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Document management — Change management for successful electronic document management system (EDMS) implementation

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Foreword

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This second edition cancels and replaces the first edition (ISO/TR 14105:2001), which has been technically revised.

Introduction

Electronic document management systems (EDMS) have unequivocally contributed to the ability of organizations to automate portions, and at times all aspects, of a business process. These technologies are successful when organizations consider that a significant amount of change will occur and that end-users, information technology, management, records managers, and archivists are all affected. Planning and/or implementing these technologies without recognizing the amount of change management typically results in systems being implemented that do not meet the organization's needs, requirements, or expectations. It is commonly recognized that without adequate planning and execution of change management, the introduction and implementation of these technologies can actually place extra burden on the end-users and organizations, at times contributing to project failures.

EDMS technologies are tools that assist the organization to improve processes where appropriate. It is critical that the organization has the ability to separate non-technology-based change from technology-based change. Planning change management, beginning with the initial project phases, results in the organization understanding what needs to change, why, and what the desired result is, without adversely impacting the end-users or the organization. Change always results in some impact; the key to change management when implementing EDMS technologies is to minimize the adverse impacts and ensure that the organization has ample time to implement the desired change in order to achieve the desired results after the technology is implemented.

This Technical Report systematically identifies and reviews the ergonomic and organizational issues and considerations associated with the selection, implementation, and work practice criteria for EDMS systems.

Document management — Change management for successful electronic document management system (EDMS) implementation

1 Scope

This Technical Report defines the cognitive, physical, organizational, and human factors as they apply to usability criteria for electronic document management systems (EDMS) development, selection and implementation.

This Technical Report provides a framework for understanding the basic issues and concepts of organizational and human factors associated with implementing EDMS technologies. It describes the principles of human factors and ergonomics in their application to usability criteria for the planning and implementation of EDMS technologies, to environmental and implementation issues, and to training for long-term productivity benefits.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
culture
pattern of beliefs and expectations shared by the organization's members

NOTE An organization's culture defines the way in which individuals and groups within the organization behave, as encouraged by the organization's values and beliefs.

2.2
ergonomics
human factors
applied science that studies, designs and adapts equipment, work and the environment to meet human capabilities and limitations and to enhance safety and comfort

2.3
EDMS
electronic document management systems
computer-based applications dealing with the management of documents throughout the document life cycle

[IEC 82045-1]

NOTE There is a difference between enterprise content management (ECM), and electronic document management systems. For purposes of discussion within this Technical Report, the acronyms EDMS and ECM are often used synonymously from the perspective that both require the use of core technologies along with policies, procedures, and methodologies to successfully design, implement, and manage electronically stored information. Also, both can include the use of records management applications that are sometimes referred to as either electronic records management (ERM) or electronic document/records management (EDRMS). These acronyms constantly change within the document and records management industry, therefore it is advisable to consider the technology being deployed and not only the current/updated acronym(s) being used by the product suppliers.

2.4
ECM
enterprise content management
set of tools and methods allowing an organization to obtain, organize, store and deliver information crucial to its operation

NOTE 1 ECM can be broken down into five major components:

a) capture;

b) manage;

c) store;

d) preserve;

e) deliver.

NOTE 2 Adapted from ISO 12651-1.

2.5
operations
business process used to carry out the objectives of an organization

2.6
readiness
willingness of employees to adapt to changes in their jobs and work environment

2.7
repetitive strain injury
class of medical condition of the joints caused by repetitive motion, which is often rapid, forceful, and/or extreme

EXAMPLE Repetitive strain injuries include tendonitis and carpal tunnel syndrome.

3 Recommendations for EDMS implementation success

3.1 General

Understanding that the issues described in this Technical Report exist and occur is not enough. Implementation success depends on how these issues associated with planning and implementing these technologies are anticipated, planned for, and creatively addressed. Unfortunately, too many line managers and technical project managers have tried to avoid the issues, only to experience disappointing results. The best way to resolve these issues and control the fate of an installation is to augment project plans with activities designed to focus on the human and organizational aspects of EDMS. This can be done by establishing a foundation of user participation that will be the methodology underlying strategic planning, organization assessment, and change management activities. To see how these activities fit into the project plan, see Table 1.

Table 1 — Success through project management

Phase 1: Planning	Phase 2: Design and preparation	Phase 3: Implementation	Phase 4: Evaluation
High-level process baseline	Anticipated process design	System installation	Post-implementation review
Detailed process baseline	Application development	Pilot system	Continuous improvement
Functional/technical requirements	Orientation/communication	System tuning	Fine-tune operations
Process analysis	Development of reward and recognition	Reorganization	External audit trial
Conduct organization assessment	Change management activities	Training	
Identify technology-based and non-technology-based change requirements	Validation meetings	Validation meetings	
Develop change management plan	Work/job redesign		

3.2 Participation and integration

3.2.1 The key to success in implementing EDMS lies in integrating the key elements mentioned:

— technology;

— readiness;

— operations;

— culture.

The best way to accomplish this integration is through the active participation and involvement of users.

3.2.2 One of the most commonly noted issues that may contribute to the failure of EDMS projects is that participants feel their views are only given nominal value and that many of the major decisions are already made and the process is being conducted to legitimize the outcome wanted by management. It is essential that people feel their views are considered and either adopted or that a reasonable and valid reason be given why their proposals cannot be applied.

3.2.3 Participation of all levels of employees in the implementation process is an underlying theme of the following recommendations. At a minimum, key users (also referred to as “champion users”) should be identified throughout the organization. These “champion users” are typically senior or lead users who can provide input and feedback via a bidirectional communication model enabling the EDMS team and the users throughout the organization to be involved in all appropriate aspects of the analysis, design, and implementation project phases. The benefits of employee participation are increased motivation, higher productivity, and improved quality. In one study in which resistance to work changes was lower in groups that participated in making those changes, researchers identified the following two key points.

a) Participation is a necessary but not sufficient means of reducing resistance.

b) Participation is “a feeling on the part of people, not just the mechanical act of taking part in discussions”.

3.2.4 Organizations that have left the “champion users” out of the planning, problem solving, analysis, and redesign or that have only marginally involved employees through random conversations and presentations have been unable to tie together the four key elements:

a) technology;

b) readiness;

c) operations;

d) culture.

3.2.5 One of the best ways to ensure participation is through a “design team”. Selected by senior management, this team should comprise representative individuals from all levels and all key job functions as well as members of the technical project staff. The goal of this group is to jointly design the new work processes and jobs to best utilize the EDMS and human resources. The formation of this team will alleviate many of the “us-versus-them” problems that arise when the technical staff, records management team, or end-user representatives work separately from the other portions of the business unit in designing a system. This design team should begin its work with a one-day or two-day training session that reviews the following topics:

— team charter, roles, and responsibilities;

— project objectives and goals;

— change parameters established by senior management;

— methodology for work redesign that looks at both the social aspects of work and the technical aspects of work;

— problem-solving techniques such as brainstorming, flow charting, using cause-and-effect diagrams, and the like;

— development of effective teams;

— effective team behaviours;

— use new technologies as support of the project.

3.2.6 The design team should continue to meet on a regular basis to accomplish the following tasks.

a) **User analysis:** identify users, determine the extent to which their needs are being met, and identify actions that can be taken to increase user satisfaction.

b) **Technical analysis:** document how work flows, where problems occur, and where these problems are first discovered. Also, determine how EDMS can impact the current business processes and the associated variances that will be affected.

c) **Business process redesign:** according to information already gathered, rethink new approaches to the business process designs.

d) **System design:** according to information already gathered, finalize system specifications.

e) **Organization design:** according to the new business processes and system capabilities, determine structural changes that need to be made in the organization, if any.

f) **Implementation plan:** identify the steps and resources required to move from the current organization to the selected EDMS technology(ies).

3.3 Strategic planning: organizational change strategy

The most important contribution senior executives can make early in the project life cycle is to participate in a strategic planning session. The purpose of this session is to clearly articulate desired project goals and objectives and the desired organizational change. Most organizations develop a “technology strategy” of which EDMS is a part. Usually this is tied to a “business strategy”. The third component of this “strategic triangle” is the “organizational change strategy”. In many cases, this third critical strategy is non-existent. Failure to articulate an organizational change strategy can lead to failure to manage the human and

organizational impact of EDMS. Trying to manage the human and organizational issues without a coherent strategy will result in an unfocused and ineffective change management effort.

The strategic planning session should focus on answering the following questions:

— What aspects of our culture are effective?

— What aspects of our culture are ineffective with regard to EDMS implementation?

— In what ways will EDMS impact our employees and key external organizations?

— What structural changes in the organization are likely to result from EDMS?

— How much change do we want in this organization? When examining the continuum of control versus commitment, where are we now with regard to management style? Where do we want to be?

— What technology based change is appropriate for the organization?

— How should the project be phased to allow adequate time for change management and organizational acceptance of the selected technologies?

— Do we simply want to automate existing processes or do we want to fundamentally change workflows?

The outcome of these meetings should be clearly stated objectives for change management and a set of guidelines for change that can be used by implementation teams. For example, are there any processes or procedures that cannot be changed due to regulatory requirements? Can certain positions be eliminated; alternatively, should all job titles remain in the organization? Can resources be redirected?

3.4 Organizational assessment

3.4.1 Data gathering models

While the development of an organizational change strategy will provide the foundation for a change management process, it is equally important to have a clear and accurate understanding of the specific issues that are important in each organization. No two organizations will have exactly the same reaction to EDMS. Therefore, another critical recommendation is to conduct an organizational assessment. Many organizations make the mistake of developing a change management program based on perceived, rather than known, concerns. This approach may have little impact and great cost.

An organizational assessment should obtain thorough qualitative and quantitative data about “readiness, operations, and culture”. The data gathered through an assessment will then be used to develop a targeted change management program. The organization should carefully consider the culture and organizational structure and utilize one or more of the following data gathering models:

— high-level and detailed process baselining;

— questionnaires;

— interviews;

— focus groups.

3.4.2 High-level and detailed process baselining

The creation of a high-level process baseline will enable the organization to identify those key areas of the business that need to be further examined along with identifying key users who are most knowledgeable about the detailed aspects of the process(es). The detailed process baselining enables the organization to gather information related to how the business is currently being conducted and also enables the key users to provide input and feedback on those areas that could be changed, updated, etc. This greatly improves the

overall communication model throughout the organization as this process requires end-user participation and input. One-on-one discussions throughout the discovery process improves the level of detail gathered and typically results in the identification of end-user “work-arounds”, issues reducing the effectiveness of the organization, and those areas that end-users recognize as needing to be updated or changed.

3.4.3 Questionnaires

A written questionnaire can be designed to gather data on many of the key areas.

A written questionnaire is particularly useful in large organizations where it is impractical to interview all employees. This tool offers one way to give each employee an opportunity to voice opinions and provide input to the implementation of the EDMS system. It is also useful in large organizations because differences between subgroups can be identified, and appropriate change management strategies can be developed accordingly.

3.4.4 Interviews

Since not all questions can be answered in questionnaire format, individual interviews are another valuable source of information. Individual interviews are particularly useful in providing employees with a forum for offering their suggestions for a smooth transition. When selecting employees to be interviewed, care should be taken to ensure a representative sample of employees for each work unit and at each level of the organization.

A written questionnaire can be used to help:

— users before meetings to prepare for process related interviews;

— users begin collecting information and materials that will be needed by the design team;

— interviewers better organize meetings and establish meeting expectations.

3.4.5 Focus groups

Focus groups provide an excellent source of data regarding “operations”, an area that does not lend itself easily to the questionnaire format. A sample of employees representing all key functions in a transaction (for example, mail clerk, claims administrator, claims adjuster, supervisor, and the like) can effectively review the process to determine the key problems, the ways in which EDMS can help solve problems, and which problems need solutions other than EDMS. Focus groups provide an additional source of data for the facilitator, i.e. they provide an opportunity to see the organization in action, which can yield additional data about such cultural issues as teamwork, communications, and management practices. The following questions are particularly amenable to the focus group format:

— How might people resist organizational change?

— How will people respond to new technologies?

— How effective are current company training and evaluation methods?

— How will new organizations change the daily life of employees?

— What are the most difficult tasks performed today?

— Where are you losing time in your job?

— How important is the ability to retrieve information from document/record archives?

— What are the tasks or activities that require communication with external organizations?

3.5 Change management program

3.5.1 General

Once the data have been gathered and analysed, a targeted change management program can be created. It is the follow-through on carrying out the change management program that will be most critical to the success of the implementation process.

The change management program should look for additional opportunities to involve key users or “champion users” in all aspects of the EDMS project. This can be done by establishing “user involvement teams”. The teams would be created to develop strategies for managing the key issues that were identified through the organizational assessment. For example, separate teams might look at issues such as communications, training, and policies and procedures. Since many of the team members may not have had opportunities to help shape their organizations, the teams, such as the “design team”, will need some initial training in team building, problem solving, and meeting management.

While each organization will develop a change management program that is unique to its own situation, three broad areas that every organization will need to address are

— communication,

— training, and

— job design.

Some general guidelines are given for these areas in 3.5.2, 3.5.3, and 3.5.4.

3.5.2 Communication

In most organizations, communication is not as good as it should be. While this is not usually detrimental to the business, lack of communication at critical times of change can lead to failure of the change effort. The following are suggestions about communicating during times of transition.

a) Fully describe the problem previously identified by the end-users and management acknowledging the input from users that were interviewed and participated in the process baselining activity.

b) Identify the following:

   1) What information is difficult to find?

   2) What challenges do the users encounter with the current process?

   3) Who will benefit from technology based change?

   4) What types of non-technology based change is desired/required?

   5) What will actually change?

   6) What secondary changes will occur?

   7) What will be changing for the organization as a whole?

c) Compensate for losses. For example, in EDMS environments, many employees feel a loss of socialization with their peers or feel that the use of these technologies will increase management oversight and force users to “account for their time”. While this may be an objective, how this is presented to the end-users will greatly affect their interest and willingness to participate in any type of change.

d) Communicate as much as possible. It is always better to over-communicate the project goals, objectives, and status, rather than under-communicating the plan and what is scheduled to occur at what point of the project.

e) Emphasize and demonstrate the active and direct support of all levels of the management team.

Some successful EDMS installations have relied on monthly or quarterly meetings, newsletters, electronic mail updates, website communication pages, hot lines, and suggestion boxes. People in each organization will need to determine what will work in their environment.

3.5.3 Education and training

3.5.3.1 A fundamental key to success is education. Education reduces fear, and the reduction in fear increases acceptability of new technologies. Every person potentially affected by the change associated with the move from current to new technologies should be involved in this education program. If a given operator is only “a spoke on the wheel”, let them understand how they support the structure and strength of that wheel. The focus of this program should reinforce the fact that EDMS systems are tools that enable the organization to operate more efficiently and effectively.

3.5.3.2 Four mistakes are common reported during/after EDMS installations as follows.

a) Application training is inadequate. Employees are expected to learn everything they will need to know in one session. Lack of follow-up training and lack of on-site support are other problems that employees in EDMS installations frequently mention.

b) Application training is performed as a presentation and not “hands-on”. The lack of “hands-on” training with the actual application being implemented along with sample data/documents similar and/or related to the actual process result in confusion for users.

c) Lack of adequate time allocation for assigned champion users. Not ensuring that champion users have supervisory approval to dedicate time to these projects typically result in the champion user not participating as they don't have adequate time, or participate at a very minimal level.

d) Training does not focus on the broader picture of doing work and doing business in a new way. Training should be customized to demonstrate how the user would actually perform their work.

3.5.3.3 These critical problems should be alleviated by the execution of the following recommendations.

a) Arrange for on-site assistance after training. One option is to ask the vendor to provide this resource. Another option is to use an in-house expert. This could be a way to recognize an individual who has gained the skills and has been helpful in supporting the change process. It could also be a way to utilize a supervisor or other employee who has been displaced by the system.

b) The closer the training data is to actual “look and feel” business documents, the better the training experience for the users. The use of actual business documents familiar to users greatly improves the quality of application training

c) Make follow-up on-site training available. No one can remember 100 % of what they learned during a training program. Ongoing training can take a variety of forms such as teacher-led classes, video-based instruction, and instruction through workbooks with examples. Two one-hour sessions of training are often better than one three-hour session of training.

d) Create computer video sessions showing how to use specific portions of the system enabling users to receive “quick” pointers on how to perform basic functions.

e) Provide training on the enterprise plan for EDMS and its use throughout the organization. This means educating employees about business objectives, giving them insight into customer satisfaction, and teaching them how their work relates to the work of other key groups. This information can lead to higher quality and better performance as each employee learns how their work is affected by and affects others.

3.5.4 Job design considerations

The characteristics of job design are discussed above. Special care needs to be taken with scanning and indexing jobs created by EDMS systems along with how these technologies can change aspects of the "process". Many organizations have given the tasks of scanning/indexing to single individuals. While this approach appears to be efficient, it does not lead to the creation of motivating jobs, and performance may not meet expectations. Wherever possible, these functions should be combined with other functions to create a single job with an appropriate amount of skill variety. At the very minimum, a rotation schedule should be set so that no one individual is doing just one task constantly.

Remember that scanning and/or indexing is a repetitive job. The more the indexing portion of the process can be distributed, the better. Organizations that use an indexing model utilizing various resources rather than one or two people have greater throughput and typically greater quality control. The quality control improves as it is easier to establish quality control processes with multiple people available to check and correct when necessary, rather than having the primary indexer also perform the quality control check, or index verification.

3.6 Use of consultants

How can these recommendations be implemented? Many managers feel that they have neither the time nor the expertise to manage the human and organizational issues during EDMS installations. The solution is to staff the project team adequately. Most teams are composed of an EDMS specialist, management representatives, representatives from the information technology (IT) group or department, specialist, and "champion users" from the end-user department(s). The EDMS specialist can benefit the team by

a) maintaining confidentiality during the organizational assessment phase,

b) providing an objective, third-party view of the organization,

c) providing subject matter expertise,

d) keeping focused,

e) identifying potential risk related items associated with project progress,

f) assisting the management to identify risk items,

g) highlighting non-technical issues as they arise, and

h) providing expertise to take on major tasks such as

    1) designing and facilitating strategic planning sessions,

    2) conducting organization assessments, and

    3) designing the change management program.

EDMS/ECM consultants or specialists should have experience evaluating, selecting, designing, and implementing EDMS/ECM technologies. If the organization does not have available internal resources with this level of experience, it is important to have a qualified EDMS/ECM consultant participating as a subject matter expert. It is unwise to expect general IT consultants, others who have neither the experience or expertise with EDMS/ECM technologies or understand the intricacies of how these technologies operate and what to consider through all project phases. Some examples of suitable qualifications are the following:

— substantial experience analysing, evaluating, selecting, designing, and implementing EDMS/ECM projects;

— training and education through EDMS/ECM related industry associations that are vendor-neutral in nature;

— excellent analysis, group facilitation and training skills.

3.7 Time management

A lengthy project is dangerous because nobody sees the end. Define steps that can be achieved in a reasonable time. Development of a project plan that all affected users and departments follow is critical and should be prepared with the input of all members of the management team. This will ensure that other organizational activities and projects are scheduled preventing “project overload” and/or different projects competing for the same resources. When competing projects occur, all projects suffer and enormous stress is placed on the users and members of the management team to not only complete the projects, but also continue to complete day-to-day business activities. Recognizing that the organization will continue to have day to day business operations, the project planning should be developed to minimize any potential adverse impacts.

3.8 Backfile conversion

A key issue is the archives; i.e. is it useful to convert the past? There are three standard approaches as follows.

a) Digitize nothing: paper archives are kept in papers; only new papers are digitized; also referred to as “day-forward” conversion.

b) Digitize everything; all archives are converted into digital format; also referred to as “full backfile” conversion.

c) Mixed of the two previous approaches (digitize if the document is needed); also referred to as “as-needed” conversion.

The choice is not easy and should be based on the organizational requirements and needs. The choice should be justified and explained to all employees.

Other key questions that should be asked are related to the disposition of paper copies after conversion are:

— Should they be destroyed?

— Can they be legally destroyed or are there rules/regulations/legal constraints that require permanent storage in their original format?

All these questions should be reviewed by the organization and carefully considered prior to selecting how to approach any backfile document conversion effort.

3.9 Project objectives and goals

Project objectives and goals should be defined before starting the project. The project objectives should clearly define the expectations of management, end-users, and the information technology (IT) staff. Not every objective will be related to all people participating in the project. For example, the project objective to have a single EDMS platform for the entire organization primarily affects the technical support (IT) team, and not necessarily the end-users as long as the user interface meets the user requirements. Another example would be for a project objective to be to reduce time spent copying, printing, and manually routing documents. This objective clearly affects the end-users and can't be managed by the technical support (IT) team.

When defining the project objectives, it is important to ensure they are clearly defined and there is a clearly defined method used to determine whether the objective was, or was not, met.

The project objectives and goals should always be shared with the end-users to ensure they understand why the project is being undertaken and the anticipated benefit(s) the organization expects to achieve from the selected technology. During these discussions and during process discovery, it is important to work with the users to define project goals from the user perspective along with goals of process improvement, decreased processing time, decreased manual processing costs, etc.

4 Usability and ergonomic interfaces

4.1 General

This clause provides a framework for evaluating the ergonomics of user interfaces associated with EDMS systems.

4.2 End-user analysis and usability

To tailor any image application to fit user behaviour, the developer should understand the general capabilities and limitations of the human being in the areas of perception, learning, memory, and attention. This analysis is a fundamental component of the re-engineering process associated with the move from conventional paper processes to EDMS systems implementation. It is extremely important for the organization to ensure that they have performed detailed end-user requirements analysis from the EDMS technology perspective to ensure the implemented system meets the needs of the users and does not force the users to unnecessarily change the business process simply because the selected product does not provide the level of desired functionality. All current EDMS solutions provide mechanisms for the end-user organizations to customize/configure the user interface(s). While many EDMS vendors encourage end-users to use an “out of the box” user interface, it is always recommended that the end-users consider whether a customized/configured interface would better meet the needs of the organization.

The consumer of EDMS systems technology should carefully review EDMS system vendor or EDMS consultant proposals to ensure the inclusion of a system-specific end-user analysis. This analysis should be the basis for conceptual design of the system's user-interface as well as the criteria for usability verification testing.

4.3 Ergonomic criteria for selection of EDMS systems

4.3.1 Fundamental qualities

The principles in this section are based on five fundamental qualities that make application interfaces usable and easy to learn. These five qualities follow

— consistency,

— simplicity,

— flexibility,

— user control, and

— system responsiveness.

4.3.2 Consistency

4.3.2.1 To design for consistency means to produce an application that is predictable in appearance and behaviour. Consistency in user-interface design has two dimensions:

a) internal consistency;

b) external consistency.

Internal consistency refers to consistency of look and of behaviour of screens throughout the application (and even across applications). *External consistency* refers to the users' conceptual model of how an application should work. The user interface should confirm the conceptual model by providing the outcome users expect for any action. This occurs only when the application model is the same as the users' conceptual model.

4.3.2.2 Consistency is also fundamental in the case of a multilingual context:

— translation of user-interfaces is easier to produce;

— training is easier to address, but equally as important.

4.3.2.3 Consistency in user interactions

— reduces the memory load on the user,

— reduces the time it takes to learn the application,

— enables the user to perform tasks more quickly and easily, and

— minimizes the confusion of the user who should navigate between multiple applications.

4.3.3 Simplicity

To design for simplicity means to produce an application that the user finds both easy-to-learn and easy-to-use. The fewer concepts, commands, and menus the user should know or traverse to perform an operation, the simpler is the operation for the user. Keeping the user interface simple to use and easy to learn enables the end-users to focus on using the EDMS tools to perform work activities. Another advantage to keeping the application interface simple and not over-loaded with graphics and complexity is associated with accessing the system via non-dedicated communication lines such as wireless communication over long distances.

4.3.4 Flexibility

Flexibility in an application is reflected in how well the application responds to the needs of different kinds of user expertise. The EDMS vendor should be able to quickly customize/configure the user interface to meet new and changing user needs and requirements. This flexibility ensures that the organization is able to address new and changing business needs and requirements without being forced to either redesign an entire user interface, or not incorporate other functionality simply due to the limitation of the existing user interface development/integration tools or development libraries.

4.3.5 User control

User control is the degree to which the user perceives himself or herself to be directing the interactions within the application. In general, the more the user feels in control, the more satisfied with the application he or she feels. Users should be allowed to initiate actions and control the interaction, including terminating any command, easily reversing or undoing unwanted actions, or setting the pace of interactions. Users should be able to produce reports or generate EDMS queries without the need to begin a development effort. This user-control capability should also include the ability for a user to save individual reports and/or EDMS queries for future use without requiring specialized training.

4.3.6 System responsiveness

System responsiveness is the degree to which the system responds to the user's input. Whenever a user performs an action, the system should, at minimum, provide basic feedback acknowledging the user's command. The system should never leave the user wondering whether the system has accepted his or her input. This responsiveness is especially critical when long delays (in excess of 2 s) occur between screen transmissions. Ergonomic studies have shown that displaying some visual indicator of progress (such as an hourglass) greatly increases the user's acceptance of variable length delays.

The impact of system delay varies greatly depending on the task. EDMS applications used for document management work generally have tolerances for longer delays than non-EDMS systems dedicated to high-speed data entry. EDMS systems dedicated to high-speed data entry should have the ability to display images faster than the human operator can process them. Exception-based delays should always be accompanied by some visual acknowledgement or status message.

4.4 Software usability check-list

The following software usability check-list provides explicit usability criteria for software development and selection. Although these usability heuristics are not EDMS-specific, they are relevant to EDMS applications.

When evaluating EDMS software interfaces, ask the following questions to ensure that related criteria are satisfied; usable interfaces fulfil these criteria.

a) *Is display information organized and presented in a clear and useful manner?* Criteria include whether

   1) the information appears in an expected, natural, and logical (task) order,

   2) the readability is optimized (text is of mixed case, use of abbreviations is minimal, and menus and user-entry areas are visually distinct from other displayed information),

   3) the command names or menu items are meaningful and distinctive,

   4) the use of colour is appropriate (four or fewer colours are used consistently, and an optimal contrast combination is used),

   5) when available, on-line help or documentation is formatted for easy scanning,

   6) the pull-down menu options are formatted as single column lists and logically grouped, and

   7) the irrelevant or rarely needed information is displayed on request only.

b) *Is the language of menu items, commands, error messages, and on-line help appropriate?* Criteria include whether

   1) the language uses task-related terms familiar to the user rather than system-oriented terms, and

   2) the language does not use jargon that is difficult to understand and translate.

c) *Does the application minimize the amount a user should remember?* Criteria include whether

   1) the information appears in a familiar and directly usable form,

   2) the application does not require the user to remember information from one display to another,

   3) the application visually maintains the conceptual thread when a procedure requires that the system display ancillary screens,

   4) at the user's request, the application provides prompts for command syntax, and

   5) the application makes available text labels for screen icons.

d) *Is the user interface consistent?* Criteria include whether

   1) the user interface uses the same term for a given item, action, or concept throughout the application (very important in case of a multilingual system),

   2) the user interface is consistent in the format and placement of information in the displays,

   3) the user interface provides a standard display area for command entry, and

   4) the user interface makes the behaviour of objects on the screen consistent with the user's mental model.

e) *Does the application provide sufficient feedback?* Criteria include whether

1) the application highlights items that are selected,

2) the application acknowledges processing delays,

3) the application informs the user of the success or failure of a requested action, and

4) when an error does occur, the application provides understandable information that includes both a statement of cause and a suggested remedy that the user is able to perform.

f) *How easy is it to navigate and exit the application?* Criteria include whether

1) the application provides a home menu or display,

2) the means of navigation is visually distinct,

3) the structure of the application is optimally organized for the most common or most important user tasks and reflects a natural sequence (according to experience, cultural norms, and the like),

4) the menu structure does not require the user to transverse more than three levels to perform a task or to access information,

5) the user can return to the next higher level of menu with a single keystroke,

6) the user is able to exit at any point in the application, and

7) the means of exiting is clearly identified.

g) *Does the application provide shortcuts for the knowledgeable user?* Criteria include whether

1) the application allows the user to abbreviate command names, and

2) the application allows menu selections to be bypassed with command entry or rapidly processed keystrokes.

h) *Is the application robust; does it act to prevent unintended results?* Criteria include whether

1) the application requires the user to review and confirm destroy commands,

2) the application requires the user to review and confirm global actions,

3) the data units are clearly defined (meter, inch, mile, $, £, €, etc.),

4) the exiting of the application does not result in the loss of data without confirmation from the user, and

5) depending upon the language and the type of EDMS system, the application may or may not be case sensitive [in some cases, applications accept user input regardless of the character case (upper, lower, or mixed case) and in other cases, applications do not accept input (i.e. international application containing names of Italian, German, French, English, Spanish people or cities)].

i) *Does the application observe human factors principles that make data entry tasks easier to perform?* Criteria include whether

1) the application captures data at first entry (user does not need to re-enter),

2) the application breaks long strings into manageable chunks for data entry,

3) the application does not require the user to enter leading zeros, and

4) when an error is detected, the user needs to rekey only the information that needs correcting.

5 Workplace ergonomics

By their nature, EDMS systems represent a significant change in the workers' environment. Workers who have primarily used paper-based documents to complete their work have developed certain individual routines for working with and managing paper documents for completing their work.

While office environmental conditions (such as conditions of lighting, glare, afternoon reflection, seating, and work surfaces) were adequate or tolerable when work was paper-based, these same conditions may present significant problems to workers who are stationary in front of a workstation for long periods of time. Workers who had a workstation with a low-resolution display and used the workstation infrequently may have been able to avoid or tolerate lighting and physical problems for short periods of use. These same conditions may become intolerable when a worker uses a workstation as the primary means of completing his or her work.

Cognitive ergonomics plays a major role in the design of EDMS systems and in the associated productivity benefits. Human-engineered systems always consider the cognitive processes associated with use of a system or completion of a task. Effective and commonly accepted systems development protocols always begin with an analysis phase. This phase typically incorporates an end-user analysis or process-based analysis that identifies cognitive and physical requirements for the existing work practice. Conceptual models are developed that translate the user's processing strategy or cognitive structure into a framework used as the basis for the new user interface design.

Cognitive ergonomics plays a critical role in the development of user-centred computer interfaces. Human engineered interfaces reflect an understanding of user behaviour, knowledge, and preferences.

6 Use of change management for EDMS success

Focusing on technology alone will not ensure EDMS success. Avoiding the human and organizational aspects of EDMS can lead to disappointing results.

The positive and negative potential of EDMS to impact individuals and organizations is enormous. Not only can EDMS change workflows and speed transactions, it can also be a catalyst to enhancing jobs, improving organizational structure, and developing a more committed workforce.

By enhancing project plans to include strategic planning, organization assessment, and change management, all resting on the foundation of user participation, the promise of EDMS can be transformed into reality.

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