Temporal properties of legal decision networks: a case study from the International Criminal Court

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Abstract. Many studies have proposed to apply artificial intelligence techniques to legal networks, whether it be for highlighting legal reasoning, resolving conflict or extracting information from legal databases. In this context, a new line of research has recently emerged which consists in considering legal decisions as elements of complex networks and conduct a structural analysis of the relations between the decisions. It has proved to be efficient for detecting important decisions in legal rulings. In this paper, we follow this approach and propose to extend structural analyses with temporal properties. We define in particular the notion of *relative in-degree*, *temporal distance* and *average longevity* and use those metrics to rank the legal decisions of the two first trials of the International Criminal Court. The results presented in this paper highlight non trivial temporal properties of those legal networks, such as the presence of decisions with an unexpected high longevity, and show the relevance of the proposed relative in-degree property to detect landmark decisions. We validate the outcomes by confronting the results to the one obtained with the standard in-degree property and provide juridical explanations of the decisions identified as important by our approach.

Keywords. Legal decision networks, International Criminal Court, Complex networks, Directed acyclic graphs, Temporal analysis

1. Introduction

Many papers have proposed to combine law and computer science. To that regard, one of the main contribution of computer science has been to apply artificial intelligence techniques to legal networks, whether it be for highlighting legal reasoning resolving conflict or extracting information from legal databases. Recently, a new line of research has emerged which consists in considering legal decisions as part of complex networks in order to study the structure composed of the citations between the decisions [1,2,3]. In this context, the networks are depicted by *directed graphs* in which nodes stand for legal decisions and edges stand for citations between decisions. This citation network approach has been applied extensively to the American Supreme Court case-law [4,5,6,7] and has been used in various contexts, ranging from the Canadian [8] to the Italian [9], Dutch [10], French [11,12] or even international [2] legal systems.

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This approach has proven to be particularly efficient for ranking decisions in terms of their importance and even predicting their relevance to ground future decisions. However, most of the former studies consider citation networks as static objects and aggregate all available information, letting aside the temporal aspects of those networks. Yet the importance of a decision strongly depends on its position in the network and thus on the moment it has been issued.

In this paper, we show how accounting for such temporal aspects enables to refine a structural analysis conducted on a citation network. To do so, we first extend standard metrics defined for directed graphs in order to account for temporal properties and propose the notion of *relative in-degree*, *temporal distance* and *average longevity*. We then compute those metrics for the networks composed of the decisions taken in the *Lubanga* and *Katanga* case-law, the major trials of the International Criminal Court (ICC). Each of those historical cases generated more than a thousand decisions, a remarkably high amount of decisions for a judicial proceeding. Results show the relevance of the proposed metrics for highlighting non trivial properties of the temporal structure and identify landmark decisions.

The reminder of the paper is organised as follows. First we describe the context of the ICC and in particular the two cases under study (Section 2) before defining the framework and the metrics used throughout the rest of the paper (Section 3). Then we conduct a temporal analysis on the two case-law (Section 4) and use the proposed metrics to rank the decisions in terms of their importance (Section 5). Finally, we conclude the paper by laying the foundations for future works (Section 6).

2. The International Criminal Court

The International Criminal Court is the first permanent international criminal jurisdiction. It aims at ending impunity for the perpetrators of the most serious crimes against the international community: genocide, crimes against humanity and war crimes.

The creation of the ICC follows the steps of the first international tribunal, held in Nuremberg in 1946 to prosecute the Nazi leaders responsible for the crimes committed during World War II. It was successive to the two United Nations special international tribunals set up in 1993 and 1994 to judge the crimes committed in ex-Yugoslavia and Rwanda. This International Criminal Court was created by an international treaty – the Rome treaty signed in 1998 and endorsed today by 123 countries – and started to function in 2002. It is then an extremely recent international Court, whose first trial opened in 2009 and that rendered its first verdict in 2012.

Until now, twenty-two cases have been opened. They concern nine countries: Democratic republic of Congo, Uganda, Sudan, Central African Republic, Kenya, Libya, Ivory Coast and Mali. So far only 3 cases are closed, the ICC reaching a verdict on the guilt of the accused and pronouncing a sentence: the *Lubanga* case [2], the *Katanga* case [3] and the *Ngujolo* case [4]. These two last cases – *Katanga* and *Ngujolo* – were originally joined

[2] Verdict on the 14th of March 2012; Sentence on the 12th of July 2012; both decisions confirmed on appeal on the 1st of December 2014.

[3] Verdict on the 8th of March 2014; Sentence on the 8th of May 2014.

[4] Judgement of acquittal on the 18th of December 2012; decision confirmed on appeal on the 27th of February 2015.

and only severed into two different cases after the trial to allow the Court to acquit one of the accused – Mathieu Ngujolo – for lack of evidences. Yet, the *Ngujolo* case produced in itself too few independent decisions (88 decisions) after being disjointed from the *Katanga* case to be included in our analysis.

Thus in this paper we only focus on the ICC first closed cases: *Lubanga* and *Katanga*. But even if the number of cases is not very large, it is important to state that they produced almost 2300 decisions providing a rather important corpus to analyse. Besides, those cases are the first of this innovator jurisdiction and, as such, are of the utmost importance.

The *Lubanga* and *Katanga* cases were indeed the two first trials held by the ICC. They were related to the crimes committed in the Democratic Republic of Congo. Thomas Lubanga Dyilo was a former political leader and warlord. He was convicted on the 14th of March 2012 for having committed war crimes (enlisting and conscripting of children under the age of 15 years and using them to participate in hostilities). He was sentenced to 14 years of imprisonment. Both decisions were recently confirmed on appeal, on the 1st of December 2014. Germain Katanga was also an armed group leader and was found guilty as an accessory of crime against humanity and war crimes, for murdering and attacking a village in the DRC. He was sentenced to 12 years of imprisonment. In both cases, the decisions on the victims reparations have still to be rendered. Dealing with war crimes and crimes against humanity, these two proceedings were extremely long and complex. They were affected by numerous suspensions and interlocutory appeals, making them original and fundamental cases for the Court, as well as paradigmatic examples to our study.

3. Directed graphs and temporal constraints

It is quite usual to represent a citation network as a directed graph $G = (V,E)$. In our context, a node $v \in V$ will represent a legal decision – identified by its ICC number – and a link $(u,v) \in E$ between two nodes u and v exists if the decision u cites the decision v.

Note that although this representation does not directly integrate temporal information, some constraints due to causality are somehow encoded in the formalism. The graph is in fact a *directed acyclic graph* (DAG) since, for obvious reasons, the decisions can only refer to existing ones, thus inducing an acyclic property in the structure.

Once the citation network has been represented through the use of a DAG, one can turn to a formal analysis of the structure. In the rest of the section, we detail the possible approaches. We start by recalling the usual metrics defined for a DAG (Section 3.1) before proposing two new metrics accounting for temporal properties: the *relative in-degree* (Section 3.2) and the *average longevity* (Section 3.3).

3.1. Standard metrics

Depicting a citation network as a directed graph enables to analyse its structure. The usual statistics used to characterise such a graph involve its size ($n = |V|$), its number of links ($m = |E|$) and its average degree ($k = \frac{2.m}{n}$), that is the number of citations a node has on average. Over those notions, one can also study the density $\delta = \frac{2.m}{n.(n-1)}$. This quantity is usually small as real networks happen to be very sparse.

Those metrics characterise the general organisation of the links but we can also focus on specific metrics defined to quantify the importance of a node in a networks. To this purpose, the standard approach consists in relying on the number of times a node is cited by another one. More formally, if $v \in V$ is a node, we denote by $C_{in}(v) = \{u \in V \mid (u,v) \in E\}$ the set of decisions that *cite* v and we call $d_{in}(v) = |C_{in}(v)|$ the in-degree of v[5]. Intuitively a high in-degree indicates that a decision is used to ground many future decisions thus quantifying its importance. In the context of legal networks, this notion is also referred to as the *authority score* [5,10]. Applied on the Lubanga case, we showed in a previous study that it enabled in particular to shed some lights on the procedural aspects of the International Criminal Court and put an emphasis on the key themes addressed by this jurisdiction [2].

3.2. Relative in-degree

However, it might be objected that the in-degree of a decision is strongly related to when it was issued. For instance, recent decisions will more likely have a small in-degree due to the fact that fewer decisions have the possibility of citing them.

To overcome this issue, we propose here to put this absolute value into perspective and relate the in-degree of a decision to its position in the network. Let $v \in V$ be a node and $t(v)$ be the date at which $v \in V$ is created. We call *relative in-degree* of v the value $d_{in}^{rel}(v)$ defined by:

$$d_{in}^{rel}(v) = \frac{d_{in}(v]}{|V_{>}(v)|} \tag{1}$$

where $V_{>}(v) = \{u \in V \mid t(u) > t(v)\}$ denotes the set of nodes that appear after v. Thus $|V_{>}(v)|$ corresponds to the maximal value the in-degree could be. This modification of the standard in-degree property should enable in particular to detect important decisions that arise at the end of a case.

3.3. Temporal distance and average longevity

Another temporal aspect might help detecting landmark decisions. Several studies [5,6] highlighted the fact that, while most of decisions cease to be cited after a while, landmark decisions continue to be cited over time. Relying on this observation, we propose to use the time between the date of two related decisions as an indicator of the importance of the decision being cited.

More formally, we call *temporal distance* of a link $(u,v) \in E$ the value $td(u,v) = t(u) - t(v)$. Building upon this notion, we define the *average longevity* $lg(v)$ of v as the average temporal distance over all in-links of v :

$$lg(v) = \frac{\sum_{u \in C_{in}(v)} td(u,v)}{d_{in}(v)} \tag{2}$$

A high average longevity of a decision means that this decision keeps being used to ground future decisions as time passes thus indicating that it is a good candidate for a landmark decision.

[5]Dual notion for the out-degree can be defined as well.

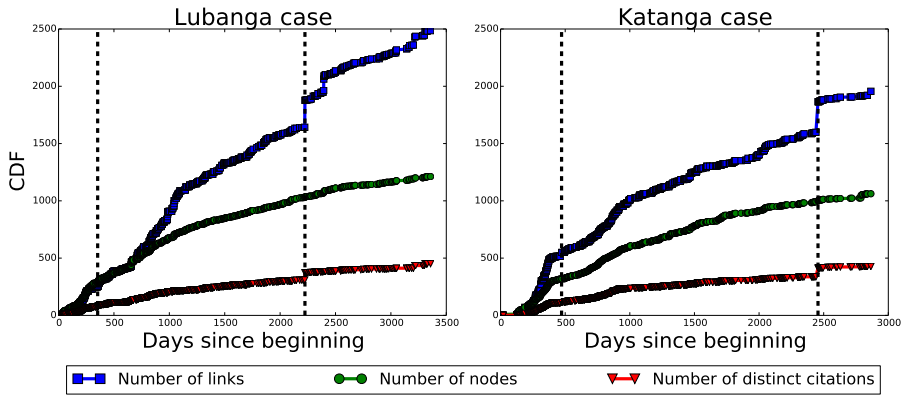

Figure 1. Evolution of citation networks for Lubanga (left) and Katanga (right) cases.

4. Temporal analysis

In this section, we analyse the evolution of different metrics over the time for the two ICC first closed cases, which generated almost 2300 decisions and some landmark decisions. Note that the two networks under studies are very similar in terms of their global characteristics (see Table 1). They have a similar size (around 1 000 decisions and 2 000 citations), an almost identical density, and lasted both approximately 3 000 days. This legitimates the comparison of the analysis conducted on those two cases. It is worth noticing that the average in-degree is low (around 4 citations only in average) which is in contrast with the in-degree of landmark decisions (close to hundreds of citations). This phenomenon, already observed and analysed in [2] justifies the use of degree-related properties to detect important decisions.

	***Lubanga* case-law**	***Katanga* case-law**
nb of decisions	1 212	1 061
nb of citations	2 486	1 955
nb of citations / decisions	4.10	3.69
density (10^{-3})	3.4	3.5
duration (days)	3 358	2 865

Table 1. Global statistics of the *Lubanga* and *Katanga* decision networks

We turn now to a proper temporal analysis of those networks. We start by studying how global quantities evolve (Section 4.1) before focusing on nodes and links properties (Section 4.2).

4.1. Evolution of the network's structure

We start by studying how the networks of citations grow. Figure 1 presents the cumulative distribution function (CDF) of the number of citations (top), the number of decisions (middle) and the number of distinct cited decisions (bottom) both for the *Lubanga* (left) and *Katanga* (right) cases. The vertical dashed lines stand for the dates of the two main

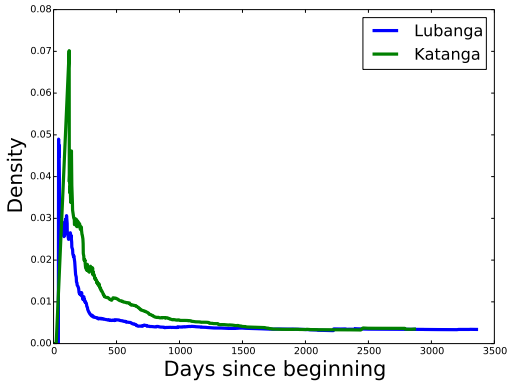

Figure 2. Evolution of the density of the networks in the *Lubanga* and *Katanga* case.

decisions of the cases, namely the *Decision on the confirmation of charges* which marks the end of the pre-trial and the beginning of the trial (first line) and the *Verdict* which marks the end of the trial and the beginning of the appeal phase (second line).

The two studied cases show a similar behaviour. While the number of decisions increases with a continuous rate since the beginning of the cases, one can observe that the number of links has a sharp increase around the end of the pre-trial phase, thus revealing that the number of citations per decisions has changed. But although this increase is important, the number of *distinct* decisions cited remains quite low. This indicates that some of the decisions attract most of the citations while others remain poorly referred to. This non trivial phenomenon highlights again the relevance of degree-related properties to help identifying important decisions in the networks.

Another noticeable property is the sharp increase of the number of links just after the verdict in both cases. As expected, this decision triggers many citations, in particular in the context of the *Lubanga* and *Katanga* cases considered in this study which are the first cases of the ICC and thus well referred to. A second sharp increase just after the Court reached a verdict in the *Lubanga* case can be observed. This is due to the *Decision on sentence*, the second main decision with the verdict, rendered at the end of a trial.

It is worth noticing that this continuous network's growth is not trivial and other properties does not follow such an evolution. Figure 2 presents for instance the evolution of the density of the networks over the time. The behaviour is completely different from the one above. One can indeed observe some fluctuation at the beginning of the cases with particularly high values. But after a very short period of time (before the end of the pre-trial), this property rapidly converges to a value which turns out to be the density of the complete network. Note that, as expected in real complex networks, the density is very low. A link between two nodes is particularly rare (only less than 1% of the possible links exist) thus strengthening the meaning of a citation when it exists.

4.2. Distribution of temporal distances and average longevity

The observations stated in the previous section focused on global statistics. We turn now to properties of single nodes and links of the networks and study to that purpose the metrics defined in Section 3.3.

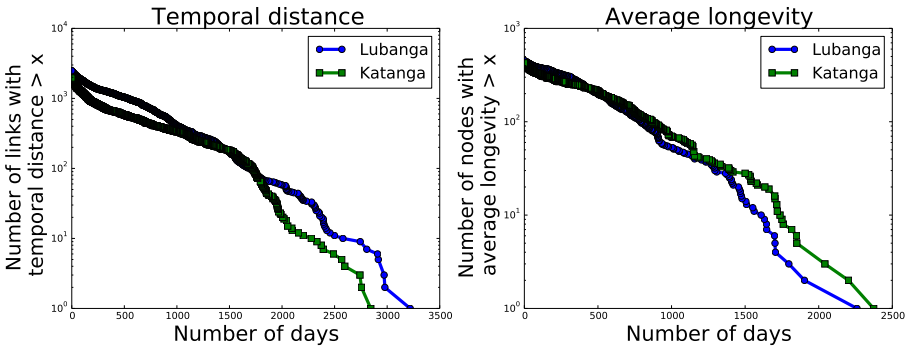

Figure 3. Inverse cumulative distribution of the temporal distance (left) and average longevity (right) in the Lubanga and Katanga cases.

Figure 3 presents the inverse cumulative distribution function (ICDF) of the temporal distances of all the links (left) and the average longevity of all the nodes (right). In other words, a (x,y) dot in the plot indicates that y links (resp. nodes) have a temporal distance (resp. an average longevity) greater or equal to x. It is worth noticing that the y-axis is in log-scale in both plots, which allows to zoom in on small y-values (right part of the plots) but tends to compress high values (left part of the plots).

Whether it be for the *Lubanga* or *Katanga* case, the left plot shows an expected distribution of temporal distances around small values. For instance, it turns out that more than half of the citations in the *Katanga* case-law have a temporal distance lower than 6 months while the trial lasted more than 6 years. Similarly, the right plot shows that decisions tend to rely on recent decisions in average, which is what is commonly observed in such contexts.

However the two plots also show a surprising behaviour. It is indeed remarkable that some links have an unexpected high temporal distance, some of them covering almost completely the time span of the networks. Similarly, some decisions have an average longevity particularly high compared to what is commonly observed. This indicates a non trivial temporal property of those legal networks which strengthen the interest of relying on temporal distances to detect landmark decisions.

5. Ranking decisions

Following the observations made in the previous section, we turn now to the use of the proposed metrics to sort the decisions. This section presents the results obtained when relying on the standard in-degree property (see Section 3.1) compared to the proposed relative in-degree (see Section 3.2) or average longevity (see Section 3.3). For the two trials, we sorted the decisions by decreasing order of the considered property and kept the ten top decisions.

Tables 2 and 3 present the different rankings obtained using the three properties for respectively the *Lubanga* and *Katanga* case-law. We do not comment the in-degree ranking (left column) since it has been done extensively in a previous paper and let the reader refer to [2] for detailed explanations. Let us only recall that the first decisions

Rank	In degree	Relative in-degree	Average longevity
1	ICC-01/04-01/06-2842	ICC-01/04-01/06-2842	ICC-01/04-01/06-2
2	ICC-01/04-01/06-2901	ICC-01/04-01/06-2901	ICC-01/04-01/06-773
3	ICC-01/04-01/06-1119	ICC-01/04-01/06-2904	ICC-01/04-01/06-568
4	ICC-01/04-01/06-1401	ICC-01/04-01/06-2909	ICC-01/04-01/06-1084
5	ICC-01/04-01/06-803	ICC-01/04-01/06-2517-Red	ICC-01/04-01/06-1399
6	ICC-01/04-01/06-772	ICC-01/04-01/06-1401	ICC-01/04-01/06-1562
7	ICC-01/04-01/06-1432	ICC-01/04-01/06-1119	ICC-01/04-01/06-803
8	ICC-01/04-01/06-1191	ICC-01/04-01/06-1432	ICC-01/04-01/06-772
9	ICC-01/04-01/06-2517-Red	ICC-01/04-01/06-2844	ICC-01/04-01/06-1556
10	ICC-01/04-01/06-1335	ICC-01/04-01/06-2434-Red2	ICC-01/04-01/06-1486

Table 2. Decision's ranking of the *Lubanga* case-law

Rank	In degree	Relative in-degree	Average longevity
1	ICC-01/04-01/07-1	ICC-01/04-01/07-3319	ICC-01/04-01/07-1547
2	ICC-01/04-01/07-90	ICC-01/04-01/07-3371	ICC-01/04-01/07-717
3	ICC-01/04-01/07-3319	ICC-01/04-01/07-3327	ICC-01/04-01/07-1788
4	ICC-01/04-01/07-846	ICC-01/04-01/07-3003	ICC-01/04-01/07-1665-Corr
5	ICC-01/04-01/07-933	ICC-01/04-01/07-1347	ICC-01/04-01/07-747
6	ICC-01/04-01/07-1347	ICC-01/04-01/07-1347-Corr	ICC-01/04-01/07-1737
7	ICC-01/04-01/07-1347-Corr	ICC-01/04-01/07-1	ICC-01/04-01/07-1553
8	ICC-01/04-01/07-259	ICC-01/04-01/07-846	ICC-01/04-01/07-1967
9	ICC-01/04-01/07-108	ICC-01/04-01/07-933	ICC-01/04-01/07-1347
10	ICC-01/04-01/07-1491-Red	ICC-01/04-01/07-1737	ICC-01/04-01/07-357

Table 3. Decision's ranking of the *Katanga* case-law

detected are indeed among the most important of the cases, namely the verdict, the sentence and the decision on victim's participation (respectively ICC-01/04-01/06-2842, ICC-01/04-01/06-2901 and ICC-01/04-01/06-1119 in the *Lubanga* case-law for instance). If the two first decisions are expected, the third one shows that such metrics enables to detect non trivial decisions. Indeed the place of victims in front of International courts is a fundamental question that judges have currently to address and one of the major stake for the legitimacy of the ICC.

As regard the ranking provided by the relative in-degree, it turns out that it makes emerge important decisions that are more recent (highlighted in dark red in the column) and not detected by the in-degree property. This is particularly obvious in the *Katanga* case-law as the top ten decisions identified by the in-degree property are among the oldest. They have in average only 336 older decisions (less than 33% of the total number of decisions). In contrast, the top ten decisions identified by the relative in-degree are among the youngest: they have in average only 262 younger decisions (less than 25% of the total number of decisions).

Regarding the *Lubanga* case, the ranking generated by the relative in-degree shed light on one of the fundamental decisions of the case: the *Decision establishing the principles and procedures to be applied for reparations* (ICC-01/04-01/06-2904). It is one of the three decisions on the merits that the ICC issues at the end of a trial (along with the verdict and the sentence). This decision was not part of the decisions classified as important by the in-degree. The relative in-degree then allow to capture this very important

decision (ranked third), along with the appeal (ICC-01/04-01/06-2909, ranked fourth) against this very decision which is indeed still subject to proceedings.

As regard the ranking related to the average longevity, this property also reveals other important decisions (highlighted in dark red in the column) not identified as important by the other metrics. Among them, one can point out in particular the *Decision on the manner in which evidence shall be submitted* (ICC-01/04-01/06-1084, ranked four) in the *Lubanga* case which, although dealing with a procedural aspect, is of utmost importance in the proceedings and is related to several litigation that occurred during the trial.

Those results show that the proposed metrics, and in particular the relative in-degree, are able to highlight the importance of recent decisions, even if they have not reached an amount of citations that make them emerge at the same level than old legal decisions (for instance, ICC-01/04-01/06-2842 has 82 citations while ICC-01/04-01/06-2904 has only 21 citations). However, one can notice that old landmark decisions are still detected in the rankings (ICC-01/04-01/06-2842 and ICC-01/04-01/06-2901 at the same rank in the *Lubanga* case and ICC-01/04-01/07-1 in a lower rank in the *Katanga* case). Those metrics seem then well balanced and are a good alternative to assess the importance of new decisions to ground future legal decisions.

6. Conclusions

In this paper, we analysed the legal decisions of two first trials of the International Criminal Court in the light of the network science approach. It consists in studying how the citations between the decisions are organised in order to detect landmark decisions. In order to refine standard metrics used in such contexts, we proposed to rely on the notion of *relative in-degree*, which relate the number of citations a decision receive to its position in the network, and the notion of *average longevity* that attempts to put an emphasis on decisions that are continuously cited over the time.

In order to validate the proposal, we computed the top ten decisions identified as important by the metrics and confronted the outcome to the standard in-degree property. Results show the proposed metrics are able to highlight the importance of recent decisions while still detecting older landmark decisions.

Those results lay the foundations for future work. First, it would be interesting to assess the relevance of the dual notion of relative out-degree which could be an alternative to the *hub score* [5] for detecting decisions well grounded. Besides, it would be fruitful to extend the temporal analysis such as the one proposed here to the evolution of the citations between legal decisions and articles of law. Indeed, we already showed in [2] that analysing the hybrid structure involving both legal decisions and articles of law allows to reveal non trivial overlapping among the citation processes. It is very likely that time plays also a key role in the way such overlapping organise themselves and that integrating time constraints would shed some new light on these key structural properties.

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