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THE MODEL OF THE DOCUMENT MANAGEMENT SYSTEM IN THE PUBLIC SECTOR

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Abstract: *Modern solutions regarding the use of unstructured information are based on the concept of Content Management (CM)*, [08] and [09]. *This is a good solution for those document contents that will be generated once the CM is in place, but the question remains of what to do with hundreds of millions of documents that have been generated over the course of many years in the public sector.*

This article analyzes some of the features of the existing document systems in the public sector, and then discusses the needs of business processes reengineering, which are concerned with generating official decisions of relevance for both individual and business end-users. Furthermore, we propose a practically feasible model for the Document Management Systems (DMS) design, based on modern information and communication technologies that can manage and support the use of documents already in the system. In the end, this article takes a look at a general model for the calculation of costs and benefits associated with an introduction of a new DMS.

Keywords: *Document Management System, DMS, public sector, imaging.*

1. CURRENT STATE OF DOCUMENT SYSTEMS IN THE PUBLIC SECTOR

An analysis of the current document systems, which has been carried out in a number of the governmental institutions and public services (jointly: public sector - PS) in Croatia, yields an objective picture of the existing document-related processes, examines the role of the IS related to the generation and use of those documents, and clarifies the differences between the document systems in the public sector and for-profit organizations. Generally, it can be said that the analyzed document systems have reached their limit in terms of capability, such that it is no longer possible to operate in the same way without jeopardizing business efficiency and effectiveness of processes carried out in those organizations. The current situation can be described in terms of several parameters:

a) Individuals and businesses are the end-users of services provided by PS. They file their claims to the various national or county administration bodies, or decentralized departments in the public services. Some institutions receive over 100,000 such claims per year. Each claim must be accompanied by additional documents and is processed in accordance with an administrative procedure. The claimant's file is used in the process, and the output of the procedure is a new file or *decision*. All documents submitted with the claim, as well as all documents from prior procedures are stored for between 10 to 80 years depending on legal stipulations.

b) Client work is organized by the principle of specialization of administrative officers in PS and the segregation of duties. A collection of documents (or a dossier) needed to resolve a particular claim circulates between various departments or posts, and each step in the process is recorded on the dossier cover or computer. This type of organization of work (set up by Taylor and Ford back in the first half of the twentieth century) has some advantages: specialists carry out certain steps, while the flow of the dossier is monitored so the files do not get lost easily. However, this setup is bad for the clients as they have no access to the status of their claim, are unable to refer to any officer in particular, and yet are requested frequently to submit additional documents to substantiate their claims. That is why some cases may take very long before they are settled.

c) The volume of the documents on file has been steadily increasing, such that some public services in Croatia hold over 100 million documents, with an annual trend of increase at the rate of 3% to 5%. The maintenance cost associated with such document systems grows more as in linear fashion.

d) All documentation is not archived. However, functionally speaking a distinction needs to be made between the documentation that is actually archived and the documentation that is temporarily filed away and can be retrieved at any time in the claim process. In reality, both of these processes are carried out in more or less the same way, as prescribed by the general act and specific regulations governing each business activity. All business documentation in for-profit organizations is almost always eventually archived, while in PS it is temporarily filed away before eventually being archived and is repeatedly used over a long period of time in the processing of various claims.

e) The public sector works with a large number (1000 and over) of various types of documents of highly unstructured content, while the for-profit sector works with a significantly smaller number of well structured documents (e.g. payment orders, purchase orders, checks, etc.). These differences will affect greatly the design of the document management system.

f) Paper is most commonly used as the basic medium in document storage, and so is microfilm though to a much smaller degree. Paper documents that refer to the same person are filed in the same dossier and arranged in

chronological order, which is difficult to maintain. Microfilm contains documents of the same kind (regardless of who these documents are associated with), which are ordered by microfilm number. In for-profit organizations, all documents of the same type are stored together mostly by date of creation regardless of the document storage medium used.

g) In PS organizations that work with clients, many of the dossiers contain unnecessary documents (e.g. notes and calculations, multiple copies of one document, decisions on previous claims, etc.). Also we should add here all those documents, which have been stored without real need in those government bodies where a client submitted a claim but which was generated in a different body.

h) Just as the bodies in the public sector are not located in one central place so that they could provide greater access to clients, so too the archives they use are decentralized. This is another important point of difference with the predominantly centralized archives in the for-profit sector, which also will affect the design of the document management system.

i) The existing IS in the public sector have been designed primarily to meet all legal regulations on document archiving, rather than support the processing of claims raised by their clients.

j) The consequence of the aforementioned characteristics is that all the existing document systems in PS are very costly and not efficiently enough, and the efficiency will drop even faster as the volume steadily continues to increase. Storing paper documents is very expensive, as it demands the use of large high-quality facilities. The cost goes up even further due to extensive manipulation, because for each claim case the documents need to be retrieved from the archive, updated with new documents, and returned to the archive. So the overall annual cost of some of the existing document systems in PS in Croatia exceeds 2 million €!

The above description shows that the documents and document-related procedures applied in PS greatly differ from those in the for-profit sector. It is to be expected then that the organizational, technological and technical solutions for document systems also greatly differ, given that the same solution cannot be applied at the same time to two different claim types.

2. NEW DOCUMENT MANAGEMENT SYSTEM IN THE PUBLIC SECTOR

Some of the for-profit organizations today have extremely well organized document storage systems, which use a combination of modern ICT and the microfilm. However, it would be wrong to presuppose that identical solutions will yield equally good results in the public and private sector, although they might function technically well in both. Solutions applicable to for-profit document systems cannot be copied over to PS, because archived documents are neither frequently used in for-profit organizations nor are they used in key business processes. On the other hand, document systems in PS must work with documents

that are used daily in the provision of services to individuals and businesses alike. In fact, this is the core business of such organizations – it is their fundamental mission! Other major differences are described in greater detail in the previous section.

Additional arguments for the statement above can be deduced from the strategic analysis of benefits modern ICT has on business processes in the public sector. Here the analysis was done with the help of McFarlan's BCG matrix and is shown concisely in Figure 1.

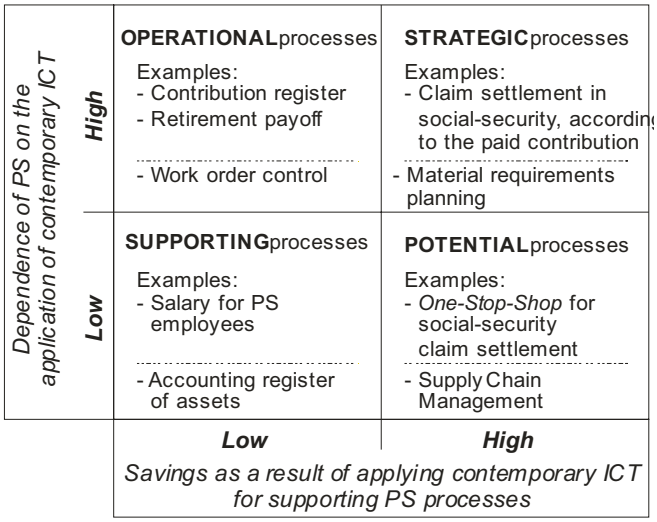

Figure 1. Strategic position of some processes in PS and in for-profit organizations

The analysis must be carried out for each organization separately. However, Figure 1 gives a general overview, exemplar processes are taken from retirement insurance (as it is typical for public services) and imaginary production for-profit organization. In the above BCG matrix business criteria are sorted according to two criteria: (a) potential savings as result of application of modern ICT and (b) the extent to which the processes are dependent on the application of ICT. Example processes referring to retirement insurance are located in the top half and those of a production for-profit organization in the bottom half of each square. Each of the fields will be filled with a number of processes on which ICT has a similar impact:

Supporting processes are those processes where anticipated savings are small and whose efficiency is lightly dependent on ICT. The support for processes of this kind comes in form of applications, which are not critical to the organization.

Operational processes are those processes, which virtually cannot be carried out without ICT, although the application of ICT here does not result in major savings. For these processes each organization must use ICT, because without it the operations could not be carried out effectively.

Potential processes are those processes, which are currently not highly dependent on the application of ICT, but implementation of ICT here in the future

could yield great savings. These processes should be taken into account when planning a further implementation of ICT.

Strategic processes are those processes whose effectiveness depends on the application of modern ICT, and have a large impact on the reduction of costs in an organization. The implementation of ICT in these processes must be an absolute priority of every organization.

The above analysis shows that the working with large volumes of archived documents (financial documents, payment orders, etc.) in for-profit organization is concentrated in the support processes. On the other hand, daily use and management of large volumes of documents in a PS organization is related to strategic processes, where the provision of services to individuals and businesses is based on data from extensive documentation that was being collected for a significant period of time.

A different nature of the document systems in two different types of organizations (for-profit and PS) calls for different improvement strategies:

a) Improvements to document systems in for-profit organizations can be made autonomously («insular» IT implementation), and the introduction of new ICT does not necessitate transformation of core business processes. This approach is typical of support processes.
b) Improvements to document systems in PS cannot be done merely introducing of imaging technologies, but to be effective the solution must integrate all business processes. That means that a new solution for PS must be designed as an integrated Document Management System (DMS) and strongly linked with the core business of non-profit organizations.

The process of building a new DMS in the public sector must be carried out in accordance with the principles of Strategic Planning of Information System, in [01] and [02], and be compatible with the implementation of ICT in strategic processes. This process is carried out in three interrelated stages:

1. Carry out Business Process Reengineering (BPR) of all key business processes. In effect this means that legislation governing PS must me amended as well.
2. Following reengineering stage, new imaging technologies need to be used. That encompasses a set of the interrelated steps: document capturing with a digital camera, optical character recognition (OCR), storage of the digital image in computer's mass memory and the linking of the digital image with the client database (CDB) on the object the digitalized document is associated with. Since the laws in Croatia right now recognize only microfilm reproductions as equivalent to the original, in some cases microfilming of documents might be required.
3. The existing information system must be modified in such a way that it can directly support new business processes after the reengineering and take full advantage of all the features offered by new information and communication technologies.

In this article we shall focus only on those methodological procedures of business process reengineering and modeling which are carried out in the first stage.

2.1. CONCEPTUAL MODEL FOR NEW DMS IN PUBLIC SECTOR

A general DMS concept is shown in Figure 2 using technique, which is also known as «rich picture».

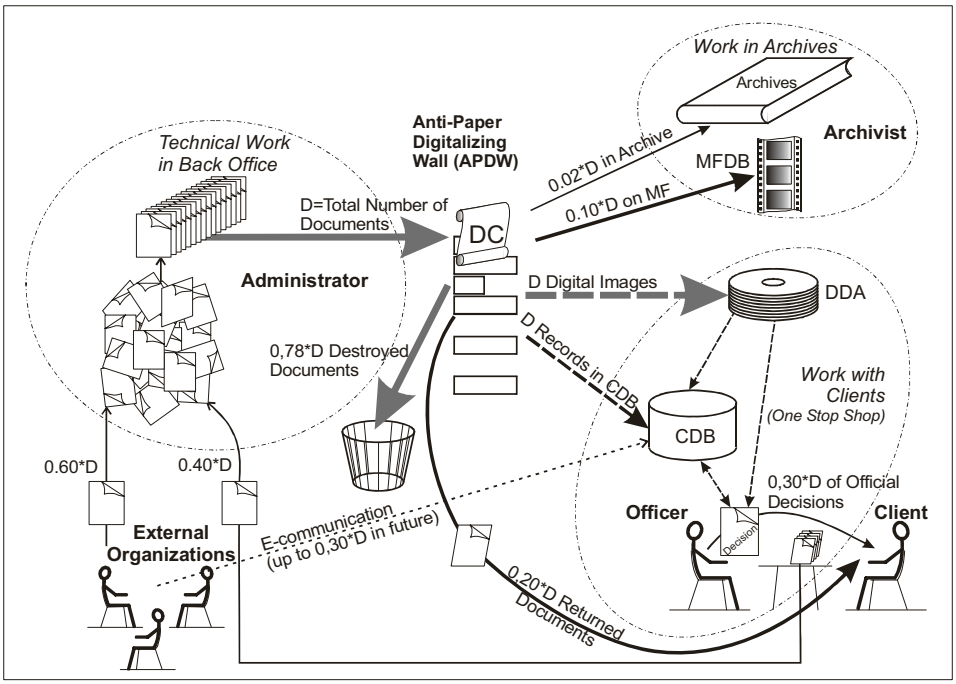

Figure 2. General concept of proposed DMS

Figure 2 is a meta-model of the modern DMS and shows a general document flow. It describes the target state which project implementation needs to attain, while the transition from the actual to the target state is considered separately. The figures provided next to each particular flow in Figure 2 should be read as shares in the overall document volume **D** that appear in annual operations of the PS organization under analysis.

To understand the model it must be noted that the plan envisions the complete transformation of business processes. The existing organization of work will be replaced by a new one-stop-shop business technology, which permits better utilization of the modern ICT potential. In terms of practical implementation this means:

1. A three-person team comprising an *officer*, an *administrator* and a *legal expert* will carry out all client work. The job titles differ from the actual to emphasize the difference between how the work is carried out now and how it will be in the future. Each team is assigned a specific number of

clients it works with, and each client makes all claims through his team only.

2. Operational work with clients is kept separate from specialized work, which is done in the *Back Office*. Each team, if necessary, will set up a contact between its client and the specialist and register the documented opinion of the specialist relating to the client's case.

Each team member, according the *one-stop-shop* principle will have a clearly designated role:

a) *Officer* is the front-end person on the team in charge of client contact. He receives client claims and provides information, completes documentation, maintains data about the client and drafts decision proposals. The officer uses a computer, has access to client documents in the digital document archive (DDA), and the right to update the data about the client in CDB.

b) *Administrator* is concerned with offering technical support to the team. He selects and digitalizes documents adhering to the scenarios set forth in the document catalog (DC) and is responsible for the whole documentation fund in the DDA, on microfilm or in the archive.

c) *Legal Expert* is the team leader. He plans all steps in the claim process, organizes activities that require specialist assistance, sees to it that the decision is legally sound, signs it and issues final decisions.

All documents in the PS come from one of the two sources: (1) the client (who is depicted in Figure 2 with a symbol in the lower right-hand corner) and (2) from external organizations (employers, public institutions, various state administration bodies, courts, etc.) which are shown as a group of people in the lower left-hand corner. Clients bring in the documents, which are taken and checked by an officer, who forwards it to an administrator to digitalize it. It is the officer's duty to prevent unnecessary and superfluous documents from entering the organization. The documents from external organizations refer to a larger number of clients, and are hence forwarded to the administrator, who will sort, digitalize and make them ready for use. Currently most of the external-organization documents are paper-based and need to be gradually replaced by email, so that it can be expected that in the future at least half of all external-organization documents (or 0.30***D**) enter the DMS via email [03].

The administrator will digitalize the documents once they have been received and sorted. In this way a sort of barrier is formed preventing a further inflow of paper documents, termed here as *anti-paper digitalizing wall* (APDW). This "wall" enables operational tasks related to client claim processing to be carried out on the digitalized equivalent of the paper-based original only. The APDW concept symbolizes here all those technological solutions whose use will ensure that the received paper documents are handled in one or more of the following ways:

a) All of the **D** documents received will be digitalized and their digitalized equivalent will be created and stored in the digital document archive (DDA).

b) The address of each digital document stored will be entered in a client database CDB and linked with the client computer-based record the document refers to. Data contained in the document will be used to directly update the respective record in the CDB, or using the OCR procedure from standardized documents.

c) In the process of digitalization *analog equivalents* of some documents may be created. They contain data contents that prove legal validity of each decision issued, «go through» the APDW and are stored in the microfilm database (MFDB). No more than 10% (0.10***D**) of documents should be handled in this way. Microfilming can be considered a temporary solution until the legislative changes are effected, which will consider document reproductions from a digital image equivalent to the original.

d) Some of the documents listed under c) are of special import as archival materials, which must be captured and then stored in original form in accordance with the law. No more than 2% of the overall number of documents in PS will fall under this category (0.02***D**).

The procedure described necessitates that each document type be unequivocally defined in terms of rules of handling in the special «Document Catalog» (DC). The DC will contain the definition of each document type and all procedures with document, i.e. it will set forth the scenario for each individual document. This scenario can be entered into equipment for imaging and automated. The logical mechanism on DC use is explained in article [04].

In processing the client claim an officer will no longer work with paper documents, but exclusively with data available at the CDB and digital images of the original paper, stored in the DDA. Also, according to this model printouts will be done for a client only, because all decision-related data will remain in the CDB, thus forming a historical record of changes for that client. This will eliminate the unproductive *setup* time (spent on carrying dossiers from and back to the archive and ordering of documents so they can be used) and the time it takes to process a claim will be reduced significantly.

A microfilm database (MFDB) will be used only when there is a need to prove legal soundness of a particular claim-related decision. This is a temporary solution until the reproduction of digitalized documents becomes considered legally authentic in Croatia.

In the future, ordered archival materials will not be used in the operational work in PS, but only the digital equivalents of documents in the DDA. In this way valuable documents will be preserved in source form, which after all is an actual purpose of an archive.

The general model shown here is applicable in all PS organizations. Of course, documents vary in content and claim procedures are governed by different sets of regulations. However, Figure 2 is always applicable to all document flows, and the differences need to be built into different scenarios for each document type and present in the items of DC, each of which is PS organization-specific.

2.2. WORKFLOW MODEL FOR NEW DMS

The general concept of the new DMS in Figure 2 is explained in more details in workflow diagram [05] in Figure 3. For sake of clarity, business processes have been divided into three groups and marked in different manner: client processes are white, document processes are gray and IT processes are with written in capital letters. Some of the processes include decisions, so they are shown as diamonds containing the issue to be decided on. The roles (or actors) are shown as *swim lanes* with titles in the upper left-hand corner, and the processes have been placed on that role which performs (or is responsible for) them. Document flows are depicted as solid arrows, data and information flows with broken-line arrows. The marking is consistent throughout the text and in picture. That is why processes are in **bold**, documentation and information in *italics*, and roles in ***bold and italics***.

A ***Client*** comes to a local PS unit to **Request entitlement or service** and so, with his *Claim and documents*, he will go see an ***Officer***. The officer will check the client's identity and **Record the claim and start the procedure**. In doing so he will enter *Data on client and claim*, just opened, into the CDB and give *Feedback information* to the client on how the claim will be handled and how long it will take to issue a decision.

A ***Legal Expert*** is informed that a new case has been opened on the basis of *Data on client and claim*, which appear on his computer screen whenever he logs in. The legal expert will evaluate the claim on the basis of data he has and **Determine the steps of solving process**. To do this he can use one of the standard claim scenarios (stored in the computer), or he can plan a new scenario if the client claim is unique. In each case he will have to register the chosen scenario as *Steps of solving process.* Each claim scenario is made up of a sequence of steps, each step provides description, person responsible and time allotted. This will create the preconditions for case monitoring.

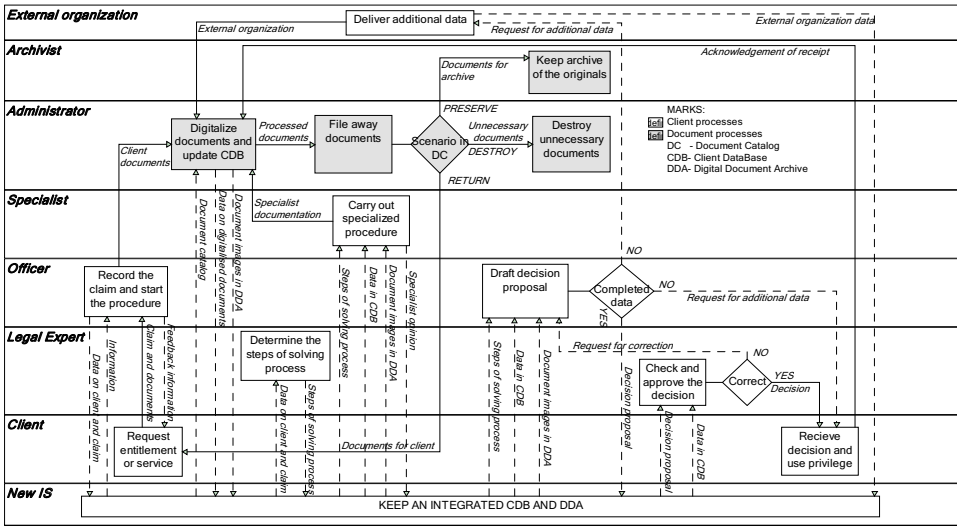

Figure 3. Workflow Model for PS Using New DMS

Each actor involved with the case (***Officer, Specialist***) will receive on-screen instructions on what to do. If so planned in *Steps of solving process*, the ***Specialist*** will **Carry out specialized procedure**, and enter *Specialist opinion* in the CDB. If the data required to process the claim is complete, the ***Officer*** will **Draft decision proposal**, otherwise he will determine what is missing and send *Request for additional information* to the ***Client*** or ***External organization***. Completeness of information is checked on the basis of *Data in CDB* and *Document images in DDA*. On the basis of complete data the ***Officer*** will *Decision proposal* and enter it in the *CDB*.

The ***Legal Expert*** monitors activities related to claim procedure**.** When a new *Decision proposal* appears on his screen, he will **Check and approve the decision**. If he determines that the *Decision proposal* is incorrect, he will give the ***Officer*** *Request for correction***,** otherwise he will print out the final *Decision,* sign it and send it to the ***Client***. The ***Client*** will acknowledge the receipt of *Decision* with *Acknowledgment of receipt*, which is returned to the ***Administrator*** for registration.

In addition to these, there is another group of processes, which refers to ongoing, gathering and recording of client-related data and documents, and is done for the duration of the entire lifecycle of the client's dossier. These processes are marked in Figure 3 in gray. There are two main incoming document flows for those processes. The first originates with the ***Officer*** or the ***Specialist*** and carries documents that come up during the claim process (*Client documents* and *Specialist documentation*). The other originates in external organizations and in Figure 3 it is shown under *External organization documents.* Both document groups go to the ***Administrator***, who will **Digitalize documents and update CDB**, in accordance with the instructions for each document in the *Document catalog* (DC).

Once digitalized they become *Processed documents*, and go to the process **File away documents**. This process unfolds according to the scenario described for each document in the DC. Generally, three things can come up: (1) The digitalized documents belong to the ***Client*** and must be *RETURNed* to them, thus giving rise to the *Documents for client* flow (according to Figure 2 around 20% of documents could fall under this category); (2) The majority of documents once digitalized need not be kept in source form, but should be *DESTROYed* as *Unnecessary documents* in the process **Destroy unnecessary documents**. According to Figure 2 there could be up to 80% of documents of this kind; (3) Finally, a small portion of documents constitutes valuable archival materials, which once digitalized need to be *PRESERVEd*. These *Documents for archive*, which we estimate should not exceed 2 %, enter the process entitled **Keep archive of the originals**, which is done by an ***Archivist***.

The processes in the second group, which deal with data and documentation, represent the functional aspect of a concept that in Figure 2 is introduced as *Anti-paper digitalizing wall* (APDW).

All of the processes in the described document-based procedures unfold with a strong ICT support, which is shown in Figure 3 as the process entitled **Keep an integrated CDB and DDA**. The logical structure of the client database (CDB) and

the digital document archive (DDA) are not described here in detail, but only a working definition is provided:

- CDB is an integrated, normalized, non-redundant, and optimized database that contains all data on clients, client-related events and transactions, and which must be the only data resource for the unfolding of processes in PS.
- DDA is an archive of digital images of original documents. Each document will be captured only once, and in the process of digital capturing an analog version on the microfilm may be produced as well. Operations on each document are described in the DC. An address system used for image saving allows that the same digital image of a document be linked either with the person it refers to or with the claim process in which it will be used. DDA is the only source of information on documents used in the operational work.

3. COST/BENEFIT ANALYSIS FOR NEW DOCUMENT MANAGEMENT SYSTEM

To assess the cost of introduction and benefits associated with the new DMS is more complex than the literature of those companies that manufacture hardware and software components for the DMS would have us believe [08]. These are, so for, three major reasons for that:

- Organizations with already a large volume data opt for a new DMS, so we need to figure in additional costs of data migration to e-media,
- DMS calls for a change in the core processes in public-sector organizations, so the introduction of the actual DMS must be preceded by business process reengineering, which incurs additional costs, and
- For reasons mentioned above the introduction of a new DMS last several years, which means that the benefits are greatly delayed as compared with the time of the actual investment.

The cost/benefit model will encompass a total of n years from project kick-off. Within this period hardware will be a cost item for h number of years, licensed software for s number of years, user programs (applications) for a number of years, specialist involvement in BPR for x number of years, new DMS training for e number of years, and the digitalization of old data for d number of years. The following applies to the above time periods: $x < s < a < e < h < n$ and $d < n$, which means that BPR should be the first investment, followed by training, etc.

Costs incurred by implementation of a new DMS can be broken down into the following components:

1) Total costs of investment in hardware C_H, software C_S, applications C_A and experts for BPR C_X are calculated as sum of annual investments for the analyzed period of n years.

   Total hardware cost C_H is calculated using the list of necessary DMS resources. Hardware can be purchased gradually within the first several years

from the project kick-off date. Total software costs (C_S) refer to the purchase of licenses for particular software, delivered by DMS equipment manufacturers. They are incurred gradually as are the costs C_H, but within a shorter period of time.

Total cost of user applications (C_A), including modifications to the existing IS, incurred early in the project. Total cost of experts (C_X) are linked with BPR and implementation of new DMS. These costs are incurred in the very early stages of project implementation.

The period of investment differs for each particularly type of cost, so the following applies:

$$C_H = \sum_{i=1}^{h} Ch_i \; ; \; C_S = \sum_{i=1}^{s} Cs_i \; ; \; C_A = \sum_{i=1}^{p} Ca_i \; ; \; C_X = \sum_{i=1}^{x} Cx_i \qquad (1)$$

In the expressions above Ch_i, Cs_i, Ca_i and Cx_i are annual investments in the *i-th* year of the project, related to hardware, software, applications and experts, respectively.

2) Annual cost of depreciation and maintenance Cr_i is proportional to the installed hardware and grows throughout the hardware investment period, but becomes constant afterwards. If p is annual depreciation rate in [%] (including regular maintenance) then total cost of depreciation and maintenance C_R for the analyzed period of n years is calculated as:

$$C_R = \frac{p}{100} \cdot \sum_{i=1}^{n} Ch_i \qquad (2)$$

3) The cost of digitalization is proportional to the volume of documentation to be digitalized. This cost is incurred for d number of years, or the amount of time it takes to digitalize the existing documentation. If D_i is a number of documents to be digitalized in i-th year, and c_d is cost of digitalization per document, the total cost of digitalization C_D is calculated as follows:

$$C_D = \sum_{i=1}^{d} D_i \cdot c_d \qquad (3)$$

4) Costs of communication are incurred because DDA and CDB are located centrally in PS organizations, and all equipment, which officers need to work directly with clients, is decentralized throughout local organizational units. If Cc_i is annual cost of communication, the total cost C_C for duration period under analysis of n years is calculated as follows:

$$C_C = \sum_{i=1}^{n} Cc_i \qquad (4)$$

5) The cost of training for staff (see the roles in Figure 2) on new processes and procedures with documents incurred gradually and are proportional to the DMS

implementation dynamics in the decentralized PS units. If Ce_i is annual cost of hands-on training, the total cost C_E is:

$$C_E = \sum_{i=1}^{e} Ce_i \tag{5}$$

Savings will come as result of the use of the new DMS, and can be broken on directly and indirectly measurable ones. Only three components of the directly measurable savings will be analyzed here:

1. Savings on archiving costs,
2. Savings on unproductive manipulation of paper documents and
3. Savings resulting from shorter claim processes, supported by ICT.

1) Savings on the cost of archiving ***Sa*** are calculated as the difference between the cost incurred by archiving methods thus far (***Ca***) and the decreased cost for not-yet-digitalized documents (***Cn***). In any case, the cost is proportional to the amount of documentation used in year ***i*** within the period of ***n*** years. It is calculated as follows: If the current number of documents is ***D***, then it increase each year by factor ***r*** (*0.00 < r < 0.20*), so that in the ***i***-th year the number of documents to be archived Da_i is:

$$Da_i = D \cdot (1+r)^i \tag{6}$$

If a_s is the price of archive space *[€/m2]* and k_s unit capacity for document archiving *[doc/m^2]*, than annual archiving costs for ***D*** documents are generally expressed as:

$$C = \frac{D \cdot a_s}{k_s} \tag{7}$$

If the plan is to digitalize existing documentation within ***d*** years, then this can be done so that each year an approximately the same amount of existing documentation Dd_i is digitalized:

$$Dd_i = D \cdot \frac{(1+r)^i}{d} \tag{8}$$

Once the new DMS is introduced all incoming documents will be digitalized, but the organization will still incur archiving costs Cn_i for those existing documents that have not yet been digitalized. They are calculated for each year using a recursive term (9). The first factor in the term contained in parentheses, shows that each year there is a need to archive as many documents as there are that year (Da_i) reduced by a number of documents digitalized in the previous year (Dd_{i-1}). Therefore, the general term (9), which shows the cost of archiving in year ***i***, is a modification of the general term (7) since it incorporates a number of documents to be archived in that year.

$$Cn_i = (Da_i - Dd_i) \cdot \frac{a_s}{k_s} = \left(D \cdot (1+r)^i - D \cdot \frac{(1+r)^{i-1}}{d} \right) \cdot \frac{a_s}{k_s} \tag{9}$$

If during all ***n*** years the old archiving system alone were used, the total cost of archiving would be:

$$Ca = \sum_{i=1}^{n} D \cdot (1+r)^i \cdot \frac{a_s}{k_s} \tag{10}$$

But if the new DMS is introduced, allowing gradual digitalization over a period of ***d*** years, then the diminished cost of archiving will total:

$$Cn = \sum_{i=1}^{d} \left(D \cdot (1+r)^i - D \cdot \frac{(1+r)^{i-1}}{d} \right) \cdot \frac{a_s}{k_s} \tag{11}$$

Cumulative savings can be arrived by subtraction of term (10) from term (11). Taking into account that in term (11) the summation index goes up to ***d*** and not to ***n*** (because after ***d*** number of years there is no documentation left to archive in current fashion) then, after the term is revised, the total amount of savings on archiving space, over ***n*** number of analyzed years, if the digitalization of old documents is carried out in ***d*** number of years, is expressed as in (12):

$$Sa = D \cdot \frac{a_s}{k_s} \cdot \left(\sum_{i=d}^{n-1} (1+r)^i + \frac{1}{d} \cdot \sum_{i=1}^{d-1} (1+r)^{i-1} \right) \tag{12}$$

A part of the term (12) in brackets shows that amount of savings is dependent on variable ***d***, namely on the amount of time it takes to digitalize the old documentation. If ***D***, a_s, ***n*** and k_s are constant, then it can be simply shown that the amount of savings depends exclusively on the time it takes to digitalize ***d***. If ***d*** decreases the savings go up and vice versa – the savings go down if ***d*** increases. This could certainly be expected. However, term (12) shows a type of this functional dependence (which is not linear), which will allow management to optimize the duration of the transition process.

2) Savings on unproductive manipulation of paper documents ***Sw*** are generated because in the new DMS the employees will work only with digital images of documents and no longer with the originals. These savings are gradual as well and depend on the number of dossiers ***Ds*** still containing old non-digitalized documentation. By deduction, as we did to arrive at (12), we can also calculate the cumulative amount of this savings for the period of ***n*** years, if the digitalization will be completed within ***d*** number of years:

$$Sw = D \cdot \frac{c_w}{k_w} \cdot \left(\sum_{i=d}^{n-1} (1+r)^i + \frac{1}{d} \cdot \sum_{i=1}^{d-1} (1+r)^{i-1} \right) \tag{13}$$

In term (13) two new constants are introduced, which have the following meaning: c_w is average time of manipulation with dossier in old document

system (retrieval from archive, selection of documents, putting back of documents in to the dossier, and return of the dossier to the archive), which is measured in *[hour/dossier]* and k_w is an average hourly wage of an archivist, measured in *[€/hour]*. Of course, it is obvious here as well that the amount of savings on unproductive document manipulation depends on the speed-of-transition coefficient, which is the same as in (12).

3) Savings on shorter claim processes are result of the transformation of business processes and the implementation of modern ICT. Annual savings are calculated by subtracting the average time it will take to process a claim using the new method w_n from the average time it takes to process a claim today w_p *[hour/claim]* and multiply the result with a number claims submitted in a year q*[claim/year]*. If k_q is average hourly wage of an officer working on a claim, measured in *[€/hour]*, than the cumulative savings for the analyzed period of n years are expressed as:

$$Sq = (w_p - w_n) \cdot k_q \cdot \sum_{i=2}^{n} q_i \qquad (14)$$

It should be noted here that the summation index in term (14) starts at 2 (not at 1) and goes up to n, because this benefit can be expected after the first year of implementation of the new DMS project.

The total return on investment (ROI) after n number of years is calculated as the difference between total savings and total costs incurred during the same period:

$$ROI = (Sa + Sw + Sq) - (C_H + C_S + C_P + C_X + C_R + C_D + C_C + C_E) \qquad (15)$$

Figure 4 shows the costs and savings, and how they have been calculated in an actual project where modern DMS was implemented. The value of constants in the model are as follows: a_s = 12 *[€/m2]*, c_w = 7 *[€/hour]* and k_q = 9 *[€/hour]*. The calculation was done using the following values: n=7 *[years]* and d = 5 *[yrs]*. In order to protect investor's interests we are not listing values of the other constants in the model (e.g. D, k_s), so the graph does not contain absolute calculations, but rather the values have been expressed in terms of percentages against the overall project cost.

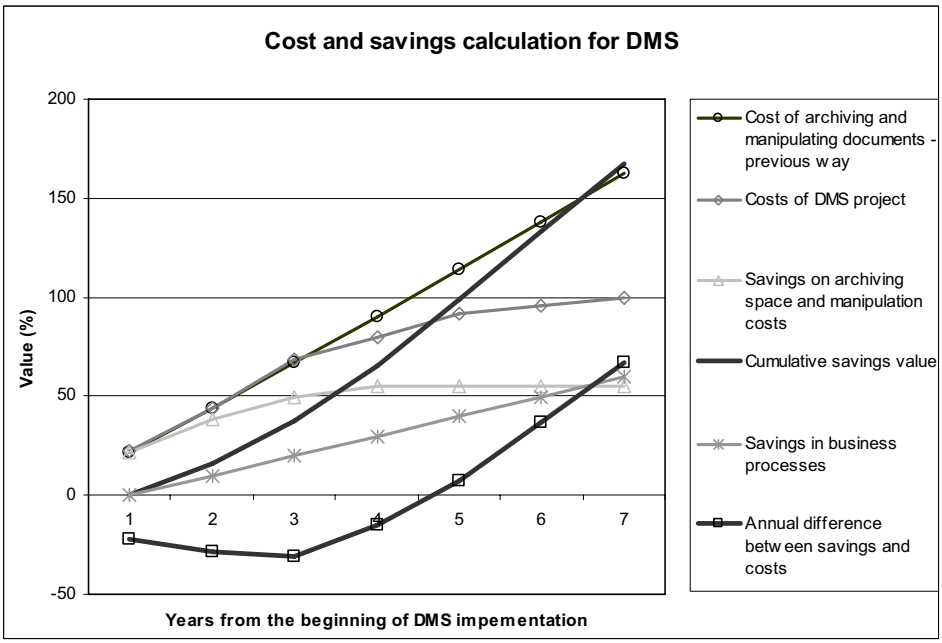

Figure 4. Cost/benefit ratio in an actual DMS project

The calculation was done for a period of 7 years, because we think this to be the shortest period of technical lifecycle of equipment used in the new DMS; in other words, after 7 years equipment must be gradually replaced. The first five curves represent cumulative values. To assess the cost/benefit ratio it is best to look at curve "Annual difference between savings and costs". In the first four years of project implementation the costs (covering implementation of new solutions, digitalization of old documentation and the old manipulation of non-digitalized documentation) are greater on all accounts that the savings. In the first year there are no savings, but in years 2-4 they gradually and rapidly begin to rise. After approximately 4.2 years the total cost equals total savings (the point of ROI), so that in fifth year and onward the benefits are extremely positive.

This analysis shows that investments in DMS can pay off even when measured by traditional financial indicators. Of course, the greatest value of this solution lies in the improved quality of service, which the governmental institutions and public services organizations can now provide to their clients – both individual and business one, and that is what they are here for.

4. CONCLUSION

The importance of unstructured documentation containing large volumes of data which has been gathered over many years and which is indispensable to effective performance of business processes, is very different in for-profit organizations than it is in the governmental institutions and public services organizations (jointly: public sector – PS). Strategic analysis shows that in for-

profit organizations the processes with documentation are **supporting** processes, while in PS this processes are of **strategic** importance. Therefore the implementation of modern information and communication technologies in the two sectors must be approached differently. In PS organizations this means that modern ICT can be effectively used only if business processes are transformed in such a way that they can take full advantage of technological potential. The concept of anti-paper digitalizing wall (APDW) and a generic model of transformed business processes, both of which have been discussed here, provide guidelines for the framework design of a modern document management system (DMS) and the design of all required functionalities in public-sector organizations.

The cost/benefit analysis of DMS shows that additional costs must be taken into account (e.g. business process reengineering and migration of old documentation to new media) as they are not listed in the literature of equipment manufacturers, but also that some additional sources of savings should be looked into (besides archiving space), such as the savings generated by optimized business processes and savings due to elimination of nonproductive physical document manipulation, which can even exceed the space-related savings. Such an extended cost/benefit analysis shows that a new DMS can be profitable even when measured by traditional financial indicators, since the ROI is achieved after four years, while greater quality of service provision for all clients comes out as a clear benefit of a well-implemented DMS project.

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