The case for computationally forecasting the evolving interactions between CJEU Judgements and EU legal acts to anticipate policy adoption

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Abstract

Before the Commission proposes new initiatives, it is responsible for assessing potential consequences, especially on policy adoption issues, ensuring that legislative proposals correspond to the needs of those most concerned and avoid unnecessary administratively costly amendments. Data-driven, empirical tools can provide valuable insight for policy-makers, enabling them to foresee potential issues or delays of transpositions. In this contribution, we elaborate on the creation of *PolNetCast* a computational framework that will use an extended version of the CJEU citation network and the conjunction of interactions with the EU mandatory acts (directives, regulations and decisions) over time, where each EU law represents the centre of specific clusters capturing the trajectory of potential issues about EU policy adoption in member states. *PolNetCast* is an application of network topology-based machine learning that can learn from the history of the network and forecast future interactions. We expect this application to be an important step for data-driven legislative proposals on EU and national level, paving the way to FAIR policy making.

Keywords – Policymaking; Complex Networks; Topological Features; Machine Learning; EU law

1. Introduction

There is tremendous potential for data-driven approaches to inform the policy research and law enforcement in the EU. In this paper, we describe *PolNetCast* (Policy Networks Forecast Framework), a policy forecasting tool using network science, and its potential benefits for policymakers in the EU. Network Science has attracted vast quantities of research in recent years, spanned multiple disciplines and offered invaluable insights into multiple phenomena (Molontay & Nagy, 2019). Additional to the future benefits on a national level policymaking, *PolNetCast* may also help law and governance researchers understand the relationship between decisions from the Court of Justice of the European Union (CJEU) and policymaking life-cycle, and how CJEU decisions influence legislative and policy outcomes.

This contribution focuses on only *mandatory* EU legal acts: regulations, decisions and directives. *Regulations* are immediately binding throughout the EU, and *Decisions* are binding only for the specified groups or individuals to which they apply[1]. *Directives* are not directly applicable but focus on desirable objectives. Once adopted by the EU, they are transposed by the individual member states, which react differently to new EU requirements[2]. National authorities have the prerogative over the details regarding the transposition and establish adequate policies. In the proposed study we define *Policies* as national governmental actions and initiatives introduced in response to new or amended compulsory EU laws. Research on the relation of EU law, national policies and related CJEU decisions as a Complex Network is scarce (Albert 2002; Blauberger & Schmidt, 2017). Numerous studies have shown that case law sets precedents for other case law; however, the exact influence of case law on EU legislation, especially *Regulations*, and also policy change, has largely been overlooked (Blauberger & Schmidt, 2017). There is evidence that legislation does respond to case law and has a substantial impact on EU policy making (Martinsen, 2015); however, more interdisciplinary research is required. Identifying indications of causality is critical in public policy impact estimation, as well as in later policy evaluation (Venetoklis, 2002). How are the CJEU's decisions involved in the policymaking process, and can they influence legislative or policy outcomes?

[1, 2]Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union (TFEU) [2016] OJ C 202/1.

Blauberger and Schmidt (2017) mention the expansive effect of case law over time, and suggest that one cannot capture its influence on policy changes by studying individual cases. We thus propose to use a whole network approach as a means for analysis of the entire legal structure. This contribution aims to include the entire EUR-Lex corpora and create an extended citation network of CJEU judgements (case law) and the corresponding EU legal acts, specifically directives, regulations and decisions. The edges will be the citations or referrals between the nodes. Furthermore, it aims to forecast the evolution of the network's expansion and connections over time and train a machine learning algorithm based on the network features and their changes in order to detect patterns. The framework aims to forecast topology, or the shape of networks, not solely to predict network links, and will demonstrate the power of combining network theory with topological-based machine learning. This will provide valuable insights into future case law and legislation interactions and introductions, which will in turn predict future issues of policy adoptions.

Many real-world networks have previously been created and analysed, particularly, there are multiple network analyses of case law, such as Van Kuppevelt & Van Dijck's (2017) application to Dutch case law, in which the nodes were the individual cases connected by citations. There has been an insightful network analysis on cases citing US Supreme Court opinions by Fowler et al. (2007). Malmgren analysed a CJEU case law citation network, but filtered out 'formal citations', those of the Court citing appealed cases (Van Opijnen, 2012). Panagis and Šadl (2015) modelled EU case law and focused on case connections through paragraph contents and text similarity, not just citations. These studies do not specifically connect the case laws with EU legal acts, nor do they track the evolution of the network over time. *EUCaseNet* is a platform that enables network analysis of all CJEU case law, analyses network topology and but not necessarily models the network evolution over time (Moodley et al., 2019a), it differs from our application primarily in that it does not attempt to connect these cases to the three EU mandatory acts.

The *PolNetCast* framework proposed in this paper will enable policymakers to foresee not only national policy implementations resulting from predicted future EU legal initiatives, but also future court cases resulting from contestations and issues due to the introduction of new laws. Although policies are not included as nodes in the network, the model's accurate predictions will provide valuable insights for future policy-making. It will supply a good overview of EU legal developments and an empirical background for decision-making.

Finally, we also acknowledge that the desirability of FAIR (Findable, Accessible, Interoperable and Reusable) principles paradigm can potentially fit into the policy-making life cycle. FAIR requires researchers to reveal all steps of their data collection and management process (Wilkinson, et al. 2016). This ensures a high standard of data quality, transparent methods and enables the data to be reused by other teams later in time (Moodley et al., 2019a). Following the same rationale, data-driven policy making can ensure a FAIR life cycle.

The remainder of this paper is set out as follows: we discuss the importance of our framework and data-driven predictions for future legal decision-making, especially regarding national policies, before explaining the technologies that will be used to make the predictions. Lastly, our conclusion summarizes the research content and identifies potential limitations .

2. Potential of complex networks forecasting of EU law for policy making

Transpositions, whilst specifically undefined, have deadlines, and the inability of a member state to implement the provisions may result in CJEU judgments regarding potential punishments[3]. Late transposition is a continual problem identified by the EU- one that prevents the objectives of the EU law from being achieved and blocks citizens from receiving its benefits[4]. A number of factors influence the implementation of policies, including national bureaucracies, politics and conflicting agendas of stakeholders (Venetoklis, 2002). Stuetz (2004) found that there are often unsatisfactory efforts to apply directives and the implementation of policies can take a very long time. Of 15 countries studied by Falkner et al. (2002), all required changes in laws to accommodate new directives, although to different extents depending on how easily the new legislation was absorbed into existing national systems. Implementation problems usually (although not always) occur if there exists a large policy mismatch between EU legislation and domestic policy methods (Falkner et al., 2002).

The Commission is responsible for assessing the potential consequences of new legislation, ensuring that the impacts of proposals correspond with their goals, and unnecessary or costly amendments are avoided (Smith, 2018). This is particularly important regarding national

[3, 4]Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union (TFEU) [2016] OJ C 202/1.

transpositions and policy adoptions. Policies have both short and long-term impacts on millions of citizens and involve substantial administrative resources (Smith, 2018). Governments are also responsible for measuring the effects of their own policies (Smith, 2018). Reliable predictions on impacts provide the opportunity to assess their social, economic and environmental dimensions (Stuetz, 2004). Governments can identify potential target populations, resources required, national capabilities and other consequences (Venetoklis, 2002). An increased ability to foresee negative consequences of, or delays in, policy adoptions would provide valuable insight for decision-makers (Smith, 2018). Governments (or European Regulatory Networks for example (Martino & Fabrizio, 2011)) would also be able to take preventative action and aim to minimize any policy mismatch (Falkner et al., 2002). Overall, this would lead to more effective policy making and implementation of EU law (Smith, 2018).

However, there is currently a lack of large-scale data-driven predictive models available to assist policy-makers. When data scientists provide technical expertise, they can help legal experts focus on applying their knowledge and experience to the interpretation of and response to the model's outcomes. The *PolNetCast* framework has the potential to enable policymakers to foresee both national policy responses to future EU legal initiatives, and future court cases resulting from contestations and issues arising because of new introduced laws.

3. Technologies behind complex networks forecasting

The advance of computerized systems in the administrative systems of courts enables systematic access to the complete database of their decisions (Leitão et al. 2019). The use of computational tools and network science methodologies to analyse such decisions has brought new insights into the collective behaviour of legislative bodies. EUR-Lex is by excellence the most important public data source that offers access to EU law and, importantly for our proposition, contains preparatory acts, legislative procedures, litigation and their linked instruments. (Moodley et al., 2019b) explores how using the EUR-Lex corpora can approximate its citations network using similarity metrics, and a large amount of research has shown the potential of exploiting the cases citation network, related to the CJEU (Mirshahvalad et al., 2012). Previous research has inquired into legal citations practices in both domestic courts, such as the United States Supreme Court (Fowler et al., 2006), the International Court of Justice (ICJ) (Alschner & Charlotin, 2018).

Complex Networks are popular tools, both theoretical and analytical, that are commonly used to describe and analyse interacting phenomena that occur in the real world (Newman, 2003). Furthermore, dynamic networks can be used to model the evolution of a system (Rossetti 2019) and studying them to learn graph evolution behaviour is feasible through a variety of approaches. The *PolNetCast* framework maps the dynamic phenomena of EU legal acts evolution and their related CJEU cases dealing with adoption issues with temporally ordered series of subgraphs snapshots at regular intervals, tentatively one month. Some work has been done that includes time-based features and incorporating dynamic changes in each graph into the analysis can also provide useful insights about the changes (Appel et al., 2018). Additionally, we will incorporate static network properties for legal citations on each subgraph as explored by Van Opijnen (2012) and more recently by Van Kuppevelt and van Dijck (2017). In our approach, each observation is a subgraph rather than a single node-node interaction making it a longitudinal set, using feature extraction methods, global and local approaches will be explored, mainly based on the proposed taxonomy by Mutlu et al. (2018). Nevertheless, we intend to start first considering computationally efficient topological features discussed by (Fire, et al., 2011).

Over the last few years, networks have been combined with machine learning approaches to predict the classes of nodes or of full networks (Fan et al., 2019). The main idea is to combine topological graph structure and temporal features. Each subgraph is in fact an ego-centric directed network on a longitudinal axis, where the centre node refers to one EU legal act, and each outgoing relation refers to the legal basis, recitals and proposals those laws are based on; each incoming relation is case law or related instrument cited. The dataset will be split on train and test, to perform machine learning modelling. We intend to make a differentiation of link prediction algorithms proposed by Chen et al. (2005) where topological features are also utilized, and whose task was to predict new relations in the graph topology. However, our task is to forecast the subgraphs behaviour by mapping their topology. Although LSTM (Hochreiter & Schmidhuber, 1997) is the most popular technique for forecasting among machine learning models, we opt for "ensemble learning" approach such as Random Forest (Breiman, 2001), invoking the advantage of interpretability over other techniques such as *Artificial Neural Networks* or *Support Vector Machines*. We will incorporate a cross-validation approach to ensure model reliability.

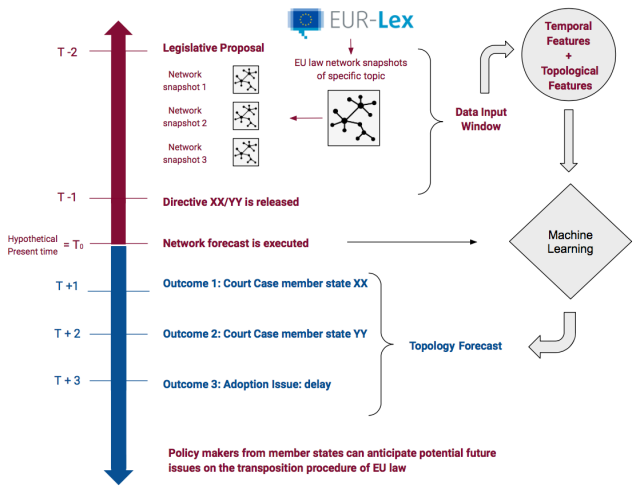

Figure 1. PolNetCast Framework: topology-based machine learning for forecasting EU policy dynamics.

4. Conclusion

We have attempted to motivate a case for computationally forecasting the evolving interactions between CJEU judgements and mandatory EU legal acts. The *PolNetCast* framework (figure 1) combines dynamic citation networks and machine learning to forecast the evolution of future interactions, which will enable more efficient decision-making regarding the adoption and transposition of incoming EU legislation on a national level. This tool will be an important contribution in promoting data-driven policymaking for national, and even international, authorities.

Our next steps will be to create methods to validate accuracy of predictions in an interdisciplinary fashion in which legal scholars, governance experts, data scientists and computer science researchers will combine expertise to design and conduct validity tests in a responsible manner. We hope that these studies lead us closer to providing an innovative and highly useful tool for aiding future legal and policy decision-making. A foreseeable complication in our research is the variability and sometimes ambiguity of legal citations. Because references to legal sources are not always easily isolated in the way that citations are collected in journal articles, for example, automatic text extraction can be confounded. The format of judicial sentences is also relatively inconsistent and citations do not always connect influences. To address this problem, we will be exploring emerging processes that combine human (legal) expertise and machine effort in optimal ways in order to ensure data quality.

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References

Albert, R. & Barabási, A. L. (2002). "Statistical mechanics of complex networks". Reviews of Modern Physics. 74 (1): 47–49. arXiv:cond-mat/0106096. doi:10.1103/RevModPhys.74.47

Alschner, W, Charlotin D (2018) The growing complexity of the international court of justice's self- citation network. Eur J Int Law 29(1):83–112.

Appel, A. P., Renato, L. F., Cunha, C.,. Aggarwal, C., Terakado, M. M. (2018) ECML-PKDD Using link and content over time for embedding generation in Dynamic Attributed Networks, arXiv: 1807.06560

Blauberger, M., & Schmidt, S. K. (2017). The European Court of Justice and its political impact. *West European Politics, 40*(4), 907-918. doi:10.1080/01402382.2017.1281652

Chen, H., Li, X., & Huang, Z. (2005) "Link prediction approach to collaborative filtering," Proceedings of the 5th ACM/IEEE-CS Joint Conference on Digital Libraries (JCDL '05), Denver, CO pp.141-142, doi: 10.1145/1065385.1065415.

Falkner, G., Hartlapp, M., Leiber, S., & Treib, O. (2002). Transforming social policy in Europe? The EC's parental leave directive and misfit in the 15 member states, MPIfG working paper, No. 02/11. *Max-Planck-Institut für Gesellschaftsforschung, Köln*. Retrieved from http://www.mpifg.de/pu/workpap/wp02-11/wp02-11.html

Fan, J., Cohen, K., Shekhtman, L.M. et al. (2019)Topology of products similarity network for market forecasting. Appl Netw Sci 4, 69. https://doi.org/10.1007/s41109-019-0171-y

Fire, M., Tenenboim, L., Lesser, O., Puzis, R., Rokach, L., & Elovici, Y. (2011). *Link Prediction in Social Networks using Computationally Efficient Topological Features*. Paper presented at the PASSAT/SocialCom 2011, Privacy, Security, Risk and Trust (PASSAT), 2011 IEEE Third International Conference on and 2011 IEEE Third International Conference on Social Computing (SocialCom), Boston. Retrieved from http://www.ise.bgu.ac.il/faculty/liorr/conf5.pdf

Fowler, J. H., Johnson, T. R., Spriggs II, J. F., Jeon, S., & Wahlbeck, P. J. (2007). Network Analysis and the Law: Measuring the Legal Importance of Precedents at the U.S. Supreme Court. *Political Analysis, 15*, 324–346. doi:10.1093/pan/mpm011

Hochreiter, S. & Schmidhuber, J. (1997). Long Short-term Memory. Neural computation. 9. 1735-80. 10.1162/neco.1997.9.8.1735.

Leitão, J., Lehmann, S. & Olsen, H .(2019) Quantifying longterm impact of court decisions. Appl Netw Sci 4, 3. doi:10.1007/s41109-018-0110-3

Martino, M., & Fabrizio, G. (2011). The policy-making structure of European regulatory networks and the domestic adoption of standards. *Journal of European Public Policy, 18*(6), 830-847. doi:10.1080/13501763.2011.593311

Martinsen, D. S. (2015). *An Ever More Powerful Court? The Political Constraints of Legal Integration in the European Union*. Oxford: Oxford University Press.

Mirshahvalad, A, Lindholm J, Derlén M, Rosvall M (2012) Significant Communities in Large Sparse Networks. PLoS ONE 7(3):33721. doi:10.1371/journal.pone.0033721.

Molontay, R., & Nagy, M. (2019). *Two Decades of Network Science as seen through the co-authorship network of network scientists*. Paper presented at the Advances in Social Networks Analysis and Mining, Vancouver.

Moodley, K., Hernandez-Serrano, P., Zarevi, A. J., Schaper, M. G. H., Dumontier, M., & Van Dijck, G. (2019a). The Case for a Linked Data Research Engine for Legal Scholars. *European Journal of Risk Regulation, 11*(1), 70–93. doi:10.1017/err.2019.

Moodley, K., Hernandez Serrano, P. V., van Dijck, G., Dumontier, M. (2019b) Pages 63 - 72DOI10.3233/FAIA190307

Mutlu, E. C., Oghaz, T. A., & Garibay, I. (2018). Review on Graph Feature Learning and Feature Extraction Techniques for Link Prediction. In Proceedings of . ACM, New York, NY, USA, 16 pages. https://doi.org/10. 1145/1122445.1122456

Newman, M. E. (2003). The structure and function of complex networks. SIAM review, 45(2):167–256. Retrieved from https://arxiv.org/abs/cond-mat/0303516

Panagis, Y., & Šadl, U. (2015). The Force of EU Case Law: A Multi-Dimensional Study of Case Citations. *Legal Knowledge and Information Systems*. doi:10.3233/978-1-61499-609-5-71

Rossetti, G., & Cazabet, R. (2018). Community Discovery in Dynamic Networks. *ACM Computing Surveys, 2*, 1-37. doi:10.1145/3172867

Smith, M. (2018). *Challenges in the implementation of EU Law at national level*. European Parliament. Retrieved from https://www.europarl.europa.eu/RegData/etudes/BRIE/2018/08841/IPOLBRI(2018)608841EN.pdf.

Stuetz, G. (2004). *Report of the Commissioner of the Environment and Sustainable Development to the House of Commons*. Ottawa Retrieved from https://www.oag-bvg.gc.ca/internet/English/parlcesd20041004e14917.html.

Van Kuppevelt, D., & Van Dijck, G. (2017). Answering Legal Research Questions About Dutch Case Law with Network Analysis and Visualization. *Legal Knowledge and Information Systems*. doi:10.3233/978-1-61499-838-9-95

Van Opijnen, M. (2012). Citation Analysis and Beyond: in Search of Indicators Measuring Case Law Importance. *JURIX, 250*, 95-104. doi:10.3233/978-1-61499-167-0-95

Venetoklis, T. (2002). *Public policy evaluation: Introduction to quantitative methodologies*. Retrieved from Helsinki: https://core.ac.uk/download/pdf/153491994.pdf

Wilkinson, M., Dumontier, M., et al. (2016) *The FAIR Guiding Principles for scientific data management and stewardship*. Sci Data 3, 160018. https://doi.org/10.1038/sdata.2016.18