Modular Argumentation and the Dynamics of (Il)Legality: A Position Statement on ICT for Governance and Policy Modelling

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Abstract. Law- and policy-makers face two pressing, and inter-related challenges. The first is understanding the interaction of new laws, and their interpretations according to different legal doctrines, within different legal systems operating at global, national or regional levels. The second is understanding the impact of new policies on the behaviour of the population affected by them, with respect to pre-existing social networks regulated by social, cultural and (il)legal sets of norms. We propose the ideas of *modular argumentation* and *multi-agent micro-population simulation* as the basis for *evidence-based regulation*, to support the processes of governance, law-making and policy-making with respect to security issues posed by transnational organized crime and terrorist networks.

Keywords: Modular Argumentation, Agent-based Simulation, Evidence-based Regulation, Policy Modelling, Social Networks.

1 Introduction: Importance to ICT for Governance

Issues pertaining to EU legislation have reached such a level of complexity that specific tools are required to support informed and argument-based (dialectic) discussion and decision-making.

When introducing new legislation, EU lawmakers need to consider the behaviour and objectives of the different communities affected by the legislation. Such behaviour and objectives are governed by a diverse set of social and cultural norms, and a diverse set of legal norms, not only EU laws but also international, national and regional laws. Moreover, these laws interact, and are interpreted and applied, in

different ways and according to different legal doctrines, which often co-exist within the same legal system.

In the European context, it is necessary to model this diversity: not only the multi-level and multi-lingual complexity of European laws needs to be taken into account, but it is also necessary to anticipate what particular conclusions may follow from it with regard to specific cases, and to what extent different laws and doctrines may lead the concerned agents (and in particular different officers or judges) to different legal solutions. This effort is required in particular (but not only) when a new EU regulation or directive is issued or is implemented through national laws: to achieve "unity in diversity" it is necessary to be able to cope with this complexity, to anticipate the interaction between the new regulation and the existing laws, the doctrinal approaches and practices, and consequently to devise and test solutions which will effectively achieve the regulatory goals.

However, evaluating the achievement of regulatory goals, as a macro-level function of the legal system, is dependent on the prevailing sets of different social and cultural norms extant in different social networks, which may operate at a regional or an international level. These norms underpin and regulate not only legal but also illegal systems, including transnational organised crime and terrorist networks. Nor can we remain at the level of norms alone: we need to consider how these norms, together with people's interests and attitudes, account for people's behaviour, after the introduction of new norms. For new laws and policies to have their intended effects, and for compliance to the new sets of norms to be pervasive, we have to model concurrent and conflicting sets of norms in different social networks.

We therefore believe that a novel approach is required, namely, a representation of legal contents and social networks which is computable, modular, and agent-centred.

The representation needs to be computable, since only computer-support enables us to deal effectively with so many norms, in the multifarious circumstances of their application.

The representation needs to be modular, since the different components of European law cannot be merged in a single repository: we cannot indiscriminately apply to a legal issue rules and concepts from the different legal systems and doctrines. We rather need to reason on the basis of the legal system (or the section of it) which is applicable to the problem at hand, and of the other legal systems to which it refers (e.g. EU law may refer to national law, which may refer to regional law, etc.), considering what alternative solutions follow from the applicable doctrines. Each legal system or doctrine must be viewed as a module which is invoked in the process of legal reasoning, when the appropriate conditions are met.

Finally, the representation must be agent-centred, since laws and doctrines become socially effective only when they are used by the concerned agents (officers, lawyers and citizens,) guiding their behaviour, in connection with the other beliefs possessed by such agents. Thus an agent-based animation is required for modelling the social impact of a legal norm or doctrine. In such cases, a simulation approach based purely on statistical models is unlikely to prove sufficient: the application of new laws and policies is inherently unpredictable on the sole grounds of previous events. Agent-based models, with appropriate mechanisms for acquiring new beliefs, goals and norms, are needed to analyse the effects of legal innovation. A structured approach to micro-population social network simulation and the modeling of the legal system is

required to anticipate the macro-level function of the system as a whole: this is the basis of evidence-based regulation.

In the rest of this paper, we will examine (in section 2) the state of the art in each of these three areas, highlighting important new research questions and related activities. In section 3 we will consider the multi-disciplinary dimensions of this research and the potential for new applications, before concluding in section 4.

2 State of the Art and Research Activities

2.1 Evidence-Based Law

For a legal norm or doctrine to be able to achieve its objectives, namely, to change social behaviour in the desired way, or remedying the problem it aims to address, it must be based on the one hand upon a broad and open debate, and on the other hand upon solid legal and social evidence.

The first aspect is usually emphasised by philosophical and legal theorists (such as [Hab99] and [Ale78]), but the second is equally important: without a broad debate (in particular within professional circles) the law could be captured by special interests, or could miss important information concerning facts, needs, and ideas; but without evidence, the debate, however broad, is likely to be confused, more emotional (intuitive) rather than objective, and prone to mistakes or manipulation. This aspect is indeed at the center of the Better Regulation initiative of the European Union, which aims at creating a regulatory environment which is simple, understandable, effective and enforceable.

Recent research on evidence-based legislation [SS09] indeed focuses precisely on the integration of arguments and evidence, as necessary components for regulating social progress though the law. This is particular important in the last few years, where the need of regulation has become apparent in various fields (such as finance), so that the law regains recognition as an effective instrument to address social problems.

To achieve this, two advances are required. Firstly, this evidence must concern in information about the existing situation, namely, the legal and social context on which the law is going to impact. Since the law at the European level consists of the EU law coupled with different national laws and doctrine, one needs to put all of this together and consider what the existing laws and doctrines entail for the problems to be addressed.

Secondly one has to consider in what ways these laws and doctrines guide people's behaviour, i.e., to explain people's behaviour as depending (also) from their adaptation to/adoption of these laws and doctrines (or their failure to adapt to or adopt them). Then one needs to take into consideration possible new norms and doctrines, to evaluate whether their adoption would constitute an improvement or rather a worsening of the current situation. For this purpose again, having evidence, means knowing what difference the new law or doctrine would make in the existing law, and what changes it will subsequently produce in social behaviour, by providing

individual with new incentives, constraints, opportunities, and consequently guiding their decision and interactions.

The technological question then to be addressed is how advances to these research questions can be leveraged to provide automated support for, for example, an evidence-based legislative drafting process advocated in [SS09].

2.2 Modular Argumentation

Intensive research has been done in the literature to study computational models for different aspects of law and legal argument [Ash91, AB06, BS03, Gar87, KS90, KT96, Pra05]. The application of formal argumentation developed in AI to legal reasoning has also received considerable attention. Works done in [AB06, BS03] have extended the abstract argumentation framework in [Dun95] with values and demonstrated that value-based argumentation frameworks provide a natural basis for modeling legal case-based reasoning.

Legal doctrines specify the principles, guidelines and rules for constructing legally admissible arguments. For example, legal doctrines in contract laws provide rules and guidelines for determining risk allocation on which the court will base its decision. To represent and reason with legal doctrines, a number of distinct knowledge bases about the beliefs of the contract parties and their expertise as well as about common market, social and legal knowledge at the time of contract making need to be established. Modules representing legal doctrines combine these knowledge bases to determine the outcome of the case.

Modular argumentation has been introduced in [DT98, DT09, DTH10] recently to provide an environment in which autonomous agents could be built to reason with and about legal doctrines in contract laws. A distinctive feature of modular argumentation is its capability to reason with several distinct (like skeptical and credulous) semantics at the same time in the same theory. It has been shown that this feature is of fundamental importance for the application of modular argumentation in modelling the legal doctrines for performance relief like force majeure, frustration of purpose and mutual mistake in contract law. Modular argumentation is also being used to model private international law, namely, the way in which different legal systems determine what national judge should decide a case and what national law he or she should apply [DS10].

2.3 Agent-Based Animation in Evidence-Based Reasoning

An agent-based model (ABM) is a computational model for simulating (recreating) the actions and interactions of autonomous individuals in a group (e.g. a network), with a view to assessing their effects on the system as a whole. It combines elements from different scientific fields as game theory, complex systems, emergence, computational sociology, multi agent systems, and evolutionary programming; usually, Monte Carlo Methods are used to introduce randomness.

Agent-based modelling has turned out to be one of the central approaches to modeling social systems and social processes in the past decade (e.g. from, inter alia,

e.g. [MBLA96] or [BMST97] via [VRSESW04] and [LCPSB05] to e.g. [Tro08] and [NP09], and many others).

In particular, the architecture and simulator developed in the context of the EMIL project [ACCC08, CACC08, CACP07, LM08, Tro08], provides rich agent models which can influence each other by direct communication and norm invocation. In addition, the agent society animation environment PreSage [NP09] developed in the context of the ALIS project has been used to study simulate regulatory compliance and alternative dispute resolution in virtual organizations [PKRN08] and compliance pervasion in intellectual property scenarios.

Specific research issues which need to be addressed in future programmes include:

- The requirement to model two different agent types, i.e. legal systems, and subjects of legal systems (people, organizations, etc.), the former requiring a modular architecture, the latter a normative architecture;
- The requirement to reason at multiple levels with multiple semantics at the same time, and to model the interaction between individual (micro) level and at the collective (macro) level, i.e. the effective use of modular argumentation on legal systems;
- The requirement to animate (through visualization, as opposed to explanation) the interactions between modules, as the basis for the (human) interpretation of evidence-based reasoning, in order to understand i) the effects of legal innovation, ii) the social impact of legal innovation, iii) the outcomes of compliance pervasion and many other aspects related to individuals' and communities' behaviour.

3 Multidisciplinary Aspects and New Applications

In summary, this research programme needs to bring together practitioners in law, computer science, cognitive science, social networks, game theory and the social sciences, to converge advances in modular argumentation, social network analysis, and agent-based animation, to produce novel evidence-based reasoning applications for proposing law and policies for addressing issues in organised crime (e.g. extortion rackets or trafficking) and terrorist networks. These applications can be targeted at specific legal domains and (through a user-centred design process) to members of the legal profession and their specific tasks in legislative drafting and/or policy-making.

A generic service-oriented architecture needs to be developed to facilitate the integration process inherent in the heterogeneous development of system components, and the incremental development and deployment of software in a research & development context. Taking of advantage of the loose-coupling, semantics oriented interaction, and the modularity of the knowledge and reasoning components, it should then be possible to identify end-user "processes" and build "applications" from combinations of (modularised) services, for example:

- to analyse, critique and prioritise policy options,
- to observe interactions between different legal doctrines and their different interpretations,

- to expose secondary or unintended consequences,
- to take into account adaptation of behaviour in response to new laws, and
- to track the use of knowledge as part of an evidence base, in any of the above processes.

Thus the primary technological objective of the overall research programme should be to build a generic, modular, extensible, and scalable eGovernance platform, to which specific services can be connected, from which (in turn) evidence-based legal reasoning applications can be built.

For example, when introducing new policy or legal amendments, law- or policy-makers must take into account the behaviour and desires of different populations affected by the proposal, and their communication and interaction [Tro10]. To model the law's impact on people's behaviour (and thus its ability to achieve people's desires) we may consider that this behaviour is governed by varied set of social and cultural norms, and in the case of legal systems, international laws and regulations (global treaties such as WIPO or on climate change (Kyoto)), and EU laws, and a varied layer of national and regional laws. Moreover, these laws interact at different level, and are interpreted and applied by lawyers and judges, in different ways and in the light of alternative legal doctrines which can apply, and which can sometimes co-exist within the same legal system.

Furthermore, We may assume that a legal system tries to realize a single macro-level function, of which legal theorists have given different characterisations (for instance, according to Gustav Radbruch, it is a synthesis of justice, certainty and efficacy; according to Ronald Dworkin, a synthesis of justice, fitness and fairness). Existing social attitudes and norms play different roles with regard to this function: they may contribute to its very characterisation (in a democratic society citizens' reasoned opinions should determine legal policies); they may provide constraints for the law to operate (unless the law respects beneficial social norms and coordinates with them, it cannot be effective and enjoy social acceptance); they may support anti-social practices to be contrasted with all means (as for norms governing criminal communities). Ultimately, one might expect law-makers to want to control or optimize this function, but it is not predictable from past behaviour of the system, and it not for certain what effect specific new laws and doctrines will have on the form of this function.

However, a legal system or layered set of legal systems, as above, does have a user population, who are formed into social networks with a discrete dynamics. The interactions in the social networks and with the legal system are a prime factor in the pervasion of compliance. This is a micro-level function, and in-between there are many intermediary levels comprising the different legal systems, whose interaction needs to be understood before one can determine the how the micro-level interactions impacts the form of the macro-level function (see Figure 1).

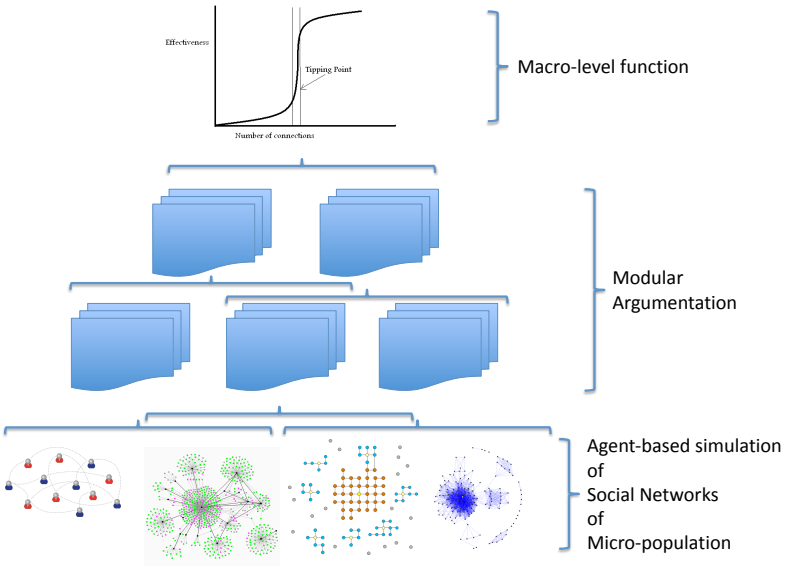

Figure 1: *Macro-Level Functions from Social Networks & Modular Argumentation*

Whether new legislation meets the purposes for which it was designed depends on the reaction of the user population including both the subjects of the legislation and the administration which has to apply it. More often than not it soon turns out that in a complex legal text some omissions lead to the effect that the application of the legislation misses its goals and opens the subjects possibilities of evading its purposes. Simulations of tax and transfer systems have often only calculated the savings or extra expenses, given the behaviour of tax payers and transfer recipients does not change as a consequence of the new law but have not considered behavioural changes which result from the perception of the legal change. Agent-based simulation can open a way to take these behavioural changes into account and give hints at why legislation might fail to achieve its goals.

Thus agent-based simulation will lead to an enhanced and more evidence-based estimation of the consequences of legislation and contribute to the further development of Regulatory Impact Analysis (RIA)[1].

4 Summary and Conclusions

To address complex social issues like organised crime and terrorism, it is required to develop a theory and technology support evidence-based law and policy-making, analagous to evidence-based medicine, but for the domains of legal drafting and

[1] http://www.oecd.org/dataoecd/22/9/35258430.pdf

policy formulation. In these domains, we cannot run a double-blind, randomised, controlled trial, not least because of the principle of "equality before the law". Moreover, drafters are not necessarily ideal persons to be proposing the 'hypotheses' for the trial.

Therefore a multi-disciplinary community needs to develop a common, generic, platform, which leverages the opinions of relevant constituencies and interested stakeholders, to generate a public knowledge resource. Legal drafters access this resource, and using innovative methods of modular argumentation and agent-based animation, can use evidence and reasoning to analyse, critique and prioritise policy options, to observe interactions between different legal doctrines and interpretations, expose secondary or unintended consequences, account for adaptation of behaviour in response to new laws, and so on.

This platform will therefore provide evidence-based support for executive decisions, and so may create an entire new e-Governance paradigm for law- and policy-making.

References

[AB06] K Atkinson and T Bench-Capon. Legal case-based reasoning as practical reasoning, *AI and Law*, 13, 93-131, 2006.

[ACCC08] G. Andrighetto, M. Campenni, F. Cecconi and R. Conte R. Conformity in Multiple Contexts: Imitation vs. Norm Recognition, *Paper accepted for the World Congress of Social Simulation*, Fairfax VA, July 2008

[Ale78] R. Alexy. *A Theory of Legal Argumentation: The Theory of Rational Discourse as Theory of Legal Justification*. Oxford: Clarendon. (1st ed. in German 1978).

[Ash91] K Ashley Reasoning with cases and hypotheticals in HYPO, *Int. J. Man-Machine Studies*, 1991, 34, 753-796, 1991

[BMST97] K. Brassel, M. Möhring, E. Schumacher and K. Troitzsch. Can Agents Cover All the World, in Conte, R., Hegselmann, R., and Terna, P., (eds.) *Simulating Social Phenomena*, Springer, Berlin, 1997, pp.55-72, 1997.

[BS03] T. Bench-Capon and G. Sartor. A model of legal reasoning with cases incorporating theories and values, *Artificial Intelligence*, 150, 97-143, 2003.

[CACC08] M. Campennì, G. Andrighetto, F. Cecconi and R. Conte (2008). Normal = Normative? The Role of Intelligent Agents in Norm Innovation. In *The Fifth Conference of the European Social Simulation Association* (ESSA). University of Brescia, September 1-5, 2008.

[CACP07] R. Conte, G. Andrighetto, M. Campennì and M. Paolucci. Emergent and Immergent Effects in Complex Social Systems. In *Proceedings of AAAI Symposium, Social and Organizational Aspects of Intelligence*, Washington DC, 2007.

[DS10] P. M. Dung and G. Sartor. Determining jurisdiction and applicable law through modular argumentation, 2010 (forthcoming).

[DT08] P. M. Dung and P. M. Thang. Towards an Argument-based Model of Legal Doctrines in Common Law of Contracts, In E. Francesconi, G. Sartor, and D. Tiscornia (Eds.), *Proceedings of JURIX 2008*. Amsterdam: IOS, 2008.

[DT09] P. M. Dung and P. M. Thang: Modular Argumentation For Modelling Legal Doctrines in Common Law of Contract, *Artificial Intelligence and Law Journal*, Vol. 17, No. 3, pp. 167-182, Springer Verlag, September, 2009.

[DTH10] P. M. Dung, P. M. Thang, N. D. Hung: Modular Argumentation for Modeling Legal Doctrines of Performance Relief, *Argument & Computation Journal*, 2010 (forthcoming).

[Dun95] P. M. Dung. On the acceptability of arguments and its role in non-monotonic reasoning, logic programming and n-person games, *Artificial Intelligence*, 77, 1995.

[Gar87] A Gardner. *An AI approach to Legal Reasoning*, MIT Press, 1987.

[Hab99] Habermas. *Between Facts and Norms*. Cambridge, Mass.: . (1st ed. in German 1992), 1999.

[KS90] R Kowalski and M Sergot. The use of logical models in legal problem solving, *Ratio Juris*, 3: 201-218, 1990.

[KT96] Kowalski and F Toni. Abstract argumentation, *AI and Law*, 4, 275-296, 1996.

[LCPSB05] S. Luke, C. Cioffi-Revilla, L. Panait, K. Sullivan and G. Balan. Mason: A multiagent simulation environment. *Simulation* 81(7), 517–527, 2005.

[LM08] U. Lotzmann and M. Möhring. A TRASS-based agent model for traffic simulation, in L. Louca, Y. Chrysanthou, Z. Oplatková and K. Al-Begain, (eds.), *Proceedings of the 22nd European Conference on Modelling and Simulation* ECMS 2008, Nicosia, Cyprus, 97-103, 2008.

[MBLA96] N. Minar, R. Burkhart, C. Langton and M. Askenazi. The swarm simulation system: A toolkit for building multi-agent simulations. *Working Paper 96-06-042*, Santa Fe Institute, Santa Fe, 1996.

[NP09] B. Neville and J. Pitt. Presage: A programming environment for the simulation of agent societies. *Proceedings AAMAS Workshop on Programming Multi-agent Systems* (ProMAS08), Springer-Verlag 2009.

[Pra05] H. Prakken. Coherence and flexibility in dialogue games for argumentation. *Journal of Logic and Computation* 15, 1009–1040, 2005.

[PRKN08] J. Pitt, D. Ramirez-Cano, L. Kamara and B. Neville. Alternative Dispute Resolution in Virtual Organizations, *ESAW VIII: 8th International Workshop*, Springer-Verlag, pp.72-89, 2008.

[SS09] A. Seidman and R. Seidman. *Drafting for Democratic Social Change: A Manual for Drafters*. (forthcoming).

[Tro08] K. Troitzsch. Multi-agent systems and simulation: a survey from an application perspective, in Uhrmacher, A., and Weyns, D., (eds.), *Agents, Simulation and Applications*. Taylor and Francis, London, 2008.

[Tro10] K. Troitzsch. Communication and Interpretation as Means Of Interaction in Human Social Systems, *Complex Societal Dynamics: Security Challenges and Opportunities*, NATO Science for Peace and Security Series, IOS Press, 2010 (forthcoming).

[VRSESW04] W. Vasconcelos, D. Robertson, C. Sierra, M. Esteva, J. Sabater and M. Wooldridge. Rapid prototyping of large multi-agent systems through logic programming. *Annals of Mathematics and Artificial Intelligence* 41(2-4) (2004) 135–169, 2004.

Appendix: Author Biographies

Jeremy Pitt is Reader in Intelligent Systems in the Department of Electrical & Electronic Engineering at Imperial College London, and a member of the Imperial College Institute for Security Sciences and Technologies. His research focuses on the theory of computational intelligence and its application to information systems, in particular for ad hoc networks, virtual organizations, and intelligent transportation systems. He has been Principal Investigator on numerous national and international (EU) projects and coordination actions. He has published widely and is well-known for his contributions to the theory and technology of agent communication languages, societies of agents, and agent simulation. He is a member of the UK Conflict Research Society, the British Computer Society, the Institution of Engineering & Technology, and the Association for Computing Machinery. He has made numerous invited presentations to academic and industrial audiences, has contributed to FET Consultations, and in 2009 was recipient of an IBM Faculty Award.

Rosaria Conte is head of the Laboratory of Agent Based Social Simulation at the Institute of Cognitive Science and Technology of the Italian National Research Council, President of the European Social Simulation Association (ESSA), and of the Italian Association of Cognitive Science (AISC). She teaches Social Psychology at the University of Siena. She coordinates several international, EU-funded, and national projects. Her main background is in cognitive science. Her publications range from cognitive and interaction modelling to agent-based simulation, from cultural evolution to the formal study of altruism, cooperation and social norms. Her research interests include formal computational study of coalition formation, social dependence, norms representation and reasoning, and the role of cognition in the propagation of norms. She published more than 120 scientific works, among others international books, refereed journal articles and book chapters

Phan Minh Dung Phan Minh Dung was awarded a PhD from the Department of Mathematics and Computing, Dresden University, Germany. He has been full professor of computer science at the Asian Institute of Technology (AIT) from 2000. Prof Dung was head of the Computer Science and Information Management department of AIT from 2000 to 2004. His main research interests are in argumentation, logic programming, programming languages, multi-agent systems, computer security, legal reasoning and dispute resolution. Prof Dung is a member of the Editorial Board of the Artificial Intelligence Journal (AIJ), Corner Editor on Argumentation of the Journal of Logic and Computation (JLC), and serves also on the Editorial Board of the Journal of Theory of Practice of Logic Programming (TPLP) and the Argument and Computation Journal. He was awarded KIT travel grants from the EC, on “Logic Programming in Knowledge Representation and Reasoning” (from 1993 to 1997) and was a principal investigator in the FP6 project ArguGrid.

Giovanni Sartor is Professor of Legal informatics and Legal Theory at the European University Institute of Florence and at the University of Bologna. He obtained a PhD at the European University Institute (Florence), worked at the Court of Justice of the European Union (Luxembourg), was a researcher at the Italian National Council of Research (ITTIG, Florence), held the chair in Jurisprudence at Queen's University of Belfast (where he now is honorary professor), and was Marie-Curie professor at the European University of Florence. He is President of the International Association for Artificial Intelligence and Law.

Klaus Troitzsch is Professor of Computer Applications in the Social Sciences in the Computer Science Faculty of the University of Koblenz-Landau, Germany, since 1986. His research focuses on computational social science and particularly multi-agent simulations of complex social systems, focusing on the interaction of micro and macro levels. He is author, co-author, and co-editor of a number of books on simulation, author of a number of articles in social simulation, and he organised or co-organised a number of national and international conferences in social simulation. He has taught social simulation for more than two decades and has been principal investigator in several national and international (EU) projects contributing to the development and application of simulation software. He is a founding member of the European Social Simulation Associations and a member of the SimSoc Consortium which owns the Journal of Artificial Societies and Social Simulation (JASSS).

Moez Draief is a Lecturer in the Intelligent Systems & Networks Group, in the Department of Electrical & Electronic Engineering at Imperial College London, appointed in 2007. Dr Draief graduated from the Ecole Polytechnique (Paris) in 2000. He then completed a DEA in Probability Theory at the University Paris VI. He undertook a PhD in the LIAFA (Theoretical Computer Science Group), University Paris VII. From November 2005 to January 2007, he was a Marie Curie research fellow at the Statistical Laboratory and a part-time lecturer in Part III (Certificate of Advanced Study in Mathematics), Cambridge University. His research interests relating to social networks are: applied probability and discrete mathematics, queueing theory and stochastic networks, and the application of these to the analysis of distributed algorithms and complex networks such as Peer-to-Peer and ad hoc networks.

Giulia Andrighetto received her Ph.D in Philosophy at the University of Rome «La Sapienza». She is currently a post doc at the Laboratory of Agent Based Social Simulation at the Institute of Cognitive Sciences and Technologies of the Italian National Research Council (ISTC-CNR). She co-chairs, together with Cristiano Castelfranchi, the Working Group on Norms, *Agreement Technologies COST Action IC0801*. Her research activity aims to develop interdisciplinary studies in the cognitive and social fields. She is interested in explaining the emergence and evolution of macro social phenomena in social systems, such as social norms and enforcement institutions, by integrating the research findings in cognitive science into a set of operational models. She has published several scientific articles on norms representation and reasoning, and agent-based simulation.