

# Improving the analysis of the judiciary performance - the use of data mining techniques to assess the timeliness of civil trials

Proposals from  
an Italian  
case study

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## Abstract

**Purpose** – The purpose of this paper is to show how data mining techniques can improve the performance management of the judiciary, helping judges in steering position with specific and timely measures. It explores different approaches to analyse the length of trials, based on the case of an Italian judicial office.

**Design/methodology/approach** – The paper presents a temporal analysis to compare the timeliness of trials, using data and process mining approaches with the support of a specific software to represent graphically the results. Data were gathered directly from the office data base, improving precision and the opportunity to monitor specific phases of the trials.

**Findings** – The results highlight the progress that can be reached using data mining approaches to develop performance analyses helping courts to correct inefficiencies and to manage the personnel distribution, overcoming the critical comments arisen against traditional KPI (Raine, 2000). The work proposes a methodology to analyse cases deriving from different juridical matters useful to set up a performance monitoring system that could be diffused to different courts.

**Research limitations/implications** – The limitations of the research regard the analysis of a selected, limited number of cases in terms of judicial matters.

**Practical implications** – Data mining techniques can improve the performance management processes in providing more accurate feedback to the judicial offices leaders and increasing the organisational learning.

**Social implications** – The performance of the judiciary is one of the relevant issues that emerged in the recent decade in the field of public sector reforms. Several reasons explain this interest, which has gone beyond the specific legal disciplines to involve public policy, management, economics and ICT studies.

**Originality/value** – Considering the literature on the judiciary (Visser *et al.*, 2019; Di Martino *et al.*, 2021; Troisi and Alfano, 2023) the contribution differs as both the methodological approach and the predictive analysis considers the intrinsic differences that define cases belonging to different juridical matters performing a cross-sectional analysis, with a specific focus of process variants.

**Keywords** Judiciary performance, Data and process mining, Judicial offices management, Public sector reforms

**Paper type** Research paper

## 1. Introduction

The performance of the judiciary is a relevant issue emerged in the recent decade in the field of public sector reforms. Several reasons justify this interest, which has gone beyond the specific legal disciplines to involve public policy, public management, economics and ICT studies (Chohan, 2021).



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The judiciary represents one of the pillars of democratic regimes: on one hand, its good functioning influences both the respect of human and civil rights and impacts on the economic national and territorial development (Knack and Keefer, 1995; Marciano *et al.*, 2018). Despite this relevance, the quality and efficiency of the judicial organisations is not so frequently analysed by public management studies.

The introduction of management practices into courts and the performance improvement of the judicial organisations have reached the institutional and academic agenda in Europe following (with a certain delay) models and reforms that characterised the public sector during the final decades of the last century (e.g. the New Public Management) and, more recently, triggered by the ICT development (Pollitt and Bouckaert, 2017). The improvement of managerial competences of the courts' judges with steering and coordination responsibilities (in Italy, the president of the Court and the presidents of the sections), the introduction of performance monitoring processes and quality indicators, the digitisation of the cases, and the development of more transparent relations with professional and general users, are some of the topics of this debate, based on the paradigm of "justice as a public service" (Vecchi, 2018; Vigour, 2018; Visser *et al.*, 2019). In any case, it is a challenging itinerary, because of the need to combine the managerial practices with the democratic principles (the autonomy and independence of the judiciary) and the goals of the judicial system (Garapon et Lassègue, 2018; Troisi and Alfano, 2023).

The issue occupies a top level in the Italian public sector reforms agenda. In fact, the Italian judiciary presents, in comparison with the other EU Member States, one of the worse positions considering the length of the civil and commercial cases. Despite some reform programmes during the last decade, Italy remains in the bottom positions of the European ranking considering the "disposition time" indicator (the measure of the time needed to decide all the backlog of pending case, maintaining the current organisational productivity level). Based on 2020 data for the civil and commercial cases, the disposition time of the three levels of judgement was: 674 days in the courts of first instance (ordinary courts), 1,026 in the courts of appeal (second instance level), and 1,156 in the Court of Cassation (third/higher level). Conversely, the median amongst the member countries of the Council of Europe, considering the three levels, is: 237 days, first instance; 177 days, second instance and 172 days third instance (Cepej, 2022).

The main determinants of this poor performance, beyond the good results of some courts, are considered the scarce organisational competences of the judges holding managerial positions [1] (traditionally Italian judges do not have an organisational background), the weak level of offices digitisation, the high level of litigiousness of the Italian society (Palumbo *et al.*, 2013), the reduction of the administrative personnel during the 2008–2020 (Cepej, 2022), the so-called "austerity period" in Europe (Pollitt and Bouckaert, 2017).

Italy is one of the main beneficiaries of the Next Generation EU Program, and its National Recovery and Resilience Plan 2021–26 (NRRP) includes objectives concerning the judiciary improvement. The plan defines specific targets to reduce the length of civil and criminal cases, improve the efficiency of the offices and reduce the backlog of pending cases. Amongst the organisational measures envisaged to reach these targets (digitisation, simplification of some judicial rites, recruitment of new judges and staff employees), the plan fosters the improvement of performance management instruments and measures to help the President of the judicial offices in detecting the critical factors that influence the proceedings length and timeliness.

In line with these purposes, the objective of the paper is to improve the judiciary performance information through data mining techniques, even in absence of a pre-structure dashboard. The current available statistics used to measure an office performance (or its sections results) do not consider both the characteristics of the different legal matters and the specific phases of the decisional processes, diminishing their utility in a steering perspective.

Differently, using the opportunity to directly access data provided by internal digital registers, we tested techniques to mining data regarding the proceedings management. This solution could help the office managers in detecting critical situations so as to decide organisational changes in a shorter time and with greater precision. Moreover, this contribution will also improve the ways to analyse the judicial data showed by the literature.

The data sources under analysis are from the Milan Court of Appeal, with attention to the civil sector because the critical situation of this area of proceedings (in Italy a court of appeal is responsible for the second instance tier; the first instance tier regards the ordinary courts and the third/higher instance tier, last resort, the Superior Court of Cassation). The Milan Court of Appeal is of interest because is amongst the largest in the country and is responsible for the country's most industrialised judicial district; moreover, it is involved in several modernisation projects. Testing the data mining approach in this complex organisation can reassure on its transferability to simpler units.

The remainder of the manuscript is structured as follows. Chapter 2 illustrates the research questions addressed in the paper. Chapter 3 presents the existing literature on the topic of this work. Chapter 4 explains the methodology and techniques proposed to monitor trials performance. Chapter 5 presents a detailed analysis of civil cases in the Appeal Court of Milan and discusses the results of the study. Finally, in [Section 6](#) we discuss the validation of the initial hypotheses, and we conclude in [Section 7](#) with final remarks and possible future work.

## 2. Hypotheses

Many papers that studied the Italian judiciary performance are based on statistical data concerning the total results of judicial offices. Otherwise, this study aims to explore performance measures (e.g. timeliness of the proceedings different phases, by matters; comparison amongst organisational sections, etc.) to investigate the efficiency and quality of courts management, leveraging the digital dataset provided by the formal register of a judicial office (Milan Court of Appeal), using data mining techniques. The main hypothesis is, therefore, an methodological one:

- H1.* Can the use of data mining techniques allow the court to obtain useful measures for a more accurate evaluation a judicial office performance, helping judges in steering position to better organise the distribution of cases and personnel, and case management?

To develop the study, we elaborated the analysis with a deeper insight on more homogeneous judicial matters, minimising the fact that judicial matters can be very different in their complexity and, also, can be different the procedures used by judges to manage a case of the same matter. This solution can help identify criticalities and opportunities for a fine-grained improvement in the execution of trials, increasing the steering capacity of the judges in managerial positions.

Moreover, other two hypotheses can be considered as a follow-up of the first one. Testing the usefulness of the proposed data mining techniques could be also a way to analyse the reaction of the court to improve the timeliness of trials, during the implementation of the National Recovery and Resilience Plan (NRRP). These further research hypotheses are listed below:

- H2.* Is the court showing a reduction of cases length, due the influence of the organisational solutions enacted by the NRPP (introduction of new personnel to assist the judges)?
- H3.* Is the court showing a reduction of cases length due the improvement in the use of simplification proceedings (allowed by the laws and enforced by the NRPP targets)?

### 3. Related literature

A consolidated way to measure the performance of judicial organisations, and to compare courts, national court districts and national judicial systems, is to analyse the flow of proceedings from the entry date to the exit date, in association with other data as the number of personnel, the level of decisions confirmed or modified by the last judicial tier, etc. (Troisi and Alfano, 2023). In general, the information system reports the entry date and the code of a case, the main events also with a date up to the decision and their formal publication. These data are the base of the main efficiency and quality performance indicators, in particular the average timeliness of a judicial section or office. The “disposition time” indicator (DT) estimates the timeframe of a judicial units or office for solving a case; it measures the time (in days) needed to decide all the pending cases (backlog), maintaining the same productivity level as during the last observed period (Cepej, 2021, 2022). Moreover, the backlog variation between the periods, the “simple clearance rate” (measured as the number of decided cases divided by the number of filed incoming cases), the “full clearance rate” (measured as the number of decided cases divided by the sum of the backlog at the beginning of the period and the incoming cases), the “age of active pending caseload” (measured as the number of days from filing until the time of measurement), the “average workload”, are other useful performance indicators (see Fox *et al.*, 2014; Voigt, 2016).

The systematic collection of these measures represents not only a statistical source to analyse productivity and the quality of decisions processes but is a fundamental managerial instrument to run an office and to increase the learning capacity of an organisation. Adding new techniques to the performance assessment process, this work wants to contribute to development of a continuous improvement of the judicial offices using data mining procedures. The aim is to get to the point of identifying the reasons for performance results at a deeper analytical level, at the level of individual organisational units and individual matters.

The utilisation of data mining techniques to analyse business processes, using event data extracted from information systems, has become an essential and well-known business intelligence and business process management toolset, but the application of process mining techniques to the judicial field is a relatively new topic. In fact, readers can find in the law and economics literature studies on the analysis of court performance using data mining approaches (Visaria, 2009; Di Martino *et al.*, 2021; Tullock, 1980). Models extracted from analysed logs can be either used to assess the correctness of the process itself, by applying specific check rules, or to maintain and eventually enhance it. Examples of the latter can be found in Voigt (2016) and Di Martino *et al.* (2015), where semantics are applied to business processes descriptions to verify the compliance to previously set rules. In Di Martino *et al.* (2017), to identify elements which could point to the causes of the delays of Italian civil trials, data have been analysed through process mining and graph techniques, to assess the coherence and correct application of the procedural model. A methodology to identify and analyse “outlier” processes has been developed to also detect characteristics which could justify delays in the completion of trials. In Cugno *et al.* (2022) the analysis provides a more nuanced assessment of the performance of civil courts than in the past and examines territorial gaps and the role of supply and demand factors in explaining the observed heterogeneities.

The estimation of the time duration of cases has become an interesting field of research in the past years. In Zhou (2008) and Walsh (Walsh *et al.*, 2015) there are some examples of methods attempting to predict the duration of civil trials using the regression analysis technique and to predict the length of time to reach a resolution to a criminal case, while in Economides (Economides *et al.*, 2015 and in Spurr (2000) the factors that influence this timing were analysed. In these works, the response variable is quantitative, and the independent variable is binary or quantitative (Zhou, 2008; Walsh *et al.*, 2015; Spurr, 2000). In Unger (Unger *et al.*, 2021), the authors analyse with process mining techniques the durations and

phases of trials in Brazil, focussing on the differences of digital and on-paper processes, and on detecting the phases of the processes that can introduce inefficiency, analysing process logs. More recently, the ability to predict the duration in days of court cases using artificial intelligence has been investigated, and while effective in normal processes, the need of better understanding the impact of features in more critical cases is stated. Other approaches using text mining (Amancio, 2015a and b) and sentiment analysis (Pang and Lee, 2008) are further applications of analytical approaches to the judicial system.

The work presented in this contribution differs from the existing approaches, as both the methodological approach considers the intrinsic differences that define cases belonging to different objects and different juridical matters performing a cross-sectional analysis, with a specific focus of the proceeding variants.

4. Methodology

A methodology to assess the trials duration and the critical points allows designing the necessary interventions aimed to permanently reduce the time it takes to settle cases. We consider civil cases in Italy, for which an information system to record all the steps of the trials and related documents is available, the SICID register. However, in principle it is applicable to any system (e.g. for the criminal proceedings digital register, if available) which is recording histories of events in trials together with metadata about recorded trials.

The availability of a large amount of data about trials over the years enables the study of critical aspects and the impact of changes, considering both normative and organisational changes. In this section, we first illustrate available data and analytical dimensions, and then we illustrate the different types of analyses that can help support the evaluation of the hypotheses listed in the previous section. First, we present the methodological approach, then we discuss results in the following sections.

4.1 Data and metadata about trials and analytical dimensions

According to the classification of the Italian Ministry of Justice, civil cases can be distinguished by macro-matter (role), matter and micro-matter (object), as exemplified in the table below. Each matter can be divided into objects that describe the topic of the case in more detail. Each role/matter/object combination has a unique identification code (see Table 1).

Cases are recorded with metadata, including this classification, the Section of the Court and the judges (anonymised) to which the case is assigned. Histories of cases are recorded following a description in terms of events and states. Each event records a significant action performed during the trial cases, often associated with a formal act (deliberation, order, decree, etc.) together with their related information. A state, on the other hand, concerns the different phases of a trial

Macro-matters (Role)		Matters		Micro-matters (Objects)		
Code	Description	Code	Description	Object n	Code	Description
1	Ordinary Civil Litigation	40	Contracts and obligations	001	1-40-001	Transfer of credits
				...	...	...
		999			1-40-999	Miscellaneous contracts and obligations
		10	Status of the person and personal rights	001	1-10-001	Interdiction
				002	1-10-002	Incapacitation
...	...	...	...	...	...	...

Table 1.  
Tree-structure  
classification of Italian  
civil cases (with  
examples)

procedure, useful to detect the progress of the case towards the final decision (for example, the phase starting with the attribution of the case to a specific judge and the celebration of the first hearing) and to analyse the activity of the different actors involved.

In particular, we consider the date of the event, the date in which the event was recorded, its unique identification code, its textual description, the state in which the process was before the event and the state reached after the event.

An example of a trial history is reported in [Figure 1](#), which shows an illustrative case history. For each case, metadata describing it are available, such as the unique identification code, the code for the role/object/matter, the office, Section and judge they are assigned to, and all the events that have been recorded in the system, with their unique codes and the current state after the event.

All cases have a starting event (IA), that brings it to the AS state (meaning that the case has to be assigned to a Section) and terminate with a “defined” state (DF), which can be associated with one or more events. In this study, we consider cases that are concluded with a final judgement (*sentenza*).

Three dimensions of analysis are considered in this study:

- (1) *Matter*: the content of the case that involves the parties and on which a decision is required by the Court, specified as indicated in [Table 1](#).
- (2) *Sections*: the Milan Court of Appeal is divided into Sections, following the type of matters and cases they handle. Each Section is composed of a panel of judges. In the analysis, we compare juridical matters at the Section level, to identify different practices with a cross-sectional analysis.
- (3) *Variants*: Case Variant analysis was developed, highlighting the most frequent flows a juridical case in that matter can follow and providing statistics on the time of completion for each variant. A Directly-Follows Graphs (DFGs) represents a process graphically.

The process mining tool Apromore [\[2\]](#) directly shows a DFG when loading an event log and was used to visualise the Case Variants of the processes (see, for instance, [Figure 2](#)). A process variant is a complete and unique sequence of activities. Variant analysis is a process mining approach aimed at comparing two or more variants of a process, to identify positive or negative deviances and to possibly generate ideas for process improvements, observing how some variants show different process completion times, with significant deviations in some cases. This approach has the positive effect of enabling targeted and more effective interventions that consider the peculiarities of each juridical object.

For each matter, after observing the principal temporal statistics for the most frequent Case Variants, the first Case Variant was analysed in more detail and deconstructed into the macro-phases that were defined jointly with the staff of assistants. This approach permits a deeper understanding of the development of the case, enabling the extraction of insightful information that can be used to drive the decision-making process to design the necessary interventions aimed at permanently reducing the time taken to define processes.

#### 4.2 Temporal analysis by juridical matter and object

**4.2.1 Analysis by variant.** The analysis focuses on examining the dossiers, grouped by juridical object or matter. The most frequent ones are considered, and a Case Variant analysis is performed. The Case Variants represent variations in the sequences of activities that occur during the development of the judicial process. Case Variant analysis helps monitor the status and performance of processes in a timely manner, enabling targeted and more effective interventions. The three most frequent Case Variants are identified (see [Figure 3](#)).



File number

Section:

Object:

Registration date:

Giudice:

## Appeal Court of Milan 999/2021

2

Property

13/04/2021

4F894EBA4465B803E040A8C001C8156A

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### History of trial

Event Date	Event Code	Current	Event Description	Event Recording Date	Event Recording Hour
DATAEV	CCDOEV	CCODST	CDESCR	DATARE	
04/13/2021	IA	AS	General Register Entry	04/13/2021	16:20:38
04/13/2021	RP	AS	Requested File	04/13/2021	16:20:42
04/13/2021	DECO	AS	Complementary Deposit (annex files)	04/13/2021	16:21:08
04/13/2021	DECO	AS	Complementary Deposit (annex files)	04/13/2021	16:21:35
04/13/2021	DECO	AS	Complementary Deposit (annex files)	04/13/2021	16:21:45
04/13/2021	DECO	AS	Complementary Deposit (annex files)	04/13/2021	16:21:00
04/13/2021	DECO	AS	Complementary Deposit (annex files)	04/13/2021	16:21:17
04/13/2021	DECO	AS	Complementary Deposit (annex files)	04/13/2021	16:21:21
04/13/2021	DECO	AS	Complementary Deposit (annex files)	04/13/2021	16:21:27
04/13/2021	NX	AS	Annotation Inserted	04/13/2021	16:22:53
04/14/2021	AS	GC	Allocation to the Competent Section	04/14/2021	10:48:12
04/19/2021	OF	UT	Judge Appointed	04/19/2021	12:46:47
04/19/2021	OC	UT	Integration of the Compulsory Fee	04/20/2021	08:16:27
06/07/2021	XV	UT	Authorisation to Examine the File (parties)	06/07/2021	11:14:43
07/16/2021	DECO	UT	Complementary Deposit	07/19/2021	09:03:37
08/13/2021	DU	UT	Setting of the First Hearing (Arraignment Hearing)	08/17/2021	12:30:27
08/18/2021	T8	UT	Court (panel of judges) Designated	08/18/2021	11:16:31
09/07/2021	YB	PC	Adjournment to the Hearing for Closing Arguments	09/08/2021	14:26:31
11/05/2021	B2	PC	File acquisition by the chancellor office	11/05/2021	13:22:00
12/30/2021	NX	PC	Annotation Inserted in the Repertoire	12/30/2021	10:06:21
02/04/2022	T8	PC	Court (panel of judges) Designated	02/04/2022	12:35:09
02/04/2022	NX	PC	Annotation Inserted in the Repertoire	02/04/2022	13:16:55
02/09/2022	NX	PC	Annotation Inserted in the Repertoire	02/10/2022	09:40:57
02/09/2022	J1	PC	Submission of Deeds	02/10/2022	09:42:32
02/15/2022	DM	D1	In decision (pending the final decision of a case)	02/15/2022	15:25:58
02/15/2022	NX	D1	Annotation Inserted in the Repertoire	02/15/2022	15:27:16
04/06/2022	DQ	D1	Defence Brief Deposit	04/07/2022	12:18:38
04/06/2022	DQ	D1	Defence Brief Deposit	04/07/2022	12:28:01
04/22/2022	DD	D1	Replication Pleading	04/26/2022	10:28:50
04/26/2022	1F	D2	File Returned to the Judge or the Panel for Decision	05/05/2022	12:06:33
04/26/2022	DD	D1	Replication Pleading	04/28/2022	10:58:31
04/26/2022	DD	D1	Replication Pleading	04/28/2022	12:18:30
05/09/2022	2B	AP	Submission of the Final Decision (Judgment) Draft by the Judge	05/19/2022	07:34:51
05/19/2022	IR	DF	Sending documents to the Revenue Agency	05/19/2022	07:36:36
05/19/2022	2E	DF	Final Decision (Judgment) Filed and Published	05/19/2022	07:35:41
05/23/2022	4B	DF	Returned First Instance File	05/23/2022	15:13:03
07/13/2022	NX	DF	Annotation Inserted in the Repertoire	07/13/2022	22:56:17

Source(s): Authors' own creation

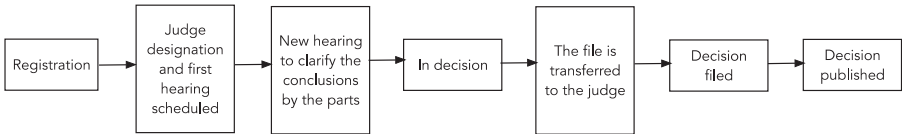
**Figure 1.**  
Example of trial  
history (partially  
anonymised)

Figure 2.  
DFG of an  
ordinary trial

*Case Variant 1* follows all the macro-phases a civil case is supposed to go through: this case represents “the ordinary procedure”. *Case Variant 2* presents an alternative route foreseen by the law, adopting simplified, fast track procedures; it identifies all cases in which the verdict is issued after the hearing. *Case Variant 3* instead solely represents those cases where the law allows to apply another specific short procedure: it includes trials for which the verdict is issued after a second hearing, the hearing for conclusions clarification.

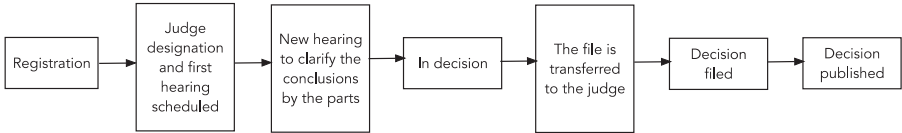
This analysis answers the issue if the supposed simpler rites are effective in the reality and, moreover, if judges are using them instead of more complex ones (when allowed by the law) reaching the expected level.

*4.2.2 Analysis by median duration.* To analyse the duration of the cases, the dossiers are first grouped by juridical matter, and then the median duration of each juridical matter is calculated to compare the matters against one another. The median duration is chosen over the mean duration because it is less affected by outliers. Furthermore, this analysis is used as the basis for the design of a classification system, designed to group matters based on their median duration. The classification defines a set of five weights (1–5) in which matters belonging to weight 1 are those that have the shortest median duration, while matters

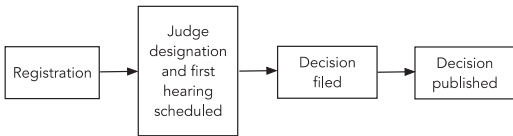


Source(s): Authors’ own creation

*Case Variant 1 – Ordinary proceeding*



*Case Variant 2 – Short (fast-track) proceeding (art. 281sexies; art. 348; art. 309)*



*Case Variant 3 – Short (fast-track) proceeding (art. 281sexies)*

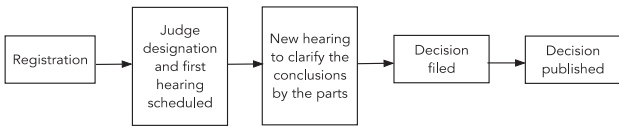


Figure 3.  
Most frequent case  
variants

Source(s): Authors’ own creation



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belonging to weight 5 are the ones with the highest median duration. The thresholds used to define the weights correspond to the empirical distribution quintiles.

#### 4.3 Analysis by section (cross-sectional analysis)

The cross-sectional analysis aims to develop a methodology to evaluate how cases are examined within the Sections, with particular attention paid to the differences that may exist in the examination and resolution of cases concerning different legal matters.

By abstracting the data with reference to the juridical matter, it is possible to observe the distribution of processes in the various Sections and it is easy to compare their performance. It is also interesting to observe the most frequent Case Variants to understand whether there are procedural differences in the case handling. This approach provides information for possible decisions to improve the performance of the Sections, suggesting judges to apply a convenient case management (if allowed by the rules). Additional information that may be important is the number of processes handled per matter and the total number of these handled within the Section. The latter data shows whether the performance of the Section is in any way influenced by the number of processes handled. Such an analysis could be helpful in directing resources to Sections that are slower than average, following an inspection to assess the practical reasons that might influence the duration. This method may be helpful, also, to monitor the long-term performance of the Sections and, in case, to support decisions about their efficiency improvement.

#### 4.4 Analysis of events and their recording timeliness

The history of each case records all events with their date, and the date at which the event was formally recorded in the system as a final step of a single procedural phase, often permitting the start of the subsequent one; considering this recording procedure, it can be beneficial to analyse whether delays in recording an event can have an impact on the duration of the trial, blocking the start of the next phase. For this purpose, process mining can be used considering events as activities, the event date as the starting point and the recording date as the ending point of a phase. Mining the process at different levels of detail, makes it possible to identify events for which delays of recording are incurred, and when these delays can be classified as *blocking*, if no event occurs until the event is recorded (or *non-blocking* in the other cases).

#### 4.5 Analysis of macro-phases of cases

While in the previous section we have discussed methods for analysing cases considering their total duration, another perspective is provided by analysing *states* and *events* recorded for each case; a perspective relevant to monitor the progress of a case to the final judgement and to compare the time needed to conclude a macro-phase between periods and between sections.

“States”, as previously anticipated, regard the progress of a case and are aggregated in macro-phases: (a) period from the formal registration when a case arrives in the Court of Appeal to the attribution of a case to a judge (judge designation) and the first hearing day celebration; (b) period from the day of the first hearing celebration (arraignment hearing) to the day of the new hearing set to clarify the conclusions by the parts; (c) period from the new hearing celebration to the judgement elaborated by a judge and its transfer for the signatures by the college president; (d) period from the judges signature of the final judgement to the filing of the judgement in the administrative office (chancellor office); (e) period from the filing to the judgements formal publication (see [Figure 2](#)).

“Events” are the activities and decisions that open a phase and close it, allowing the case transfer to another phase; examples are the date of registration into the Official Register, the

decision of a section president to appoint a case to a judge, the scheduling of the hearing date, etc. (see Figure 1). For each macro-phase, the starting event(s) and the ending event(s) are identified and the other events in that macro-phase are grouped to represent the process at a more general level.

In the study of the Court of Appeal cases, considering the ordinary cases, we have identified the main phases illustrated in Table 2. The expected durations, according to rules and best practices following interviews within the Court, are also indicated. The starting and ending events for these phases are also listed in Table 3, as they are the basis for the experimental analysis discussed in the results section.

Each macro-phase has an associated time that can be used as a reference for comparisons, in some cases mandated by law, or indicative, based on the interviews carried out and the related rules. Considering the time interval between one event and another in the histories of the examined cases, it is possible to highlight some discrepancies between the times assumed on the basis of the interviews and the real times. By highlighting these differences, it is possible to identify in which process macro-phases it may be more profitable to allocate the personnel to speed up cases decision.

5. Results

5.1 Data sample

The data sample for the analysis is represented by the files of 41,356 civil trials in the Court of Appeal registered between January 2017 and September 2022, downloaded from the SICID information system.

Trials were filtered based on the rituality identified by the system with the code 40: “Ordinary Court of Appeal of the Second Degree”. In this rituality, there are 45 different states, and the possible transitions are 3,600.

Considering cases grouped according to their matter or object can give us a different perspective. The cases analysed belonged to the most frequent juridical matters, in particular: 1/10 – *status of the person and personality rights*, 1/40 – *contracts and various obligations* and 1/45 – *extracontractual liability*. The most frequent objects were also analysed: *professional liability, other contractual liability scenarios, intellectual work performance and responsibility ex Article 2049–2051–2052 cc*.

**Table 2.**  
Phases of a trial in the court of appeal and corresponding expected durations

Phase	Duration
Judge allocation	ASAP
Awaiting hearing	min 90 days
Outcome of the hearing for the clarification of conclusions	approx. 60 days (150 days for foreign residents)
Awaiting filing of closing arguments and replies	max 60 + 20 days
Formulate judgement (verdict)	max 60 days

**Table 3.**  
Trial phases’ start and ending events and corresponding codes

Event description	Event code
General role registration	IA
Judge appointment and first hearing scheduling	OF
Referral to the hearing for clarification of conclusions	YB
In decision	DM
Referral of file to judge for decision	1F
Filing minute of final judgement	2B

The analyses were performed on those trials that reached the defined state (decision). In other cases, the final state is reached when the trial cannot be continued due to anomalies that stop the trial, such as parties not attending the hearings or withdrawals.

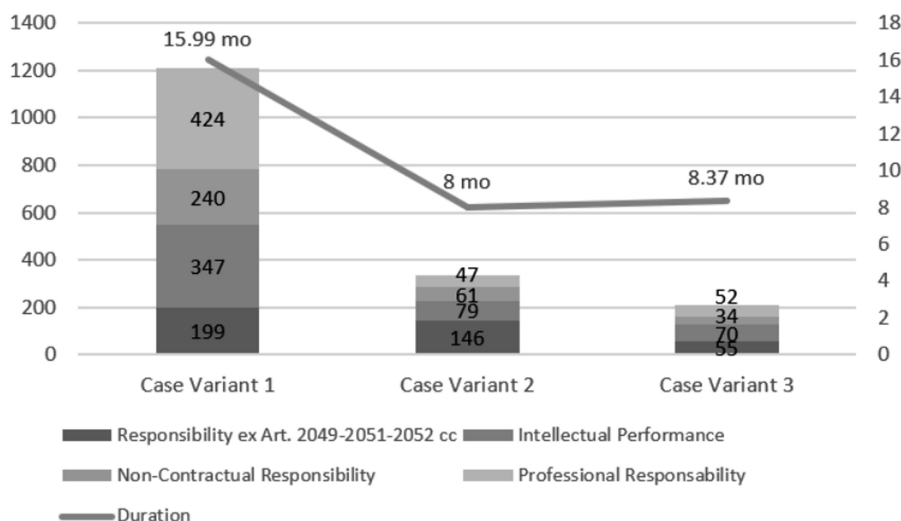
## 5.2 Results of temporal analysis by matter and object

**5.2.1 By case variants.** Variants concerns the procedural phases that characterise the path of the studied cases from the filing step to the final decision (see Table 3 for a description), depending on the selected proceeding by a judge (ordinary or fast-tracks). The analysis carried out so far shows that most cases follow the Case Variant 1 (ordinary proceeding), except for cases that fall under the *object responsibility ex Article 2049–2051 - 2052 civil code*, where the number of processes following Case Variant 1 and those following Case Variants 2 and 3 (the fast-track proceedings) are almost equal. Looking at the same data from the point of view of the Case Variants, on the other hand, if the processes follow Case Variants 2 and 3, they last about half as long as the first Case Variant 1 (Figure 4).

This result could be the base for reviews with the chiefs of the sections and the president of the court, reflecting if the level of the shorter rites is considered coherent with their expectations, or not (or after examining the number of simpler cases that could have been handled with a simplified proceeding); and in the latter case, if it depends in part on the judges' choices, in favour of the traditional ordinary but longer way. Moreover, analysing the differences at the juridical object level supports the understanding of the progress of trials, which translates into more effective targeting of resources to reduce the time required to complete processes.

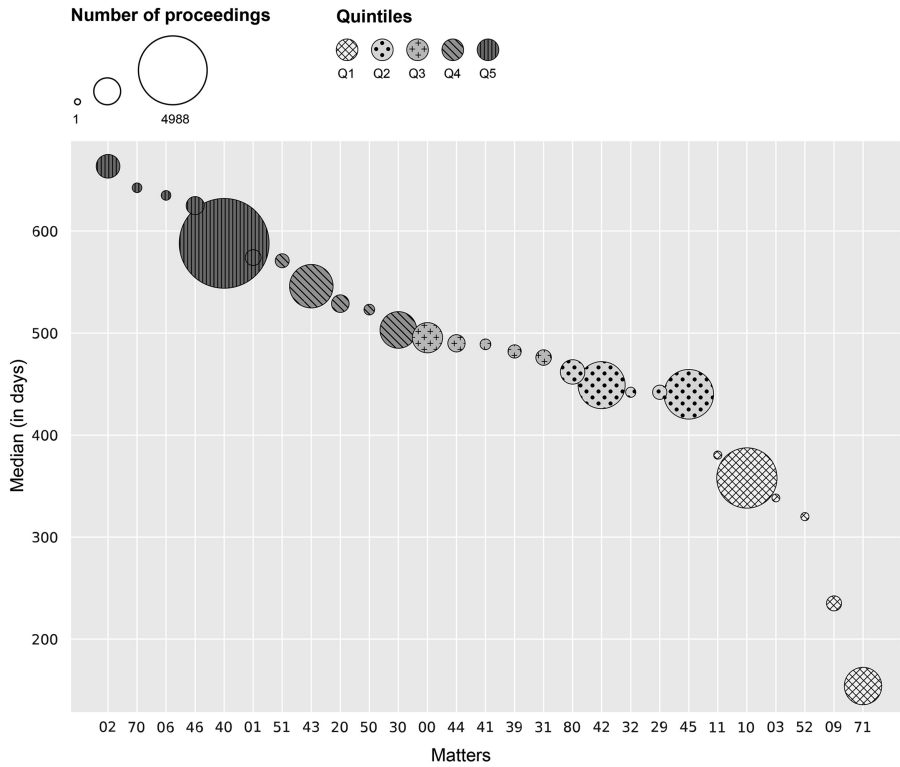
**5.2.2 By median duration.** The duration of cases was analysed by comparing the median duration of the recorded cases for each matter. In the bubble plot in Figure 5, the classification is presented. The size of the bubbles denotes the number of cases considered for each matter. Using the quintiles, the matters are divided into five classes called weights.

The weights go from the first to the fifth quintile. Weight 1 is assigned to matters that require the least number of days to complete a trial and their median disposition time (DT) is in the range of the total median time recorded in the court over five years



Source(s): Authors' own creation

**Figure 4.** Case (proceeding) variants for the most frequent juridical objects - the number of cases by proceeding variants for each object and their median durations are indicated



**Figure 5.**  
Matters grouped by  
median durations

**Source(s):** Authors’ own creation

(median = 472 days). All four other weights exceed the court median DT, with weight 5 objects requiring a longer time to be completed. Although it is important to note that some matters are very rare, with some of them having only one case recorded in the last five years, the analysis shows that there is a significant difference in terms of case duration, depending on the matter the cases fall into, but also that the most frequent juridical matters are not necessarily the ones whose cases have the longest disposition time. This classification could be used as a starting point for determining expected disposition time of the Court and thus to better distribute workloads amongst judges.

*5.3 Results of the cross-sectional analysis*

The three most numerous juridical matters were considered (at the intermediate level of detail of matters) and the First, Second, Third, Fourth and Fifth Civil Sections of the Court of Appeal of Milan were analysed, as shown in [Table 4](#). Looking at both Case Variants, the differences in the durations of the various phases can be observed. The analysis of macro-phases can be useful in identifying any problems occurring in a Section along the process.

The juridical matters considered were: 10 – *status of the person and personality rights*; 40 – *contracts and various obligations*; and 45 – *extracontractual liability*. In this case, the number of trials handled seems to influence the duration for matters 10 and 40, whereas this is not the case for matter 45. Similarly, matter 10 is quicker to resolve, due to the adoption of simplified Case Variants in terms of phases.

							Proposals from an Italian case study
Subject	Section	# of cases	Most frequent case variant	Median duration	Average duration	# of cases	
10	1	556	IA – OF – 2B	353	417	3,375	
	2	601	IA – OF – 2B	337			
	3	531	IA – OF – 2B	378			
	4	544	IA – OF – 2B	386			
	5	1,143	IA – OF – 2B	629			
40	1	1,564	IA – OF – YB – DM – 2B	614	580	4,975	
	2	496	IA – OF – YB – DM – 2B	453			
	3	874	IA – OF – YB – DM – 2B	530			
	4	2,041	IA – OF – YB – DM – 2B	723			
45	2	1,107	IA – OF – YB – DM – 2B	431	590	1,431	
	3	184	IA – OF – YB – DM – 2B	588			
	4	140	IA – OF – YB – DM – 2B	752			

**Source(s):** Authors' own creation

**Table 4.**  
Median durations  
grouped by juridical  
matter

#### 5.4 Results of event analysis

The event analysis has been applied to the available logs. As a result, three events have been highlighted as possibly critical for the delays in their recording in the system with respect to the occurrence of the event or its formal corresponding act:

- (1) General Role Registration (IA)
- (2) Referral of File to Judge for Decision (1F)
- (3) Filing Minute of Final Judgement (2B)

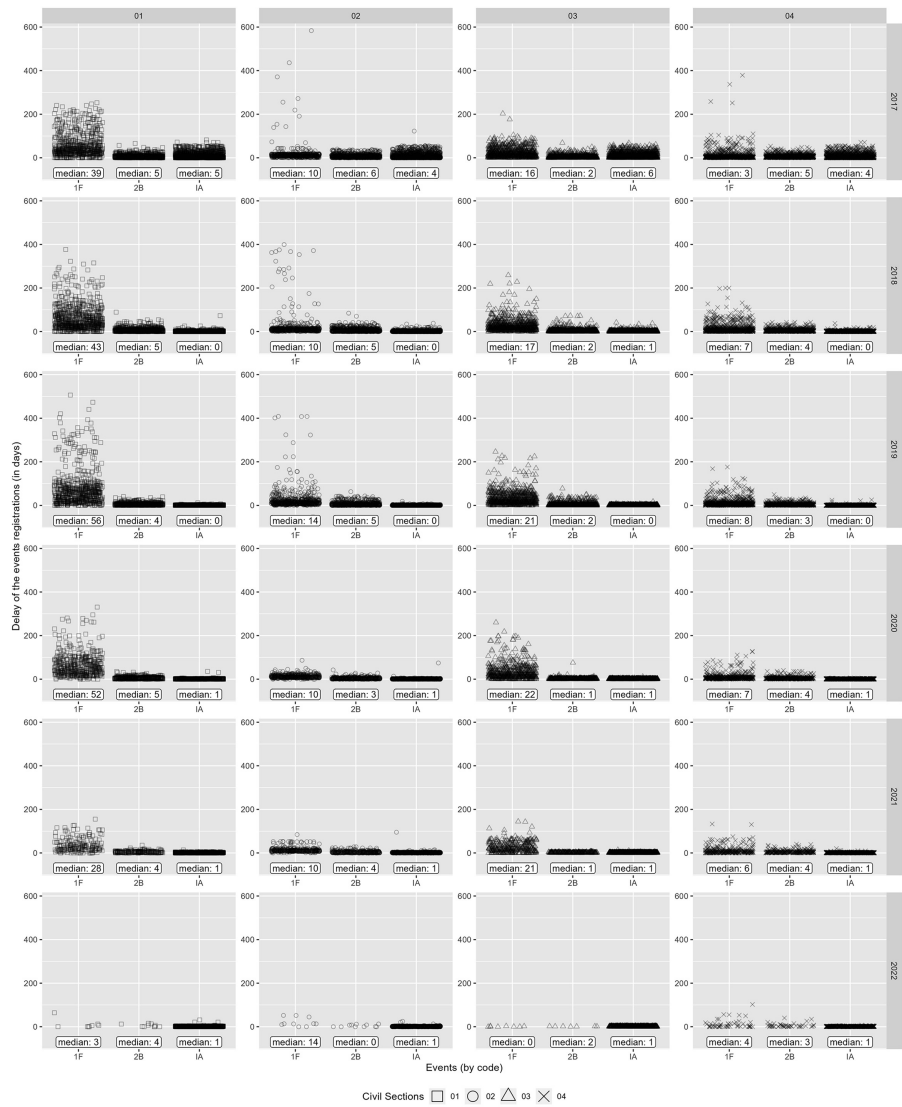
Figure 6 shows the average delays of these events according to years and Sections. In general, data show that the delays have been reduced over the years; however, in some Sections some criticalities remain also in 2022. Specifically, we note that while the delays are progressively decreasing over time, the “Referral of File to Judge for Decision” continues to be recorded sometime after the date of occurrence.

When analysing the events of sentences publication, it emerges that the delay in the registration of the “Filing Draft of Final Judgement” has a direct impact on the publication date of the verdict, as the verdict is usually published immediately after the registration of the previous event. Such a delay in 2022 has an average value for all Sections of 6 days, with a maximum absolute value 40 days. The delay in the registration of the “General Role Registration” event has an average of 1 day, which does not highlight criticalities, but in 2022 it reached a maximum value of 31 days which is still critical. This has an impact on the delay in the assignment to the Sections and therefore to the judges. In consequence, both event IA and event 2B are identified as blocking, as the cases do not progress until these events are recorded. Instead, event “Referral of File to Judge for Decision (1F)” is not blocking in all observed cases, probably due to the possibility for the judges to access trials’ files even if they are not notified.

#### 5.5 Results of the analysis of the trials macro-phases

By focussing on trials’ phases, it is possible to observe how the performance of the Sections varies not only from an overall point of view, but during the development of the case.

The analysis of averages and variances can also be useful to assess which phases show the greatest variability, so that future interventions aimed at reducing process definition times can be better targeted. The maximum durations of each phase of the trial are analysed to highlight the “critical” phases, i.e. those that in the worst-case scenario lead to the longest delay in the finalisation of the trial. This metric can be useful to understand which phases



**Figure 6.**  
Intervals between the  
date of the events and  
their respective  
registration (days)

**Source(s):** Authors' own creation

impact processes the most across all Sections, so that future interventions aimed at reducing process definition times can be better targeted.

As in the event analysis, the analysis of macro-phases of trials for different Sections has shown some variability, especially in the macro-phases “Awaiting Hearing” and “Outcome of the Hearing for the Clarification of Conclusions”. In [Table 5](#) the duration for the most frequent Case Variant in all Sections concerning matter 40 is reported. We also considered the duration of the macro-phases in all the dossiers for all matters, however, as the difference that can be

										Proposals from an Italian case study
Matter: 40	Court sections									
Event description	Event code	1	2	3	4	Avg	StDev	Macro-phase	Duration	
Judge appointment and fist hearing scheduling	0F	0.6	0.4	0.6	0.6	0.6	0.07	Judge allocation	Asap	
Referral to the hearing for clarification of conclusions	YB	4.7	4.5	4.1	6.0	4.8	0.68	Awaiting hearing	min 90 days (150 for foreign residents)	
In decision	DM	9	5.5	8.1	12.4	8.7	2.45	Outcome of the hearing for the clarification of conclusions	approx 60 days	
Referral of file to judge for decision	IF	2.5	2.7	2.7	2.9	2.7	0.14	Awaiting filing of closing arguments and replies	max 60 + 20 days	
Filing draft of final judgement	2B	1.5	1	0.8	2	1.3	0.48	Judgment formulation	max 60 days	
Average duration (months)		18.3	14.1	16.3	23.9	18.1				
Source(s): Authors' own creation										Table 5. Median duration of the macro-phases for matter 40 and comparison with expected durations

found on the average duration of civil cases present a similar behaviour, only the numbers for matter 40 are reported in this work.

This type of analysis can help to identify best practices considering how the same matters are handled in different civil Sections (and, also, by different judges), also considering the differences in the macro-phases.

## 6. Validation of the hypotheses

In this section, based on the results of the analysis, we assess and discuss the validity of the hypotheses that have been introduced in [Section 3](#).

Hypothesis [H1](#) can be positively confirmed, considering the usefulness of the measures provided by the data mining analysis. The originality does not regard the construction of the timeliness indicators, that are in general well known (see for example [Cepej, 2021](#)), but the type of analysis (data mining) based on a large number of cases (41.365 trials), even if not organised in a pre-built dashboard, joined with the easy comparison between years and organisational units. The opportunity to use data directly from the formal registers allows analysis over time and cross sectional to compare the timeliness of the different sections managing cases belonging to the same matter; moreover, it allows the timeline analysis and comparison of the macro-phases and of the main events. In terms of usefulness to improve the performance evaluation, the approaches add more alternatives to the traditional statistic models (that in fact is used by the quoted Cepej documents).

Hypothesis [H2](#) on the effect of European targets of the National Recovery and Resilience Plan on the duration of cases is weakly confirmed. Disposition time only slightly decreases over time. On the other hand, it is clear that the efficiency of the Court clerks in recording events in the system has increased considerably over the years. Considering the total disposition time, it depends heavily on two factors: the matter of the trial and the



variants of process execution allowed/prescribed by the law, which are also dependent on the matter of the trial but also, in certain cases, on the judges' attitudes and decisions. A potential for improvements can be identified in both variants, i.e. (1) comparing sections, as different sections demonstrate different behaviours in handling trials, and (2) the distribution of files to judges considering expected disposition times and expected variants.

Hypothesis H3 concerns the impact of changes in the judiciary laws on disposition times. It emerges that the application of the simplified procedure, when allowed, has an effect on variants. For some juridical objects the new norm results in simplified processes in the most frequent variant, with a significant reduction of times. Further studies are needed to consider the factors that vary in different objects and influence the application of simplified norms.

## 7. Concluding remarks and future work

This paper proposes techniques to analyse cases belonging to different juridical matters and managed by different court sections, to improve a performance monitoring system and the related feedback processes in a court; unlike other research on the judiciary based on statistical data (Raine, 2000), it used a large data set directly extracted from a court digital register. The methodology proposed permits, as underlined in section 5, the (1) evaluation of the Court Sections' performance (with comparisons over time and cross-section) and allows a (2) deep dive into the proceedings macro-phases, matters and proceedings variants to try to locate inefficiencies and to correct them. It represents, also, a fruitful interdisciplinary collaboration between public management and information systems experts.

In detail, it allows to improve efficiency in terms of timeliness of the cases during the different macro-phases workflow, considering the different characteristics of the matters; in terms of quality, it allows to assess more in deep the appropriate case management in terms of proceeding variant (fast-track or ordinary way).

Moreover, these techniques and measures can be used also in the other courts (of every level), even internationally, considering that the structure of the production process is often similar (with the limitation of a digital register availability).

Other topics can be explored in future work: (A) *Weighing files*: the five-years median process definition times can be used as an initial criterion for weighing trials in classes, to help an equal distribution amongst judges. (B) *Analysis of the activities that determine a referral*: the different activities that lead to a postponement of the process can be classified into different types, observing which ones most influence process durations and which juridical subjects are most affected by them. (C) *Judgement type*: the most likely judgements within the same legal matter (confirmation, partial reform, total reform, etc.) can be identified, highlighting patterns or issues that could be used to change the approach of the courts. (D) Improving the *predictive analysis* can bring positive effects: knowing with greater certainty the files with longer duration, it is possible to know beforehand which cases are most challenging to allocate them more staff, thereby reducing costs and decreasing the overall trial duration.

## Notes

1. In Italy, the president of the court is a judge who has organisational functions; and also the sections of the court are directed by a judge with organisational responsibilities; the administrative manager has responsibility only for the management of the chancelleries and the administrative staff.
2. <https://apromore.com/>

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