

The Performance of Distributed Problem Solving Networks: A Final Report on the OII-MTI Project¹

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This report provides a brief overview of work undertaken by members of the research team from the OII and McKinsey Technology Initiative (MTI) on a project investigating the Performance of Distributed Problem Solving Networks (DPSNs).

A key assumption of the project was that much had been learned about the rise of new socio-technical organizational forms built around the use of the Internet and other digital networks for information sharing, problem solving and co-production which encompass individuals and groups distributed geographically and across organizational boundaries. However, there has been a lack of research on how to understand and measure the performance of such DPSNs, for example in relation to alternative organizational forms or in studying the motivations behind the participation of those dedicating their attention to these networks often without direct remuneration.

The following sections outline the aims, approach and organization of the project. A guide to case studies and related project outputs is also provided, including case descriptions and analytical papers. The findings of this research are presented as the prime focus of papers identified here, which are available through the specified links on the project's Website².

This project contributes to the OII's efforts to provide an informed basis for a public discussion of the changing nature of work in a networked society, as well

¹ This report is based on input from the entire project team, all of whom are identified in the following pages. We wish to acknowledge their contribution to this project and thank David Sutcliffe and Malcolm Peltu for their editorial support in the compilation and editing of this report. The authors also wish to thank our colleagues within the McKinsey Technology Initiative, whose insights and questions were enormously valuable at all stages of the project.

² The project's Website is at: <http://www.oii.ox.ac.uk/research/project.cfm?id=45>

as the longer-term societal implications for people's lives and livelihoods in societies where a multitude of experiments in sharing knowledge, problem solving and production are being facilitated by the availability of high-speed Internet access to digital content.

Aims of the Performance of Distributed Problem Solving Networks project

James Surowiecki's concept³ of 'the wisdom of crowds' - the idea that 'the many are smarter than the few' when a large number of people can outperform a few experts by sharing information and solving problems - has encapsulated a key opportunity that has attracted many executives in public and private enterprises to consider seriously developments in digital networking which could transform the organization of information-intensive work. In addition to co-production, such DPSNs have been referred to as 'peer production', 'social production', 'co-creation', 'mass collaboration', often in an 'open' information space such as in 'open source' source software production and a 'commons' of freely accessible information.

Many uncertainties surround the performance of DPSNs and the coordination mechanisms they employ, as well as the areas in which the new forms that have emerged on the Internet offer distinct advantages vis-à-vis more familiar sources of expertise and modes of problem solving. A major goal of the OII-MTI project reported on here has been the articulation of a framework, and a synthesis of concepts and approaches, that can be applied to new forms of DPSNs emerging continuously on the Internet. This framework and the illustrations of the ways in which it can be implemented is an important step toward systematic measurement of the performance of these 'network organizations'. It could contribute towards an analytical basis for guiding the decisions of managers in the private and public sectors about allocating resources to DPSN mechanisms. It could also assist leaders of non-profit-seeking communities that are considering the formation of open commons-based peer production of new cultural products and information goods.

Approach

We have taken an exploratory approach to understanding the dynamics of new socio-technical organizations enabled by the Internet. This has involved preparing a set of case studies within the areas of computer software, e-science, and 'media production' (e.g. encyclopaedias and open-content films), news and 'opinion aggregators' (e.g. prediction markets). We have also examined new business models that involve creating Web 'platforms' to gather information that forms a basis for analysis; brokerage services that will be valuable to third parties; and the application within enterprises of 'games' that could enable a firm to modify the communication behaviours of its employees.

This approach has enabled the team to identify competing views on the performance of DPSNs, the motivations underpinning participation, and the

³ See J. Surowiecki(2004), *The Wisdom of Crowds: Why the Many Are Smarter than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations* (New York: Doubleday).

nature of information and communication technologies (ICTs) designed to support the co-production of digital goods and services by geographically distributed individuals more generally.

Organization of the Project

The project was based at the Oxford Internet Institute at the University of Oxford. It was supported by a grant from the MTI, which provided financial support for our team and also enabled members of McKinsey & Company to participate in a series of joint workshops and video and telephone conferences, including a final Public Panel⁴ and Invited Forum⁵ at the Saïd Business School at the University of Oxford.

The Project Team

The OII research team itself developed into a distributed problem solving network: 15 researchers from 8 universities, spread out across 3 continents and 5 time zones contributed their perspectives and insights. This helped us to create a set of eight diverse and informative case studies at the core of the project.

Our team ranged from senior professors to doctoral students, who came together online and in face-to-face meetings and workshops with our McKinsey colleagues on a periodic basis. We list the project team below, in alphabetical order, to reflect the importance of the entire group to the success of this project:

Robert Ackland, James Martin Visiting Fellow, Fellow at the Australian National University

David A. Bray, OII Visiting Associate and PhD Candidate (Spring 2008) at Emory University's Goizueta Business School

Irene Cassarino, Doctoral Student at the Politecnico di Torino

Karen Croxson, Research Fellow, Dept of Economics, University of Oxford

Jean-Michel Dalle, Professor, Université Paris VI and IMRI-Université Paris Dauphine

Paul David, OII Senior Research Fellow, Professor Emeritus, University of Oxford, and Professor Emeritus, Stanford University (Co-Principal Investigator)

Matthijs den Besten, James Martin Research Fellow, Oxford e-Research Centre, University of Oxford

Bill Dutton, Professor of Internet Studies, OII, University of Oxford (Principal Investigator)

Tobias Escher, Doctoral Student, OII, University of Oxford

⁴ See: <http://www.oii.ox.ac.uk/events/details.cfm?id=173>

⁵ See [Web page or link to information about the invited forum??]

Dr. Aldo Geuna, SPRU, University of Sussex, and Dept of Economics,
University of Torino

Max Loubser, Doctoral Student, OII, University of Oxford

Dr. Jukka-Pekka Onnela, Junior Research Fellow, Dept of Physics, and Saïd
Business School, University of Oxford

Felix Reed-Tsochas, Position, Saïd Business School, and James Martin Institute,
University of Oxford

Wolf Richter, Doctoral Student, OII, University of Oxford (Project Coordinator)

Philipp Tuertscher, Assistant Professor, Institute for Entrepreneurship and
Innovation, Vienna University of Economics and Business Administration, and
University of St Gallen

Overview of Project Papers and Case Studies

The framework, approach and findings of this project are the subject of a set of papers available online through the project Website. This section provides a guide to the papers that will permit you to review the entire project's output, selected cases or syntheses of the project findings.

Papers are grouped into three sets. The first includes papers that establish the overall framework and synthesis of findings. The second set includes brief abstracts of the case studies that form the basis of the research and references to more detailed, authored papers derived from the cases. The third group includes papers on cross-cutting topics, which are referenced in the synthesis papers identified. Details of the papers included are provided in the following sections.

1. Project Framework, Synthesis and Commentary

1. The Performance of Distributed Problem Solving Networks

Paper location: [LINK](#)

Authors: William Dutton, et al.(list)

This is the proposal for this study, which outlines the team's initial expectations and approach.

2. Toward an Analytical Framework for the Study of Distributed Problem Solving Networks: A Perspective on the OII-MTI Project

Paper location: [LINK](#)

Author: Paul David

This paper introduces an analytical framework that helped guide our study of distributed problem solving networks. It provides a rationale behind the selection of case studies and key theoretical expectations surrounding the choices that face management in deciding whether or not to 'crowdsource' problem solving.

3. Commentary on Distributed Problem-Solving Organizations

Paper Location: [LINK to PPT](#)

Author: Paul David

The author is preparing a 'synthetic view' of the project and its key findings. This focuses on the relationship between problem characteristics and the effectiveness of the modes of information aggregation mechanisms and novel problem solving, including those examined in the detailed case studies and those discussed at the Forum.

4. The Performance of Distributed Problem Solving Networks - Highlights of Findings

Paper location: [LINK](#)

Authors: David Bray, Wolf Richter

For the time-constrained reader, these slides from a presentation by David Bray and Wolf Richter summarize a set of key findings across case studies.

5. Networking Distributed Intelligence: How Distributed Problem-Solving Networks are Enabling Managers and Professionals to Reconfigure Information and Communication Flows within and across Organizations

Paper location: [LINK](#)

Author: William Dutton

This paper presents a perspective on the outcome of the case studies that centres on relationship of different network architectures in shaping the role of DPSNs in reconfiguring how information and communication is shared, generated and often co-produced. The author argues that DPSNs reconfigure information and communication flows in ways that can enhance the communicative power of networked individuals that span geographical and organizational boundaries. This can be done in ways that create challenges for firms and organizations seeking to capture the value of DPSNs.

II. The Case Studies

1. Sermo: A Community-Based Knowledge Ecosystem

Paper location [LINK to case study brief](#)

Authors: David Bray, Karen Croxson, William Dutton, Benn Konsynski

Exemplary of the latest Web 2.0 developments, some problem-solving networks are anchored in user-generated content, such as Sermo: a community-based knowledge ecosystem for licensed physicians in the USA. Physicians can ask and answer questions and surveys posed by other doctors or pharmaceutical firms, or other paying problem-holders. The Sermo community, of over 50,000 doctors, sorts through conversations and identifies interesting health trends, cases, and other novel health insights for the benefit of multiple stakeholders.

2. Seriosity: Addressing the Challenges of Limited Attention Spans

Paper location [LINK](#)

Authors: David Bray, Karen Croxson, William Dutton, Benn Konsynski

Seriosity is a creative use of games that builds on people's liking of earning points in order to create an incentive for individuals to pay closer attention to their use of email, with the aim of helping them to solve their problems with information overload. The system enables individuals to use a virtual currency attached to email to simulate the redistribution of resources in ways that will lead them to be more strategic about the priority messages they send, read, and open from co-workers. The Seriosity approach has interesting side-effects, such as allowing individuals to exchange the virtual currency for real-world tasks and favours in the workplace.

3. The Performance of Distributed News Aggregators

Paper location [LINK](#)

Authors: Wolf Richter, Tobias Escher, David Bray

Originating as an investigation of the Digg site, which aggregates the ratings of online news stories, this study evolved into a more comparative survey of the online 'news aggregators' space. The Digg case explores the conditions under which crowds are smart, analyzes the bias of this mode of information aggregation, and shows the risk of mob behaviour.

4. Information Markets: Feasibility and Performance

Paper location [LINK](#)

Authors: David Bray, Karen Croxson, William Dutton

The performance of prediction markets has been one driving force behind the renewed attention on distributed problem solving. This case reviewed the performance of prediction or information markets. It showed successful applications as well as the limitations of information markets.

5. The ATLAS Collaboration - A Distributed Problem-Solving Network in Big Science

Paper location: [LINK](#)

Authors: Philipp Tuertscher

Much scientific collaboration is increasingly distributed, but we chose to focus on an extreme case of collaboration with Atlas: a project launched in 1992 that engages nearly 2,000 scientists in the design of a large-scale high-energy physics (HEP) detector facility. An analysis of the communication structure between the collaborating scientists delivered insights on the decision making process of the collaboration and its development from the early design stages to implementation.

6. Bug-Patching for Mozilla's Firefox

Paper location [LINK](#)

Authors: Jean-Michel Dalle, Matthijs den Besten, H ela Masmoudi and Paul David

Firefox is one of the principle software projects based on the early Internet browser Mozilla. It is part of a collection of open source software projects. Studying it therefore enabled the OII-MTI research to look at open source software development. In particular, the case study focused on the performance of Bugzilla in supporting the identification and repair of software bugs related to

creating a more user-friendly browser. A central theme of this paper is the importance of finding the right balance between guiding the community and leveraging its power to self-organize and self-allocate tasks.

7. Distributed Problem Solving in Wikipedia

Paper location [LINK](#)

Authors: Matthijs den Besten, Max Loubser, and Jean-Michel Dalle

Wikipedia is an open content encyclopaedia that is among the most well-known and debated products of distributed problem solving, with a global array of contributors creating a resource that has been compared to any leading encyclopaedia. The study focused on embedded case studies of efforts to simplify the text of selected Wikipedia entries by community tagging, and to resolve disputes over particularly contested entries.

8. Distributed film production: Artistic experimentation or feasible alternative? - The case of 'A Swarm of Angels'

Paper location [LINK](#)

Authors: Irene Cassarino and Aldo Geuna

A Swarm of Angels was selected as a case study of open content film production. The project is based in Brighton in the UK but extended the open source model to movie making in ways that could bring in distributed collaborators into the film project from elsewhere. The case study highlighted the existence of a core group of contributors and a periphery of silent supporters, who both play an important role in the project's performance.

III. Cross-Cutting Thematic Papers

1. Webmetric research

Paper location: [LINK](#)

Author: Robert Ackland

Introduces Webmetrics as an approach to measuring and analyzing Web links in a way that presents a powerful approach to assessing the performance of some types of Distributed Problem Solving Networks. This was applied to a subset of news sites, many of them are incorporated within our case study of online news aggregators.

2. Governance Structures in Distributed Problem Solving Networks

Paper location: [LINK](#)

Authors: Max Loubser

Applies the 'exit or voice' framework to distributed problem solving networks and presents a basic taxonomy of governance models.

3. Intellectual Property Law and the Performance of Distributed Problem Solving Networks

Paper location: [LINK](#)

Author: Wolf Richter

Gives an account of the potential legal risks inherent in distributed co-creation, focusing on the role of intellectual property law. It shows that both proprietary and open collaboration are viable models of distributed problem solving and outlines the distinctive challenges each paradigm is facing.

Summary, Conclusion and Outlook for Further Research

This exploratory research project spurred the development of a multi-disciplinary, distributed team of researchers, augmented by a collaborative relationship with MTI. The team rapidly identified an array of innovative cases in which networks have been utilized to facilitate geographically distributed intelligence that could be tapped for solving a wide variety of problems. Within the project's time constraints, the case studies could be explored to only a limited degree. However, the team's initial observations illuminated by the case studies suggest that DPSNs do indeed present major opportunities to their participants. They also identify clear challenges to managers and professionals who wish to create DPSNs that will address their goals and objectives. In addition, DPSNs encompass a more variegated set of approaches than originally envisioned, which led the team to add new cases during the course of the project and to develop a range of competing typologies of these organizational forms. The team does not believe it has exhausted the range of cases that might be explored. To the contrary, colleagues see merit in further research and synthesis of the present set of case studies, in addition to widening the scope of our studies.

In the coming months, the OII and other members of the project team will be considering ways to further develop selected case studies and topics, such as the investigation of governance structures and the multiple points of control within several distributed problem solving networks. In some instances, this work will progress through further analysis and synthesis of material already collected within the course of this project. In other areas, it might involve proposals for funding from relevant Research Councils and prospective sponsors.

In such ways, this exploratory project is likely to generate a rich array of further research and dissemination. For example, the constraints on employing DPSNs in a business environment emerged as a possible focus for further research. This includes questions raised by examinations of the loss of sensitive or confidential data and the impact on intellectual property rights, which seem to justify a deeper investigation.

We focused our exploratory investigations in this project on successful examples of DPSNs, but have not documented the many failures. In order to narrow down the solution scope for 'appropriate' problems to be solved by this approach, we also need to investigate questions and socio-technical organizational arrangements that have not been successfully solved by DPSNs.

As the work on case studies and synthesis progresses, the project's Website will be up-dated to reflect more developed studies. In addition, the OII will discuss the potential for a redesigned project to take this research forward. The team will inform MTI colleagues about any plans to submit proposals for further research.