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## The socio-economics of peer-to-peer systems

### David Hales

Peer-to-peer systems, social networks and new economic models offer the possibility of radically decentralized approaches applicable to media, science and finance.

The economist Joseph Schumpeter used the term 'creative destruction' to refer to the process by which radical technological innovations often destroy existing industries, capital and business models. The recent emergence of peer-to-peer (P2P) systems on the Internet certainly challenges and disrupts existing media businesses. For example, a popular P2P protocol (BitTorrent) and an open community that relies on it (The Pirate Bay) have become controversially associated with copyright infringement, leading to highly publicized legal challenges.<sup>1</sup> A number of national and transnational legislatures are in the process of implementing new legal frameworks to monitor and police Internet activity in an effort to stamp out the use of P2P for distribution of copyrighted material. One can argue the rights and wrongs of these developments, but it is evident that P2P technology is a 'disruptive technology.'

Yet P2P technology has no necessary connection to illegal activities. Rather, it empowers users to share information without the need for central administration or control and, hence, it is almost impossible to censor. Behind P2P technologies is a design philosophy. It runs something like this: *Distributed systems are inherently more efficient, robust and responsive to user needs if functionality, where possible, is decentralized*. This means that central control, hierarchy and concentration of resources should be avoided, while peer-level coordination should be encouraged. Thus, the functionality of P2P systems needs to emerge from the interaction of peers rather than follow a centrally imposed script or goal. This is a bottom-up rather than a top-down approach.

It can be argued that the concept of the market, as espoused by Adam Smith, appeared to partially follow this philosophy, which was a reaction to the feudalist and mercantilist thinking of his time. Indeed, some early P2P systems attempted to use purely market mechanisms to achieve efficient distributed coordination,<sup>2</sup> although this approach has thus far had limited success.



**Figure 1.** The QLectives project brings together three recent trends within information systems. Q: Quality. ICT: Information and communication technologies. p2p: Peer-to-peer.

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*Figure 2.* The current version of QMedia is available at http://tribler.org.

More recently, it has become apparent that many P2P systems and other forms of online cooperative activity operate in ways that appear radically different from traditional markets. Consider, for example, open-source software and Wikipedia. In

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*Figure 3.* The current version of QScience is available at *http://www.unifr.ch/econophysics.* 

such cases, traditional organizational structures and incentives, following corporate hierarchy and market interactions, do not appear relevant.

New kinds of socio-economic theory have been proposed to understand such processes under the banners of 'peer production' and the 'network society'.<sup>3,4</sup> A key aspect of these models is the importance of the *Commons* and how they are regulated through cooperative communities formed through self-organized, decentralized networks and groups. Such models can be compared to the ideas of mutualism, self-governance and localism observed in many traditional societies.<sup>5</sup> The difference is that today, with cheap and pervasive global networks, these processes can be scaled globally on very short timescales and with minimum start-up costs.

To support these emerging trends, new technologies are required: simple and easy-to-use tools which enable people to spontaneously organize into productive collectives with minimum centralization or barriers to entry. But to achieve this goal, new socio-economic models must be developed in tandem with the tools that mediate them.

The European Union-funded QLectives project<sup>6</sup> brings together top social modellers, P2P engineers and physicists to design and deploy next-generation, self-organizing, socially intelligent information systems. The project aims to combine three recent trends within information systems, including social networks (in which people link to others over the Internet to gain value and facilitate collaboration: think of Facebook), peer production (in which people collectively produce informational products and experiences without traditional hierarchies or market incentives: think of Wikipedia) and P2P systems (in which software clients running on user machines distribute media and other information without a central server or administrative control: think of BitTorrent).

QLectives aims to bring these together to form 'quality collectives,' i.e., functional, decentralized communities that selforganize and self-maintain for the benefit of the people who comprise them (see Figure 1). The aim is to generate theory at the social level, design algorithms and deploy prototypes targeted towards two application domains, in particular QMedia—an interactive P2P media-distribution system (including live streaming), providing fully distributed social filtering and recommendation for quality (think of social television 2.0): see Figure 2—and QScience, a distributed platform for scientists, allowing them to locate or form new communities and reviewing mechanisms, which are transparent and promote quality (think of Slashdot for any particular discipline or subdiscipline): see Figure 3.

The project follows an iterative design method informed by empirical analysis. First, formalize new socio-economic models of cooperation, trust and self-organized management of the Commons. Then use these models to inform the design of novel software technologies that can be rapidly deployed and empirically tested, and subsequently revise the models and designs.

Recent outputs from QLectives can be found on the project website.<sup>6</sup> These include the first iterations of the QMedia and QScience applications, along with scientific publications that explore the role of group selection and moral sentiments in Commons dilemmas,<sup>7</sup> alternative economic models for media sharing,<sup>8</sup> generating automatic quality ratings from behaviour,<sup>9</sup> large-scale measurements of P2P systems<sup>10</sup> and distributed reputation systems.<sup>11</sup>

There is increasing interest in using self-organizing networkmediated systems for (currently centralized) financial functions, e.g., as provided by the banking system. Refreshingly, we find that many approaches draw heavily on traditional mechanisms which support social trust and have been around for thousands of years.<sup>12</sup> What is new is that emerging technologies, such as cheap global networks, powerful mobile devices and social software, provide low-entry-cost infrastructure, allowing people to interact globally in complex social ways. Combining these developments with new socio-economic models of bottom-up selforganization from evolutionary and experimental economics, complexity science and computational social science could lead to qualitatively new possibilities.<sup>13</sup> These could produce highly disruptive outcomes within the financial-services industry.

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But which comes first, creation or destruction? Schumpeter would argue for the former and, indeed, it can be argued that this is a major role that publicly funded research can play, creating new ideas and technologies that bring about the destruction of the old.

#### **Author Information**

#### **David Hales**

Delft University of Technology Delft, The Netherlands http://www.davidhales.com

David Hales is a postdoctoral researcher. He specializes in socially inspired distributed systems.

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