A systems approach to the Digital Transformation of Public Administration - ARMENIA, CASALINO, GNAN, FLAMINI

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The dematerialization with the progressive increase in digital management of documents and processes, leads to digital transformation redesigning all internal processes to increase efficiency and improve the organizational performance. Digitizing the organization activities, is not a mere replacement of the paper document with its electronic version, means designing and managing all organizational processes in an integrated and collaborative way changing the business models, operational processes, and customer experiences. To understand how digital transformation deeply affects the organizational processes in Italian Public Administration, we use the Systems Thinking (ST) and System Dynamics (SD) approaches to analyze the advantages that be can pursue through the digitalization of their processes, in terms of organizational change, productivity and economic savings.

Introduction

In the last few years, digital transformation has became a new relevant research stream (Casalino et al., 2019; Hinings et al., 2018; Nambisan et al., 2017; Svahn et al., 2017; Yoo et al., 2012) and the debate about dematerialization is now ongoing (Rieger, 2020). The dematerialization of documents, the progressive increase of digital and computerized management of documents and processes, is a key driver of organizational digital transformation. Digital transformation cannot occur without eliminating paper documents and dematerialization without a new digital technologies strategy, which inevitably requires a new organizational business model. Indeed, there is no digital transformation without dematerialization (Armenia et al., 2008).In Italy, for years now, public administrations have been at the center of an impressive series of digital changes aimed at creating structures oriented towards the culture of effectiveness and efficiency. These changes have led to e-Government, which is to say, strong computerization of the public administration, both CPA (central public administrations) level and LPA (local public administrations) level. In Italy, the implementation of e-Government has required the dematerialization of all documents and redesign all internal processes to increase efficiency through cost reduction and rise effectiveness by improving the services offered. In the last three years also some new educational activities aim to meet the training needs of public administrations, companies, and other organization that plan to acquire or train the profiles of the Digital Transition Manager and the Manager of Documents Management System, giving them innovative knowledge on organizational, technological and legal skills (Casalino et al., 2019). To better understand how dematerialization implied an digital transformation and, therefore a more substantial affect on the Italian public administratios'organizational processes, we use Systems Thinking (ST) and System Dynamics (SD) approaches.

The System Dynamics allows us to analyze the behavior of complex systems through their simulation, enabling us to understand the logic with which the process of dematerilization variables interact and the role they play in the digital transformation and overall business system behaviour. In particular, the purpose of this research is to highlight, in the context of a systemic approach to digital transformation, and through System Dynamics modeling and simulation, the advantages that Public Administrations can pursue through the dematerialization of their document and the digitalization of their processes, in terms of organizational changes and economic savings.

The article is organized as follows: section 1 analyses previous research on digital transformation and digitalization and their impact on organizational processes. Section 2 and Section 3 will introduce the key elements for an effective e-Government, especially by describing an important organizational role like the one of the Digital Transition Manager (DTM - RTD). Section 4 will analize the status of digital transformation into Italian Public Administrations (PA). The basics of the SD modeling and simulation approach are presented in Section 5, while a case-study and simulation results are briefly illustrated and discussed in Section 6. Finally, we draw some conclusions and provide future research directions.

1. THE IMPACT OF DIGITAL TRANSFORMATION AND DIGITALIZATION IN THE ORGANIZATIONAL PROCESSES

The term "Digital Transformation" has no a univocal meaning (Hess et al., 2016). New digital technologies

"demand different mindsets and skillsets than previous waves of transformative technology," (Fitzgerald et al., 2014) that in turn transform the organizations (Markowitsch et al., 2002). At the same time, the term "transformation" expresses the comprehensiveness of the actions that need to be taken when organizations face these new technologies. Therefore, digital transformation goes beyond merely digitizing resources (McDonald, and Rowsell-Jones; 2015), it will take place when organizations embrace all the potential of social learning in the design and the process of delivering contents, and it involves a company-wide digital strategy. To ensure that an organization captures the business value of a digital transformation, it should carefully formulate a digital transformation strategy that coordinates the many independent threads of it and helps it to navigate the complexity and ambiguity of identifying its own digital "sweet spots." (Hess et al., 2016).

Every organization needs to manage documents to carry out and support its operational processes (Van der Voet et al., 2004), regardless of what the organizational scope is or what is the contest in which it operates. The totality of documents existing in an organization represents its informative capital. Most of the valuable information in organizations is in the form of documents such as business forms, reports, letters, memos, policy statements, contracts, agreements, etc. (Sprague Jr, 1995). Their gathering, storage, management, and research represents for an organization a considerable cost that becomes even more significant if those documents are in their paper form.

Although different definitions exist, dematerialization refers to the reduction of the throughput of materials in human societies (Van der Voet et al., 2004). In this study, the concept of "dematerialization" indicates the progressive increase in digital and computerized management of documents and processes within public and private bodies, with the consequent takeover of dedicated solutions at the expense of traditional (paper) supports. Digital documents allow money, time and labor savings since, if they are sent, received and stored in electronic format, then they do not have to be transcribed, recorded, inserted in files, classified, moved, and searched between cabinets, drawers, folders, and boxes. Then, the processes become more efficient.

The possible evolution of a dematerialization could be seen not only as a way to define a new strategy but also as a factor that outlines a specific organizational structure. Indeed, the combination of new procedures and new transactions of an organization can be preconfigured by the characteristics of a specific technology. The dematerialization of documents is a key aspect in the digital transformation of an organization as it allows improving internal processes, structures, and working practices of an organization through the application of digital technology, hence improving internal efficiency, effectiveness, rationalization, simplification, and other reform-related goals. The primary enabler to carry out such improvements is the digital and technological environment, including related capabilities and structures established as part of the digitalization stage (Nograšek & Vintar, 2014); radical improvement through incremental steps and high level of participation (Weerakkody et al., 2011); and applying digital technology to support the operations of bureaucratic organizations and functional simplification and closure (Cordella & Tempini, 2015). Not only, but organizations also need to acquire new skills (Davenport, 2013). Today, many jobs include structured, codified, routine, and predictable tasks that are performed by computers effectively. Digitizing the organization activities means designing and managing the entire processes, internal and external (Casalino et al., 2010), in an integrated and collaborative way: it is not a mere replacement of the paper document with its electronic version, but a complete redesign of the process to obtain an increase in financial and organizational performance and an improvement in all operations carried out. As a result, digital transformation changes the business models, operational processes, and customer experiences (Berman, 2012), creating new challenges for individuals and organizations. The shift towards document dematerialization and the practical implementation of the digitalization process requires a step-by-step process and the need for internal adaptation. It is a very complex phase that involves the evaluation of many critical components: redefining some stages of the document life cycle and its processing, as well as reorganizing the management, processing, storage, and research phases in the archive.

The process of document management can take place through different and extremely varied operating procedures. As a general macro-process in document management, four distinct sub-phases can be identified (Figure 1). Such phases encompass the classic activities characteristic of document management: Ingestion, Processing, Outbound, Archiving.
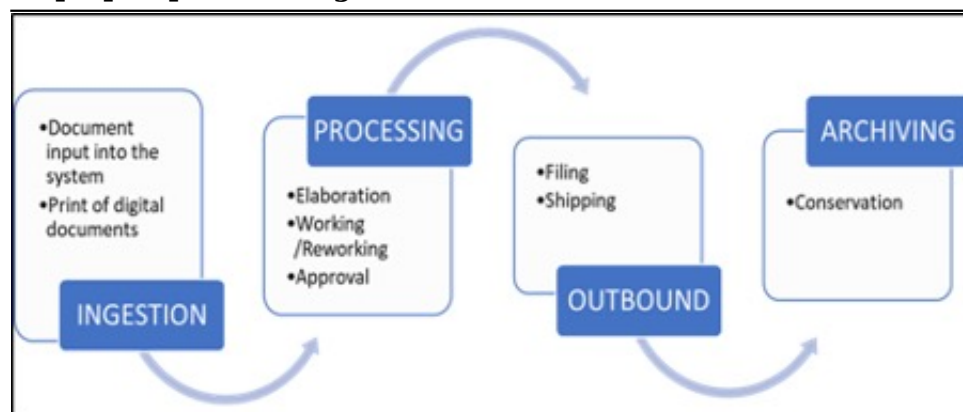
Figure 1: The process of document management. Source: own elaboration

The starting point of the process is the "**ingestion**" phase of the documents in the system; it is the phase in which the external reports arrive inside the organization. There are different types of input data: Paper documents, e-mails, PDFs, Registered documents.

The "**processing**" phase contains the following sub-processes: Elaboration, Working, Approval, Reworking. Elaboration is the first stage that incoming documents face by entering the workflow and includes activities such as document reception, filing, assignment, classification, and sorting. The document flow is managed through dedicated resources, and then the document proceeds to the next processing phase. The working phase is the central node of the workflow in which the document is processed and in which its treatment is handled entirely; the workload in this level is also supplemented by internal materials for which rework is required after having detected any errors at the approval stage or subsequently during the consultation. In the subsequent approval phase the worked document is validated or rejected; non-approval can occur for the failure to comply with process standards, for which it is necessary to rework the material in question through its return to the processing phase, or due to its refusal for non-suitability of the request that is the object of the document, with the pre-established requirements.

The documents processed and approved proceed to the "**outbound**" phase in which they are gathered in catalogs (filed); the catalogs consist of a physical space, inside or outside the organization, dedicated to the collection of the documents produced by the organization and it represents an intermediate stage between the processing of the documents and their subsequent permanent conservation.

Depending on the type of document under examination, they are then moved (shipped) from filing to "**archiving**." This is a deeper level of storage in which documents are kept until the end of their useful life-cycle (for example according to specific normatives, i.e. GDPR).

2. DIGITAL TRANSFORMATION, INTEROPERABILITY AND EFFECTIVE E-GOVERNMENT

Against a backdrop of improvement, the EU's 2019 eGovernment benchmark report notes important shortcomings. The gap between countries remains significant and Italy, despite good results on digitalization, is penalized by the low use of services. The 2019 eGovernment Benchmark Report of the European Commission shows a situation of general evolution of the digitalization of public services in European countries, but in a context of insufficient security and poor ease of use by citizens, especially in consideration of a presence that is not yet adequate of digital skills. From this point of view, there is ample room for improvement to achieve the main objective, which is to make easy the interactions of citizens with administrations, through quality public digital services, easy to use and used, but also thanks to the full use of data held by administrations, not only to avoid requesting them several times from citizens (and therefore to respect the "Once only" principle also stated in the Tallinn declaration), but also to make certain flows completely automatic, reducing for citizens and businesses the need to interact.

In this context, Italy maintains a performance generally in line with the European average, but with one of the lowest penetration in the use of public digital services and also below the potential related to the characteristics of the country. Digital transformation and interoperability of public services are tightly related to the goals of the European Digital Agenda and the European 2020 Strategy. Therefore, target groups involved in development of e-government need to have appropriate knowledge about interoperability issues. The analysis is based on information derived from research works regarding interoperability aspects both at European level and at each country level participating in the project. The target groups of the analysis reflect three potential groups of players: decision makers, public administration, and contractors developing effective e-government services. The notion of e-government has evolved, due to fast changes in the information technology field. The European Commission in a communication of September, 26 2003 (with the title "The Role of e-Government for Europe's Future"), defined e-government as: "the use of information and communication technologies in public administrations combined with organisational change and new skills in order to improve public services and democratic processes and strengthen support to public policies". In another communication, n.179/2016 of April 19th 2016, the European Commission established the basic principles on which the action for e-government must be based for the period 2016/2020. The action plan was defined as follows: "By 2020, public administrations and public institutions in the European Union should be open, efficient and inclusive, providing borderless, personalised, user-friendly, end-to-end digital public services to all citizens and businesses in the EU. Innovative approaches are used to design and deliver better services in line with the needs and demands of citizens and businesses. Public administrations use the opportunities offered by the new digital environment to facilitate their interactions with stakeholders and with each other".

The paper digitalization establishes a great opportunity for the Public Administration to spread several aids (Casalino et al., 2010). Paper digitalization is the set of actions to resolve the distinctive difficulties of the paper such as the admission and diffusion problems, extraordinary expenses of treatment, space, search, packing, and timing. The institution of an entirely digital document managing inside Public Administrations, with the connected private companies and professionals, although it represents only a small progress, can be applied in the reengineering of organisational processes and can be a goal that could take place rapidly. A document management system, still, springs the opportunity of numerous developments and more effectiveness within the central and local public organizations (Pfeffer, 1981).

With the digitalization of administrative procedures, it is possible to get enormous savings in economic and in time terms. There are at least two elements on which the public administrations should leverage to optimize their interior structure and, consequently, originate all concrete benefits for citizens and companies.

The digitalization of the purchase-to-pay process remains a critical factor for the success of players in the retail sector, also in the current context where all processes are increasingly oriented to the consumer. Interoperability between companies and data safely exchanged in real time are fundamental to develop the new collaborative logic, that creates networks between companies and puts the citizen at the centre (Casalino, 2014). Several are the resulting advantages: from cost reduction of each service to an increased speed of public supply processes. But, from the other hand, only thanks to the digitalization of the whole purchase-to-pay process and the digital integration of commercial, logistical and financial processes, entrepreneurs and companies can fully appreciate all these advantages. The needed training activities have to be seen as a means to achieve commitment, participation, communication, and cultural change, as well as to make civil servants feel comfortable with the revised processes and roles, besides to become supporters of the interoperability projects they are involved in.

3. THE ROLE OF THE DIGITAL TRANSITION MANAGER

The Digital Transition Manager (DTM or RTD in Italian) is a new managerial figure whose main functions are that of operationally guaranteeing the digital transformation of the administration, coordinating it in the development of digital public services and in the adoption of new models transparent and open relationships with citizens. The DTM - RTD office is responsible for:

- strategic coordination of the development of telecommunication and voice information systems;
- direction and coordination of the development of services, both internal and external, provided by the administration's telecommunications and voice information systems;
- guidance, planning, coordination and monitoring of IT security in relation to data, systems and

- infrastructures, also in relation to the public connectivity system;
- access of disabled people to IT tools and promotion of accessibility;
- periodic analysis of the consistency between the organization of the administration and the use of information and communication technologies, in order to improve user satisfaction and the quality of services as well as to reduce the time and costs of administrative action;
- cooperation in reviewing the reorganization of the administration;
- direction, coordination and monitoring of the planned planning for the development and management of telecommunication and voice information systems;
- planning and coordination of relevant initiatives for the purposes of a more effective provision of online services to citizens and businesses through the tools of application cooperation between public administrations, including the preparation and implementation of service agreements between administrations for the creation and sharing of cooperative information systems;
- promotion of initiatives relating to the implementation of directives issued by the President of the Council of Ministers or by the Minister delegated for innovation and technologies;
- planning and coordination of the process of dissemination, within the administration, of identity systems and digital domicile, e-mail, computer protocol, digital signature or qualified electronic signature and computer mandate, and of the rules on accessibility and usability as well as the process of integration and interoperability between administration systems and services;
- planning and coordination of the purchase of IT, telematic and telecommunication solutions and systems, in order to ensure their compatibility with the implementation objectives of the digital agenda and, in particular, with those established in the three-year plan.

Innovative educational and training initiatives have been lanched from some Universities in the last three years. These courses, updated to the most recent issued legislation, are oriented to managers of public organizations, professionals, entrepreneurs and executives interested in acquiring, on the one hand, the necessary legal skills, and on the other, organizational and technological competences within the office for the digital transition or the document management system. Digital transformation requires the contribution and involvement of every articulation of the public machine and to this end the Digital Administration Code (CAD in Italian), adopted with Legislative Decree on March 7, 2005, n. 82, recently modified with the legislative decrees n. 179 of 2016 and no. 217 of 2017, provides in art. 17 that public administrations ensure the implementation of strategic guidelines for the reorganization and digitalization of the administration. Art. 17, paragraph 1, establishes that each Public Administration is required to entrust to a single managerial office the "transition to the digital operating mode and the consequent reorganization processes aimed at creating a digital and open administration, easily usable and quality services, through greater efficiency and cost-effectiveness" by appointing a Digital Transition Manager (DTM - RTD). On October 1, 2018, the Minister for Public Administration adopted Circular no. 3 of 2018, with which all public administrations are urged to identify a Head of Digital Transition within them. The adoption of interactive company portals, certified e-mail, online process approval systems, the widespread use of customer relationship management technologies (CRM) and the change of business models highlight in many organizations difficulties in their management or in the ability to dispose of them. A considerable knowledge and awareness of the most recent digital innovations applicable in existing processes and of document and content management tools, as well as their interdependencies and organizational aspects, how to choose them, adopt them and the best way to use them is therefore necessary. The legislation contains information that is not always clear and therefore an in-depth study and an update are particularly useful for the creation and use of solutions "in accordance with the law". The courses also allow to adopt effective document management systems and comply with the new legislative provisions on legal communication, electronic invoicing, electronic archiving and storage of electronic documents.

The new Digital Administration Code introduces a set of innovations that concretely affect the behavior and practices of organizations and the quality of services rendered. The courses therefore focus on aspects such as: the methods of reorganizing the processes and document flows, the organizational rationalization and simplification of procedures, the effective introduction of the IT protocol and the electronic file, the introduction of forms of online payments, methods of exchanging data between companies, professionals and with the public administrations, the suitable adoption of the PEC (certified electronic mail), the choice and effective use of analytics services, the IoT and cloud technologies, blockchain and privacy management, accessibility and usability in digital administration, access and secure management of online services and the use of digital signature, the procedures for dematerializing documents; the evaluation of the effectiveness of document management systems, the enrichment of the contents of corporate and institutional portals in terms of transparency and traceability.

These courses aim to meet the training needs of Public Administrations, companies and professional firms that plan to train the figures of the Manager of the Digital Transition or the Manager of Documents Managament, transferring innovative knowledge and organizational, technological and legal skills. They are also addressed to executives, middle managers and officials who participate in an organization in the process of digital transformation or the management and dematerialization of documents, whether the process is carried out internally or is outsourced. Other professional figures to which the courses are addressed are: managers of company management, innovation managers, information systems managers, document management staff, functional managers in public administrations, as well as freelancers and project managers involved in realization on behalf of third parties of processes for the digitalization of processes or a system for managing documents and information in digital format.

4. DIGITAL TRANSFORMATION THROUGH PAPER DIGITALIZATION IN ITALIAN Pas

In Italy, the technological and normative evolution allows today a complete dematerialization of paper documents in the P.A. Indeed, the Italian legislation equates the digital document to the paper document, recognizing the same efficacy from the legal point of view and from being opposed to third parties. The Italian public administration, from the past decade, has started to implement a series of legislative measures, "Code of the Digital Administration" (CDA), to accelerate the digitalization of the Public Administration. The CDA in Italy has defined the right of citizens and businesses to use information technology as an interaction tool with the Public Administrations, equipping citizens, companies and public administration with tools such as: the electronic signature, replacing the handwritten signature, the certified electronic mail, the rules for automatic payments and the one-stop-shop for productive activities in electronic mode. These changes have led to e-Government, which is to say, strong computerization of the public administration, both at the level of the CPA (central public administrations) and the level of the LPA (local public administrations). In fact, e-Government means the process of computerization of the public administration which - together with actions of organizational change - makes it possible to treat the documentation and manage the procedures with digital systems, thanks to the use of ICT technologies, in order to optimize work and offer users (citizens and businesses) services both faster and new. The need to implement and support still nowadays the CDA is particularly evident from some data that regards the status of digital transformation in Italian Administrations. From an evaluation performed in 2017 related to the Digital Economy and Society Index (DESI)[1] and then performed again in 2020, it is clear how Italy is terribly lagging behind notwithstanding the presence of a very innovative normative on digital transformation.
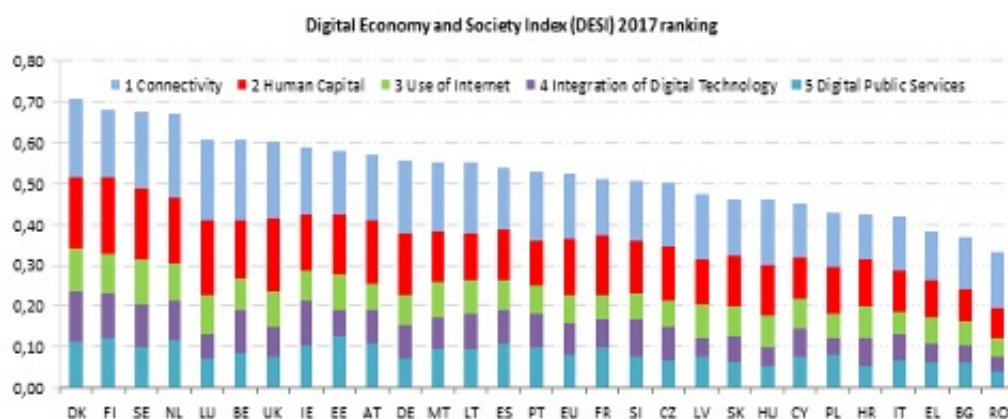

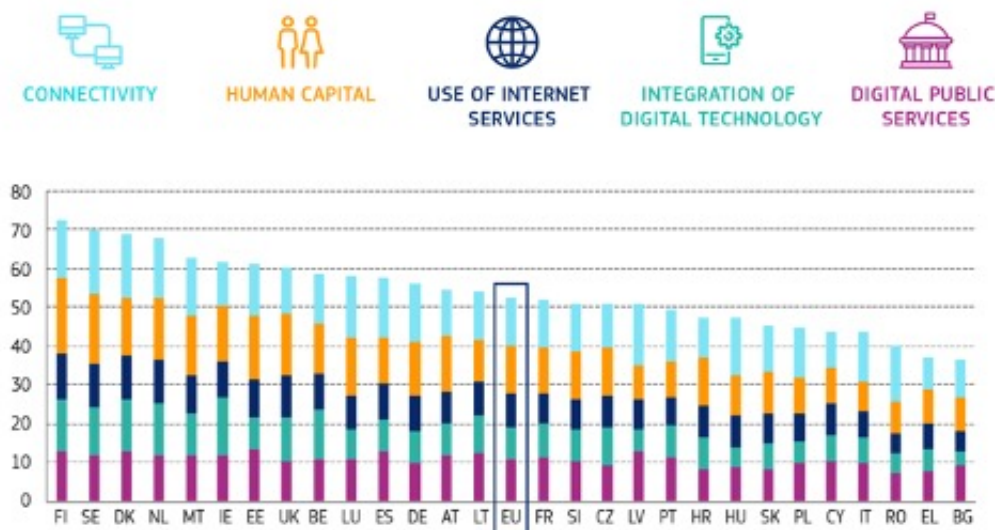Figure 2: The Digital Economy and Society Index (DESI) 2017 ranking

Figure 3: The Digital Economy and Society Index (DESI) 2020 ranking

As for the digital transformation of the Healthcare System, Italy has been decreasing over the last years its expenditure on this issue, notwithstanding the promises from various Governments and notwithstanding the pressing requests from the citizens and the associations of Medical Doctors to have innovative services for diagnosing and therapy. From 2016 data, the italian nationa expense on digitizing the Healtcare System has been:

- 1,27 bln euros (1,1% of the overall public healthcare system expenditure)
- 5% less than 2015

So pretty far from the one in other European Countries. All the same, the implementation of e-Government has required the Italian public administrations to redesign all internal processes to increase efficiency through cost reduction and increase effectiveness by improving the services offered. However, to date, the Italian public administration is facing two problems regarding the conversion of paper documents to digital: to preserve documents integrity and their storage through time and the privacy of the citizens. However, given these premises, one of the critical elements that are often attributed to the Italian Public Administration is the difficulty of implementing these legislative indications. The issues of the management and costs containment of the PA is therefore of fundamental importance, as the reduction of the complexity of internal and external procedures. Since related processes are very complex, it has been possible to witness over time the adoption of strict bureaucratic provisions to regulate the various steps required. This trend had the effect of making the service slower for the citizen, with the possibility of formal errors and lack of operational flexibility necessary to resolve any exceptions.

The introduction of specific technologies such as digitalization, the certified mail, digital signatures, the electronic ID, and the card of national service is part of change inside the PA Italian. All of these instruments represent the most important means of radical administrative transformation that digitalization entails because of the permit, in addition to a substantial change in the way of working inside the Public Administrations, significant advantages in terms of cost, time, and human resources management. The dematerialization of documents allows new development opportunities of the business through value-added automation that brings standardization and integration services to support business activities of HR departments, project offices, and marketing, and administrative departments.

It is interesting to note, from 2013 data, that every public employee has used, on average, 52 kg/year paper (mor or less equivalent to 800 A4-sheets per month). This constituted an improvement as it was 21,6 kg less than in 2006, showing that the digitalization of the Italian PA is anyway producing some results, especially thanx to the paper digitalization process.

It is also interesting to note that, still, on average, in each Italian PA, the time spent by each employee is more related to the handling of paper documents than on other type of activities.

Fig. 4: Avg Time % spent in paper documents Management by each employee

5. A SYSTEMS APPROACH TO DIGITALIZATION

To better understand the organizational impacts of dematerialization in PAs, and its enabling effect on the overall digital transformation, we choose to use a systemic perspective which is provided by the System Dynamics modeling and simulation approach. Based on Systems Theory and System Thinking (Forrester, 1961), System Dynamics (SD) is a computer-based modeling and simulation approach that allows defining the mathematical relations between different variables and instructs a computer to make the discrete-step computational effort of solving the differential set of equations (Sterman, 2000). The trends of all variables out of computer simulations are plotted over a specified period into the future. The validation of the model is based on historical data and sensitivity analyses. SD provides an understanding of the overall performance behavior of the system and the influence of the various factors to the problem to support policy design by making simulations of different scenarios (Greasley, 2005). As a quantitative modelling methodology, SD allows the explanation of performance factors in the digital transformation process of the Italian Public Administration because the SD method, by considering real systems as effectively non-linear ones, characterized by the presence of delays, and by being self-organizing, adaptive, dependent on past behavior, governed by feedback processes and resistant to change, help to understand the model that represents their dynamics. In the field of management, SD contributes by adding human-bounded rationality, information delays, managerial perceptions, and goal-setting approaches to management traditional rules and control-theoretic models (Akkermans and Dellaert, 2005).

Systems Thinking and its operational form, System Dynamics, is a way of looking at systems from a holistic point of view. Its purpose is to determine what is the system's structure and in what way the structure affects its behavior over time (Sterman, 2000). The use of System Dynamics allows a different approach to the analysis, over time, of the functioning of complex systems and their formalization, since it is able to manage intrinsic characteristics of real-world systems, such as non-linearity, presence of delays, self-organization, dependencies on past behavior, feedback processes and resistance to change (O'Connor and McDermott, 1997). Thanks to these features, the SD approach will allow for the definition and analysis of simulation results of a digital transformation process like document management, hence proving to be versatile and representative of operating methods, also related to non-homogeneous organizational structures.

In other words, through a systemic approach, it is possible to capture the intrinsic complexity of the PAs and, therefore, the behavioral dynamics of these organizations. By means of a System Dynamics simulation model, it is thus possible to evaluate these dynamics and make scenario analysis and eventually identify the points with high leverage towards change and improvement (policy levers).
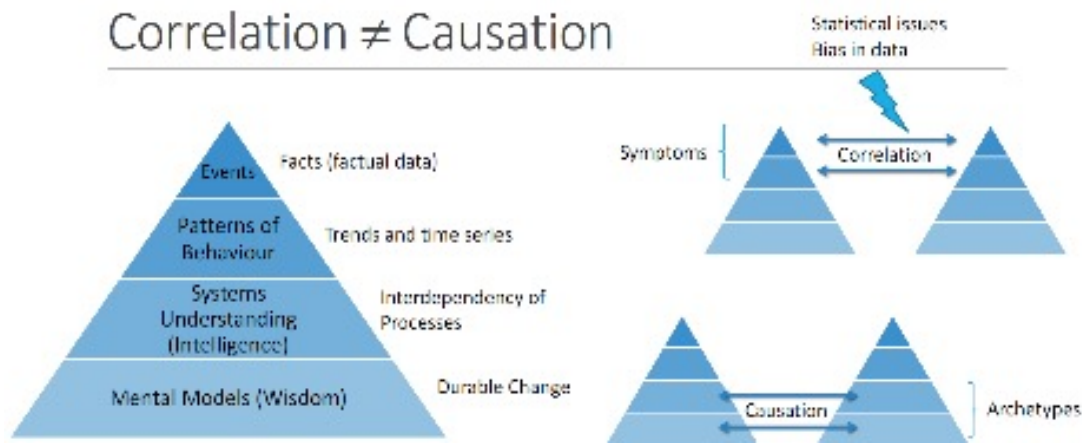
Fig. 5: Correlation differs from causation. The figure shows how only a systems approach aimed at understanding how data is driven by the organizational structure can allow the application of effective decisions for a durable change

By considering the four phases in the document management process (see Figure 1), we have examined the organizational impacts deriving by the introduction of digitalized document management, by comparing the simulation results of two different SD models. In fact, the first model describes the situation in which the organization works using only documents in paper format, from the ingestion to the archiving process; conversely, the second model represents an organization that creates and manages documents directly (and only) in digital format.

The structural differences between the two models are due to the unavoidable organizational need to redesign processes that a digital solution needs, if compared to a traditional paper-format solution.

In fact, in the digital context, it is possible to automate business processes and manage the work of resources thanks to workflow management software that allows to design, implement, and automatically manage document processes within the organization. As already mentioned, digitizing company activities means creating and managing the entire internal and external processes in an integrated and collaborative way: it is not a mere replacement of the paper document with the electronic but a moment of redesign of the entire process in order to obtain an increase in performance and an improvement in the operations carried out in their entirety (Armenia et al., 2008). In other words, it is an intrinsically systemic activity.

The transition to digital management requires specific solutions for the organization under study with the primary objective of guaranteeing the validity, legitimacy, and compliance with the current national and international regulations of the new digital process. The considerable paper volumes linked to the analogic management of the documents generated daily, from the initial "ingestion" phase, through the "processing" phase, up to the "outbound" phase with the last "conservation" of the document (which generally takes place over a long period of time), has a considerable impact on all the cost items related to the logistic management of a document: the filing, the storage, the research and the shipment. The amount of produced paper documents, in turn, also influences the actual storage times which, despite being already quite long due to the limits imposed by the regulations, end up lasting even more due to the need of maintaining a direct control over the document life cycle, with a consequent increase in the costs of renting the storage rooms, the costs of space management, security, etc.

Case Study

With the partnership of Infocert, a leading company in the Italian market in digitalization services, we have defined and analyzed the document management process of the Italian Public Administration. We designed two SD models representative of the management of the generic document process with the support of the Powersim Studio® software.

The first model, called "As-Is", represents the situation in which the reference organization operates, is a traditional model of "paper-intensive," where there is no implementation of solutions for the dematerialization of document management. The second model, called "To-Be", describes the future situation. The "To-Be" model represents the situation that the organization should tend to optimize its processes and sub-processes by increasing its performance, reducing paper consumption, and the costs associated with managing the entire system.

All the sub-processes and work activities constituting the dematerialization process have been treated as black boxes; since the main objective of this work is not to understand the specific functioning but the behavior of each of the phases at a given input solicitation.

Our conceptual model considers the following aspects/issues/objects:

- **Documents**: can be paper or digital;
- **Human Resources**: employees are the core point for the development of dematerialization processes;
- **Processing**: document management activity that includes both Inbound documents, the incoming flow from both outside and inside the company, as well as Outbound documents, that is shipping, archiving, waste;
- **Management**: refers to long-term management and current management, which concerns the definitive and non-definitive documents, respectively;
- **Archiving**: allows daily and non-current documents to be consulted;
- **Preservation**: maintenance of papers over the long term, which refers to an extended time horizon, both for legal reasons and for the value of the documents that represent the possibility of potential analysis for the comparison of historical data;
- **Costs**: linked to all activities related to materials (from the use of the card for reproduction to the cost of shipments to the cost of research, etc.). They represent the main advantage derived from the implementation of digitalization policies that bring numerous savings;
- **Time**: linked to the timing of each activity, which thanks to digitalization is considerably reduced, reducing the costs related to the loss of efficiency (a concrete example is a time required for the search, or the waiting time to receive an authorization signature);
- **Productivity**: refers to the number of documents in a time interval, which each employee can "process," "work." This number, which is a fundamental element for the continuity and speed of the management flow, with the new solutions has a value almost higher than 100%.
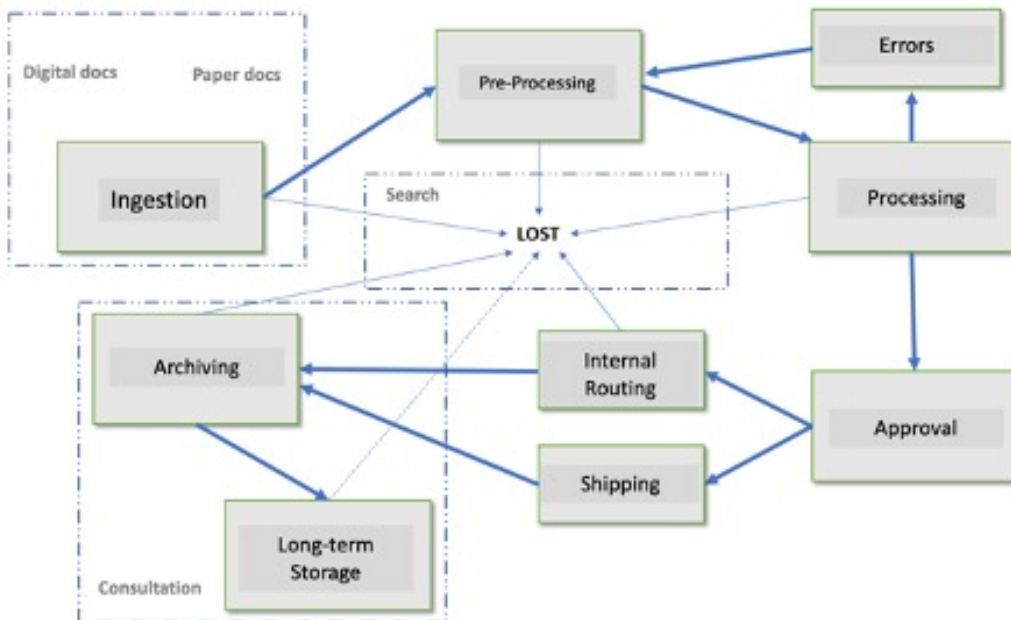

Fig. 6: An evolution of the process model aimed at introducing the various steps and states in which a document can be found inside a typical document workflow. Source: own elaboration

As-Is process description

In the "As-Is" model, the reference scenario is characterized by workflows performed traditionally without the implementation of any digital solutions: in this situation, the "ingestion" phase is characterized by two distinct channels for incoming documents: one related to digital ones and another for paper ones. A Public Administration, which works exclusively with paper documents, will have to print them from electronic sources.

Fig. 7: As-Is workflow overall decription. Source: own elaboration

In the "As-Is" scenario, the introduction of documents into the system takes place according to the document arrival rate; the entry is divided into two different flows, one relating to paper documents regulated by the parameter "*Arrival rate of paper documents*" and another pertaining to digital documents regulated similarly by an "*Arrival rate of digital documents*". The former creates an accumulation of digital files in a stock called "*Documents to be printed*", that are documents that need to be transformed into paper format before entering the normal workflow. The behaviour of this stock (the amount, over time, of documents to be printed) mainly depends on the processing resources dedicated to the management of "ingestion" documents, multiplied by the reources' productivity (determining the "*Elaboration Workrate*", the outflow of the "documents to be printed" stock). In the overall document management process, the organization suffers from severe efficiency and effectiveness problems deriving mainly from the intrinsic delays in the workflow, the reduction of organizational efficiency, the loss of potential business due to delays (as with those happening during the procedures of signing contracts and documents in general), the damage to the image of the organization due to the "loss" of sensitive documentation (or failure to authenticate it), environmental costs related to the extensive use of paper, customer dissatisfaction, etc. Once "ingested" and elaborated, the documents then enter the management process. The "*Processing*" stock is fed by the flow of documents from the previous phase and by the flow coming from the "*Docs to be reworked*" stock. The latter is fed back by "mistakes" deriving both by the subsequent phases of documents consultation in the archives and from the papers in conservation, or from the papers that do not pass the validation phase. Once the processing has been completed (that is, all the activities foreseen and necessary for documents management are carried out) documents are moved to the approval phase: specific processing resources, depending on the role and department, will proceed with the analysis of the documents and verification of their compliance to normatives. Thus, we can establish two outflows from the stock: the first "*Needing Rework (Processing)*", which concerns documents that do not satisfy the normative constraints (necessary for the process in question due to errors in the compilation) and therefore transferred to the aforementioned level "*Docs to be reworked*", which in turn feeds back to the "Processing" stock. The second flow, is instead related to the documents that match the process standards and can continue their path towards their approval. This is represented through the "Approved" stock of documents that can proceed towards the successive phases of shipment and storage). A part of the documents approval process concerns the need to route documents that need to be phisically shipped ("*Transmitting*"), represented through the stock "*Documents to be prepared for phydical transmission*", involve the distribution outside the organization through the use of dedicated channels according to the specificity of the documents being managed. For these, it is foreseen first the creation of a paper copy of the document and subsequently the preparation of the documentation required for sending them away according to the chosen transmission methods available to the organization for shipping and which increase their related stocks ("Fax", "Courier", "Ordinary Mail", and "Registered Mail").

The archiving phase is represented by the "*Archive*" stock, increased by the "*Archiving* " rate inflow from the approved documents and decreased by its "*Long Term Conservation*" outflow, that manages the transit of documents to the subsequent "*Conservation*" stock. The "*Archive*" level is linked to the consultation activities of the documents, which is represented through two opposite flows, one ("*Consultation of documents in archive*") outgoing from "*Archive*" and going towards another stock named "*Documents being consulted*", and a returning flow from the latter to the archive ("*Return documents from consultation to archive*").

Outgoing from the "*Documents being consulted*" stock, we also find another flow named "*Errors found while consulting archived documents*" and directed towards another stock named "*Documents to be reprocessed*", related to any incorrect documents that may be found after the approval process (discussed above) has already happened and moved by mistake a wrong document into the pipeline. An outflow of the "*Conservation*" stock is the "*Document disposal*" flow that moves the documents in the archive out of the organization at the end of their useful life-cycle and after the legal storage time (this is regulated by the "*Disposal time*" parameter related to the specific process, and therefore documentation, in question).

As for the case of the Archive, even for the "Conservation" stock, we find two opposite flows, one related to the activity of consulting documents already being in their final storage and leading to a stock named "*Consultation of documents in conservation*" and and another one flowing back to "Conservation" after consultation.

Also from the "*Consultation of documents in conservation* " stock, we find an outflow that determines an amount of "*Errors encountered in conservation consultation*", related to documents that present errors despite the fact they passed an approval test, and that therefore are moved to the "*Internal documents to be reprocessed*" stock. At each of the described stages, we have also included a "*Lost Documents*" stock, accounting for the documents that

the company literally "looses" on average, during the physical mobilization of documents in the execution of the various document management activities. Each "*Lost*" stock is fed by a "*Loosing Documents*" flow related to documents dispersed in that specific phase and is decreased by the "*Documents recovered or replicated*" flow. It has been assumed that percentage of lost documents are the same for each phase of the process.

To-Be context:

In the "To-Be" context, in the new digital environment, the document processing has been transformed in terms of operations and management following the re-elaboration of its various sub-processes to ensure compliance with the reference regulatory framework and coherence/consistency with the new digitalized workflow management.

As previously stated, the fundamental difference between the digital process and traditional paper management is the introduction of systems such as the digital signature, a necessary tool to guarantee the complete digitalization of the document workflow.

The advantages associated with this technology are significant in terms of reducing operating and management costs (Casalino, Armenia, Draoli, 2009). The entire document coordination process, as well as the administrative work, are streamlined, and all the steps that lead to the approval of the document, are drastically simplified:

- Documents that need to be routed via mail, fax or courier to be approved can be transmitted directly digitally, hence making the validation process more efficient;
- The administration of incoming mail, and therefore the "ingestion" phase, as well as the preparation and management of outgoing mail, re more functional;
- The production of documents that require a signature is sped up as there is non more the need to print documents;
- The digital archiving and storage of electronically signed documents takes place in a more profitable and functional way by acquiring and directly recording the signed document with zero time and without the need for resources dedicated to managing the archive.

Based on the above, the "To-Be" model to which the organization aspires, envisages a progressive implementation of the necessary technologies and hardware and software solutions allowing a management of electronic documents only, hence leading to a reduction in the creation of paper documents. The model foresees the management and creation of documents exclusively in digital format, and the objectives to be pursued in order to achieve the described results (with a view to dematerialization) concern the following:

- the reduction, and therefore the elimination, of paper documents from the "ingestion" stage;
- the introduction of ad hoc technological tools, such as digital signatures and certified electronic mail, for the management of documents in the "processing" phase and the transmission of documentation outside the organization, "routing" phase;
- the transition in the "archiving" phase to digital preservation or substitutive conservation, therefore exclusively in the electronic format, managing to retrieve and consult information, also belonging to different sectors, more quickly and effectively.

6. SIMULATION AND RESULTS

The work that has been carried out on the analysis of the transition to the digital management of a documented process and the dematerialization of paper documents has had as its primary objective to develop a simulation model to demonstrate the organizational advantages connected with digitalization. In qualitative terms, the main differences that emerged from the comparison between the two models ("As-Is" and "To-Be") concern:

- The number of incoming digital documents to be managed. These, by hypothesis, are greater in the "To-Be" scenario and tend to increase based on the digital culture implemented by the organization, leading to an increase in dematerialization processes which in turn trigger a reinforcement mechanism on the request for digital documents which inevitably changes the flow of information and the ways of working within the organization;
- In the ingestion phase, in the "To-Be" context, the printing processes of documents are smaller, making the

flow of information more fluid;
- In the "To-Be" context, printing costs are almost totally zero;
- The digital filing of digital documents takes place wholly and directly automated through specific software and without the need for resources dedicated to this activity, with a saving of funds used for this activity and the time required;
- In the "To-Be" context, the transmission of documents to the outside takes place mainly through certified e-mail addresses with a substantial reduction in total shipping costs.
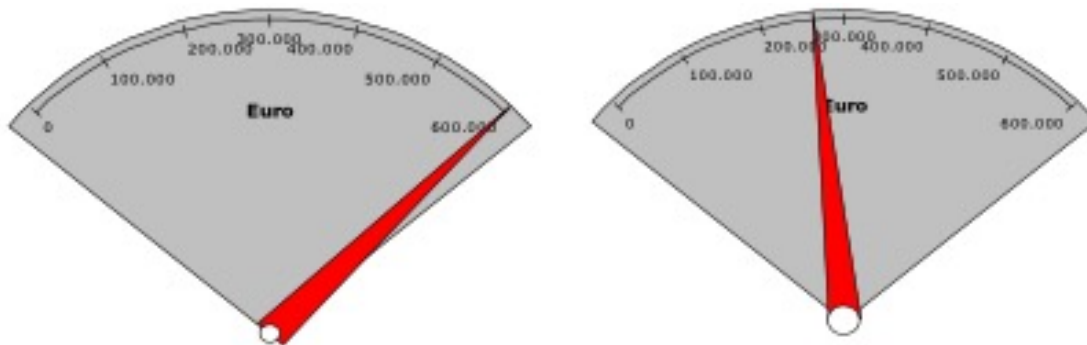

Fig. 8: AS-IS vs TO-BE total costs for document management in one year. Source: own elaboration

The results of simulation showed that the reduction in total costs of documents management process is almost 60%.

- Total costs from paper-form model (per year): 641.061 EUR;
- Total costs from digital-form model (per year): 263.161 EUR.

It iws worth noticing that the analysis took into account only the direct costs related to the activities envisaged in the four processes. It did not evaluate the savings achievable in terms of recovery of working time of human resources in the organization.

The graphs below show the trend of the two costs for the management of the paper vs digital document processes, as a result of the sum of the individual costs that compose them.
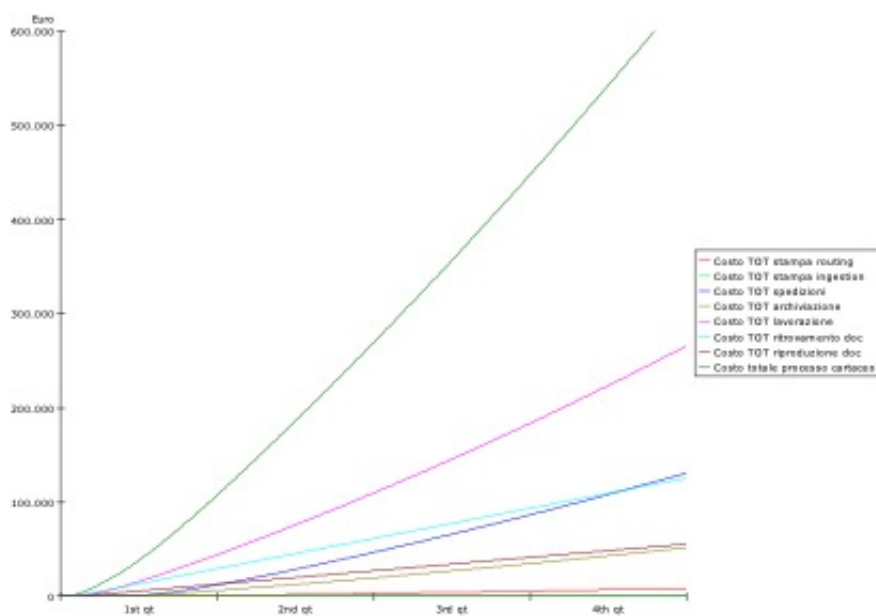
Fig. 9: Total cost of paper documents management. Source: own elaboration

The most conspicuous cost is represented by the cost corresponding to the processing phase equal to about 42% of the total annual costs, the paper practice of the activities envisaged as registration, certain date and processing in general, has a considerable impact on total costs; in second position there are the costs associated with the search for documents lost during the process, despite the prudential approach adopted and the reduction in costs associated with these documents compared to the values indicated in the literature, and the total costs of shipping, both equal to almost 20% of the total annual cost. This is followed by the costs of reproducing lost documents (about 9%), the costs of archiving documents (about 8%), printing costs for documents sent outside and those in ingestion (about 1%).

In relation to the dematerialized process, the greatest costs are represented by the capital invested for the transition to the digital solution; the largest item is represented by the purchase cost of the platform, a one-off cost to be incurred in the first year for the digitalization of processes; it follows the fixed cost, always annual, due to maintenance and assistance for the management of the preparatory applications for carrying out the activities. The sum of the remaining costs relating to shipping, printing for routing, retrieval and reproduction of lost documents are equal to 5% of the total annual cost of managing the digital process. Thanks to the efficiency related to digitalization, these items are drastically reduced becoming almost irrelevant. We remind you that these costs have been maintained, even in the computerized process, only for completeness of information.

Through the return on investment index and the payback period, it is possible to define the return on investments related to dematerialization and the time period required to recover it through positive cash flows. The results are of great effect and clearly show the convenience of the transition to computerized management of the document process, from an assessment carried out over a period of one year it is clear that the ROI is equal to 143% and the PBP is just 5 months .

By repeating this analysis over a longer time horizon, such as 4 years, it is possible to amortize more the cost of the initial investment related to the purchase of hardware and software tools, in fact the ROI is about 400% and the PBP is instead equal to just 2 months.

7. CONCLUSIONS

The member countries of the European Union are committed to pursuing objectives of innovation and transformation of the decidedly ambitious e-Government processes. They will have to make relations between citizens, businesses and institutions more transparent and effective on the basis of the principle of mobility within the single market.

To achieve these goals, the ICT will play a decisive role, also from a social and environmental sustainability point of view. In the first place are the creation of "user-centric" services based on the principles of openness, flexibility and transnational collaboration. Services of this type should help to create a reality in which, for example, in an easier way than today a citizen can go to study in a country other than his own, create a professional activity in yet another and spend years of retirement into yet another. Particular emphasis was placed on the concept of "mobility in the single market" principle which requires the provision of efficient and economically convenient services of a "cross-border" nature. Alongside solutions developed for the benefit of institutions, citizens and companies of individual countries, therefore, services to facilitate the opening of commercial activities from one country to another. Among the other possible solutions are the digital signature valid in all countries, electronic identity cards recognized by all administrations, authorization and payment services based on common standards. Among the aims of these innovations there is also that of making the single European market more competitive in the world economic scenario. Another common goal on which there has been much discussion is the use of ICT to achieve environmental sustainability purposes. The ICT can contribute to the achievement of these objectives changing the way of working and conducting business. As reported in Mergel et al. (2019), technology per se does not change organizations, rather it is the way organizations work and theirse of technologies that changes their work practices. They also state that the use of digital tools allows for changes in the way public administrations deliver their work, communicate, and provide services, but can also have a much more extensive impact such as changing the

structure and culture of an organization, or engaging and integrating citizens and other partners into the co-design and co-delivery of public services.

Under such a perspective, the shift towards document dematerialization and the practical implementation of the digitalization process requires a step by step process and the need for internal and external adaptation; it is a very complex phase that involves the evaluation of many critical components, it is essential for example:

- redefine some steps of the document life cycle and the process related to its processing;
- reorganize the management, processing, storage and research phases in the archive;
- evaluate the impact of these changes on human resources and organizational models in relation to the wide variety of existing documents;
- assess the organizational difficulties related to the use of new technological tools, the implementation of new procedures and the relationship difficulties outside the organization with reference to the end customers of the process;
- confer full legal validity to electronic substitutive documents in relation to the updated laws continuously in force.

Organizations are continually looking for solutions that reduce operating costs and gain a competitive advantage over other companies in the market, and since most decision-making processes require approval or formal authorization, they are directed to the adoption of specific tools that improve the automation of the central business processes.

The complete success of the dematerialization process and the implementation of the computerized and automated management of information and document flow requires the systematic implementation and wide dissemination of all the technological solutions available to guarantee the authenticity of the documentation and the adoption of systems of classification with annexed procedures for the conservation and research of documents. The reference legislation, in addition to defining the general principles and the requirements of the system, also establishes the characteristics of the technological tools and internal organizational rules that the company must observe to ensure the certification and document management services in compliance with the security and integrity requirements data and respect for privacy. In addition to the economic savings that can exceed 80% of the cost of the traditional process, according to the estimates of the Electronic Billing Observatory of the Politecnico di Milano, with digitalization there are further advantages that can be achieved: increase in productivity linked to the simplification of processes and therefore to a reduction in the time associated with operating activities.

The dematerialization process requires huge investments. The costs that any organization has to face in order to successfully carry out a process of dematerialization are not only those related to the purchase, maintenance and assistance of the digital platform but are above all linked to the enormous sacrifice in terms of resources and time for the planning, planning, management of organizational change and also to enrich new workers with a real revolution in terms of work processes. Thanks to the efficiency connected to digitalization, it is possible to make organizations, and in this case, the Italian Public Administration faster, more flexible, dynamic, not only in the management of information flows but also in skills.

The lack of clear information on the productivity of resources, and the exclusion of this dimension from the study, did not allow to fully define and analyze the business scenario. The increase in efficiency generates new available resources, i.e. man-days, that can be redirected to activities with greater added value. Finally, a phase of overlapping of the two models (paper and digital) should be also considered. The analysis, through simulation, of the transition phase would be an element of considerable added value as it allows to verify:

- implementation periods;
- possible critical issues;
- response from employees involved in the transitional phase;
- and that of the users with whom the organization is related.

Through a systemic approach, aimed at modelling and simulating the As-Is (paper) vs To-Be (digital) document workflow, we were able to assess the savings that are obtainable in a small context and that hence preludes to the wider savings that can be achieved from public administrations.

Although it represents only a small improvement that can be implemented in the digital reengineering of administrative processes, dematerialization is a goal that could be achieved quickly. Digitalization, for its cross-cutting importance, is in fact nowadays present in a stable form into many aspects of the public system and that is why it is necessary to operate it with even more significant policy aimed at raising awareness of the use of the public digital transformation.

In conclusion, our study confirms once again that the paper digitalization is a major challenge for the benefits that public administrations can realize but of course is just a single step (though pretty relevant) on their path to digital transformation. In fact, several other relevant studies currently ongoing and related to other aspects of digital transformation are emerging in the last few years. Some relate to the key roles needed in facilitating digital transformation (as also argued in this work with reference to the Digital Transformation Manager) and to the fact that such roles need to have a systemic perpective and systemic skills (like Systems Thinking) and some others focus on the tools, like new generation decision support systems (Armenia, 2019) that the Public Administration can use in order to improve its performances while offering its services to the citizens.

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