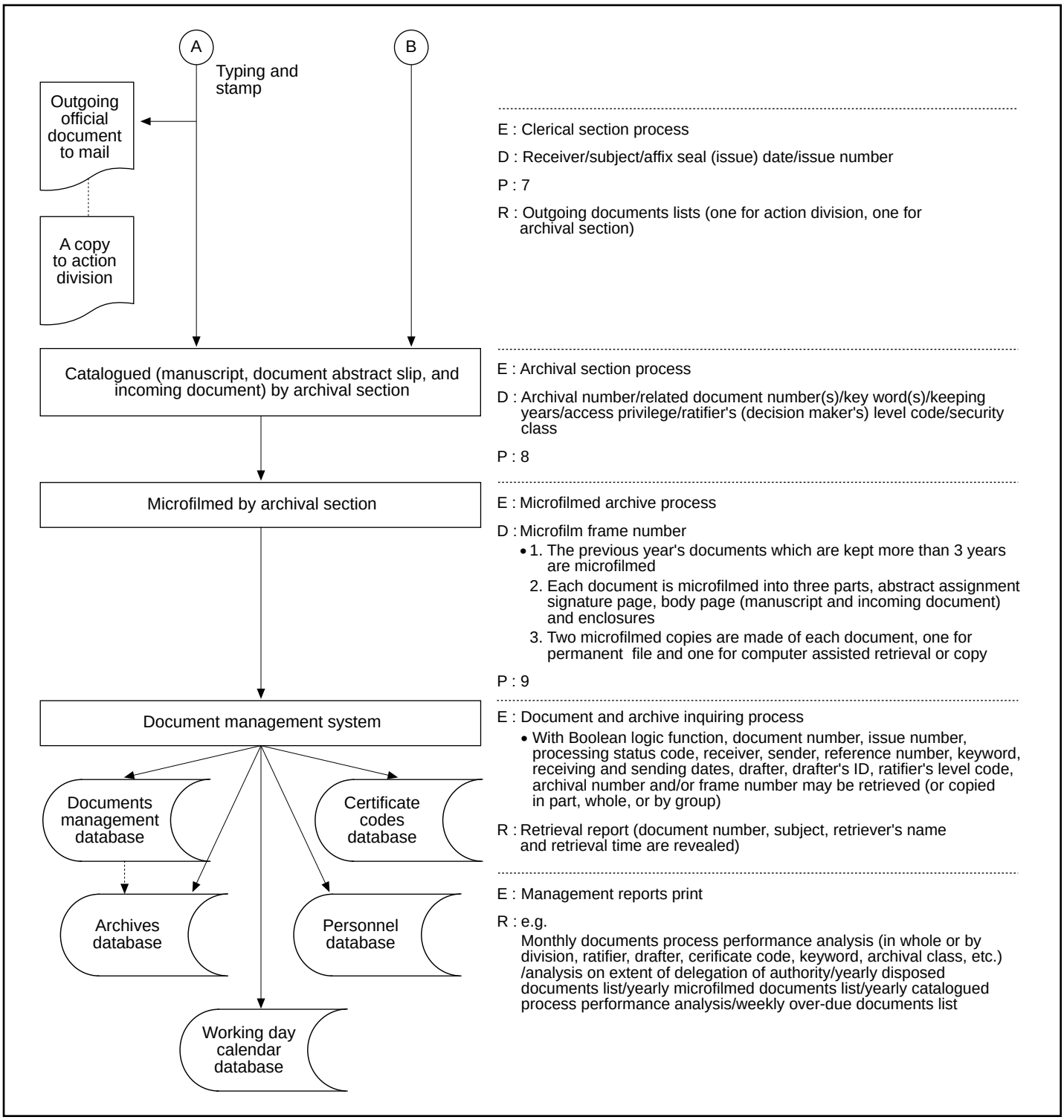
P – Processing status codes and display message
0. Transfer (from assigned to action division)
1. Pre-process (in clerical section)
2. Process (in action division)
3. Co-process (with another division(s))
4. Submit (by action division or by clerical section)
5. Ratify (by delegated person)
6. Word process (in clerical section)
7. Complete (issued or filed)
8. Catalogue (by archival section)
9. Microfilm (by archival section)

Remarks:

Ratifier's (decision maker's) level codes
0. Director general
1. First deputy director general
2. Second deputy director general
3. Chief secretary
4. Division directors
5. Section chiefs

(*Continued*)

Appendix 2.



Ming-Yueh Tarng is Professor at the Institute of Management Science of the National Chiao-Tung University of the Republic of China. He is also the Secretary General of the Chinese Institute of Industrial Engineers. Han-Yuh Liu is a doctoral candidate of Information Systems at the Institute of Management Science of the National Chiao-Tung University and he works as Director of Management Information Service of the Industrial Development Bureau of the Republic of China.