

NETWORKS OF INNOVATION

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EVIDENCE FROM THE UK INNOVATION RESEARCH CENTRE

New information and communication technologies, such as computers, smart phones and the internet, have been some of the most prominent innovations of recent decades. By increasing the availability of information and easing communication, these technologies have also made possible new forms of interactive innovation across a wide range of industries, notably through what are known as 'distributed networks' and 'online communities'.

The open and interactive character of much contemporary innovation is reflected in the adoption of a range of new practices by large US firms, such as Procter & Gamble, IBM and Intel, as well as in the development of new 'markets for technology', such as Yet2.com and Innocentive. The growth of open source software has also contributed to the increasing prevalence of distributed forms of innovation encompassing a range of different endeavours – from crowdsourcing to knowledge exchange hubs.

These forms of innovation have long been the norm in many professional service firms, which act as 'brokers', bringing knowledge, ideas and people's skills from one place to another. For many of these organisations – which dominate such industries as law, accountancy, management consulting, design, architecture and engineering consulting – there are tight and overlapping external relationships with clients, suppliers and other professionals. In these environments, projects typically span different organisations to achieve specific tasks (Salter and Tether, 2012).

SOCIAL NETWORKS

UK~IRC researchers are investigating the emergence of distributed innovative communities and how their evolution influences the creation of knowledge and the development of innovative products. At the heart of this analysis is the significant role played by 'social networks' as means for individuals and organisations to get access to information, resources and support.

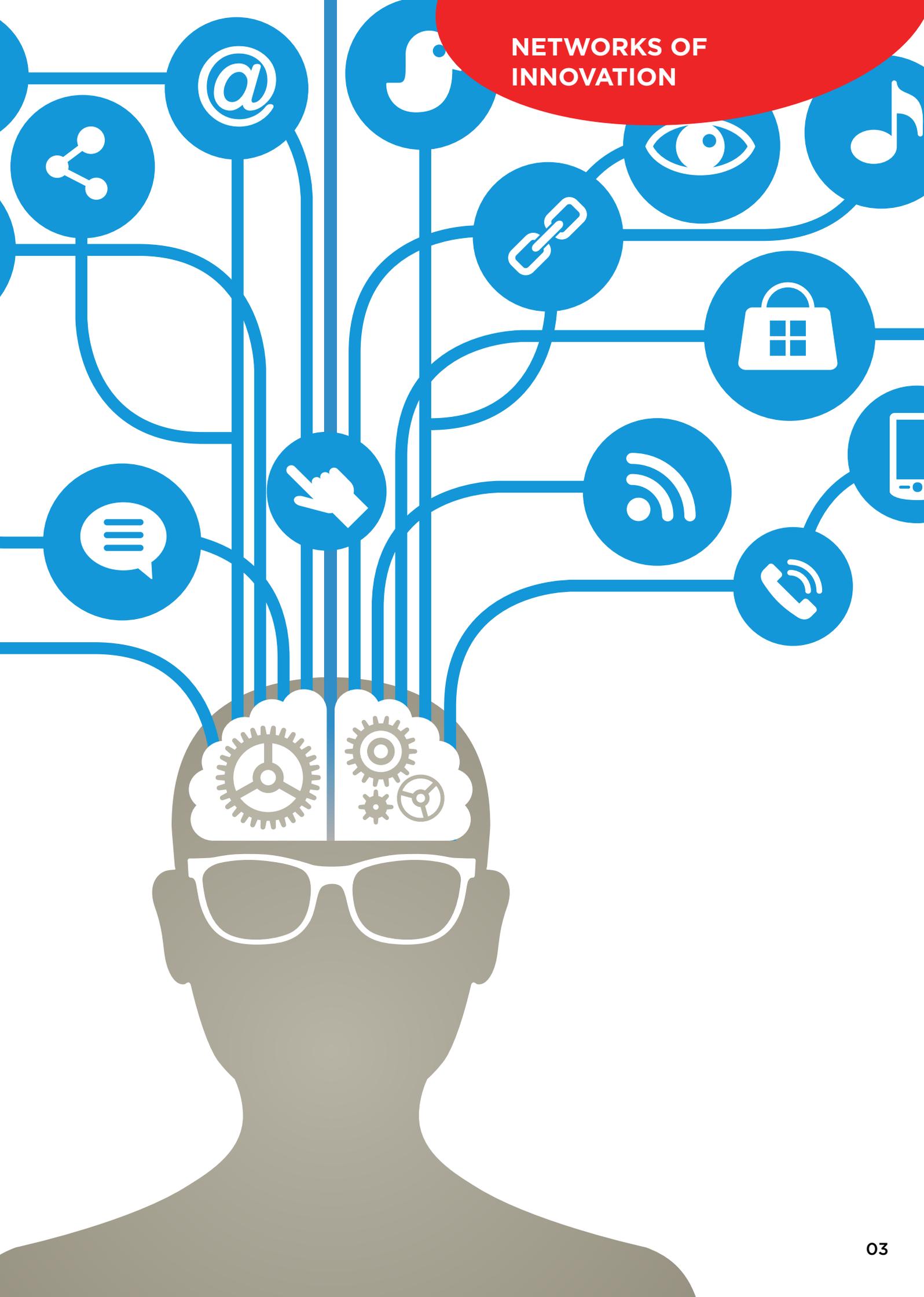
Who people know, who they collaborate with and how they 'broker' connections between other people and projects – their 'network position' or 'social capital' – all have an important influence on their decision-making and professional outcomes. So too does the global nature of a given network – the extent to which it is a 'small world' in which everyone is connected by fewer than 'six degrees of separation'.

UK~IRC explorations of the impact of individuals' network positions and global network structures are providing insights into what makes networks of innovation succeed or fail. These are of value not only to the individuals and communities themselves but also to traditional firms pursuing new opportunities for innovation. The successful products of online communities (Linux and Firefox are two famous examples) might inspire them to try to adapt to some of the practices in their workflow.

In addition, the research raises important issues for policy-makers seeking to encourage the innovation that drives economic growth.



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OPEN SOURCE SOFTWARE

The development of open source software has been described as resembling ‘a great babbling bazaar of different agendas and approaches’, in which large numbers of individuals self-organise into a variety of different projects. Each individual programmer in this marketplace is likely to make rational decisions by taking account of three things: their personal interests; the trade-offs between effort and reward; and the likelihood that a given project will be a success.

Self-organisation in an open source community is likely to be underpinned by careful calculation on the part of all those engaged in scanning for potential projects to join. The result of all these individual decisions tends to be a system in which programmers cluster around a relatively small number of projects. In addition, the innovative nature of the enterprise (developing original software) leads to high uncertainty in the outcome and therefore many unsuccessful projects.

In this context, the goal of a programmer is to choose projects that have the greatest potential for achieving a viable outcome (a released piece of software). Yet, it is difficult to know in advance which new projects are likely to be completed. Programmers are at risk of joining and contributing to projects that fail to develop.

If programmers commit significant effort to failing projects, they may find that they garner little in the way of reward. If a programmer joins the wrong projects, their efforts may be lost. If they join too late, they may become lost in the crowd, lowering the potential that they will be recognised for their efforts.



HOW SOFTWARE DEVELOPERS CHOOSE PROJECTS

Programmers typically achieve informal leadership in open source software communities through processes of technological contributions and social networking. But how do social networks affect individual programmers' choice of projects?

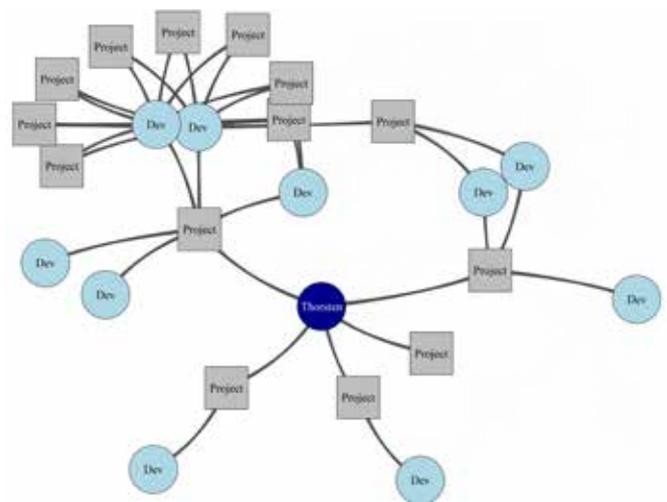
The UK~IRC research is examining how an individual's network position influences their ability to join the right projects. It also explores the global structure of the network and how, by transforming flows of information, it shapes the returns that individuals can capture through their network position. In particular, the researchers are looking at an online software development community called SourceForge and using the tools of social network analysis to study the developers who interact on the platform (Vernet et al, 2013a, b).

The SourceForge data set contains over 250,000 individuals and 200,000 projects since 2006. From this, it is possible to extract dynamic information on the network affiliations of open source programmers and project teams, as well as many aspects of community behaviour in open sources, including message boards, downloads, team size (typically between two and ten people) and days from project launch to software release for successful projects (usually 50 to 70 days).

These data can be analysed to understand how individuals accrue social capital by anticipating successful projects in their early stages, the influence of networks on the movement of programmers between projects, and the effects of social capital on project success.

Most creative efforts in open source software end in failure, increasing the chances that individuals will expend their time and energy on abortive projects. In the SourceForge data, for example, fewer than one in ten projects end in a release of software. To confront this uncertainty, individuals need to draw on their personal and professional networks to mobilise resources, support and advice.

The UK~IRC study shows that an individual's network position – measured by their levels of brokerage between individuals in the network of open source software developers and by their levels of brokerage between projects – can significantly shape their ability to choose successful projects. In addition, the structure of the overall community in which an individual evolves also shapes their choices.



The structure of an online community can hinder or enhance the advantages that individuals draw from their position. Brokers have been shown to benefit from their position in many settings, obtaining quicker promotions and larger bonuses (Burt, 2009). The advantages of brokers come about from better information and some control on the circulation of this information. But in open online communities, they seem to be at a disadvantage – although that disadvantage is reduced in situations where information is spread more evenly, such as in a 'small world'.

MANAGEMENT LESSONS

The UK-IRC research has two sets of implications for management; those that are specific for software development platforms; and more general insights on how managers can use knowledge about the functioning of social networks.

The results should encourage platforms to shift their focus from project to individual when trying to identify promising projects. Indeed it seems that individuals are better able to identify promising projects when occupying certain network positions. This should lead a platform to identify those individuals at any point in time and carefully monitor their decisions to uncover the most promising projects.

At a more general level, the study highlights the importance of networks in decision-making. It might lead managers to think carefully about mapping their collaborators and organisation networks and using the map to identify individuals who are likely to be the best at evaluating uncertain ventures. Consequently, managers will rely more heavily on those individuals' opinions when making a decision.

The research also has implications for recruitment to staff. Increasingly, the performance of potential employees depends not only on their personal characteristics but also on their propensity to build networks both within and outside the organisation. Adopting a 'follow the money' approach – looking at what someone successful does next – could be effective. But there should be a health warning: in uncertain environments with high failure rates, such as software development, past success is not necessarily a guarantee of future success.

For smaller companies with limited internal resources, having individuals with networks that can provide access to information and support is likely to be especially beneficial. For bigger companies, the benefits are less obvious and indeed, there may be disadvantages if strong social networks lead to people leaving to work on different projects in different organisations. They may prefer to rely on internal networks for the exchange of information and resources. At the same time, external networks may provide access to information on possible acquisition targets.



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POLICY IMPLICATIONS

The fact that a great deal of innovation happens outside of firms in a distributed environment raises the question of how policy-makers can encourage such innovation. Distributed innovation does not mean that there are suddenly no labour costs. Neither are all contributors to open source working for free: some are paid by foundations; others by software companies that have interests in the software.

Clearly, there is room here for thinking on how policy-makers can encourage distributed innovation. A key area might involve support for start-up companies, particularly in uncertain environments where there is value in creating self-sustaining clusters of organisations. Networks that encourage a free flow of information, ways of learning about others, and sharing information and expertise may be more beneficial for the innovation system as a whole than the open innovation strategies of individual firms.

Around open source software, a growing ecology of companies has emerged. These companies have business models that incorporate the open-source nature of their product, gathering revenues from providing support in using or deploying their software in production situations. Better understanding of how projects and individuals self-organise is helpful for understanding to what extent those innovative business models are sustainable and what government can do locally to support this highly dispersed industry.

FURTHER READING

Burt, Ron (2009) 'Structural Holes: The Social Structure of Competition', Harvard University Press.

Salter, Ammon and Bruce Tether (2013) 'Innovation in Services: An Overview', in *Managing Services: Challenges and Innovations* edited by Kathryn Haynes and Irena Grugulis, Oxford University Press.

Vernet, Antoine, Martin Kilduff and Ammon Salter (2013a) 'Information, Control, and Small Worlds: Studying Returns to Individual Network Positions Under Different Global Structures'.

Vernet, Antoine, Martin Kilduff and Ammon Salter (2013b) 'The Two-pipe Problem: Analyzing and Theorizing about 2-mode Networks', in *Research in the Sociology of Organizations* edited by Daniel Brass.

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