

i-works

How high value innovation networks
can boost UK productivity



The Advanced Institute of Management Research (AIM) was founded in October 2002. It is a multi-council initiative of the UK's Economic and Social Research Council (ESRC) and Engineering and Physical Sciences Research Council (EPSRC). With activities at over 34 institutions in the UK and overseas and offices at London Business School, our mission is to significantly increase the contribution of and future capacity for world class UK management research.

Our four objectives for management research are to:

- Conduct research that will identify actions to enhance the UK's international competitiveness
- Raise the quality and international standing of UK research on international competitiveness
- Expand the size and capacity of the active UK research base on management
- Engage with practitioners and other users of research within and beyond the UK as co-producers of knowledge about management

Current AIM research projects focus on:

- UK productivity and other performance indicators for the 21st century
- Sustaining innovation while meeting competitive pressure
- Adapting promising practices to new circumstances
- Developing an agenda for public service innovation and effectiveness

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As I join AIM, as the initiative's new director, I am delighted to see the early work of our AIM Scholars come to fruition. The AIM Scholars scheme takes some of the UK's best and brightest young academics and sets them the challenge of summarising what is known about specific topics.

This report, the first in a series, deals with the issue of networks and how these help firms become more innovative. The report is underpinned by a systematic review, which involved the AIM Scholars looking at over 600 publications dealing with the issues of networks and innovation.

The best of these papers were summarised and the core themes from this vast body of knowledge synthesised. It is this background material that was used to develop the i-works concept and associated report.

I trust that you find the report of interest and value and invite you to contact my colleagues and I at AIM if you would like to discuss this, or our other related work, more fully.

Professor Robin Wensley
Director, AIM Research

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Improving the competitiveness of the UK economy is a national priority. Recent studies – the Porter Report¹ and the Department of Trade and Industry (DTI) Innovation Review² show that the UK lags behind its major competitors in terms of productivity. There is a growing consensus that closing the productivity gap relies on transforming the UK from a low cost to a high value economy.

Innovation – the successful exploitation of new ideas – is a prerequisite for a high value economy. Despite an impressive science base, the UK lags behind other developed economies in converting new ideas into commercial applications. Both the Porter Report and the DTI Innovation Review identified networks as vital to the creation, dissemination and exploitation of ideas.

As part of its ongoing work, the DTI asked AIM to undertake further research into the state of networking and innovation in the UK. This report provides an overview of the findings of a team of management scholars selected by AIM to review existing research on business-to-business networks and innovation.

Key findings

It is clear that networks play a major role in the innovation process. Moreover, a certain type of high value network is far more effective at sparking innovation. We call these Innovation Networks or i-works. i-works have the following characteristics:

- Highly diverse: network partners from a wide variety of disciplines and backgrounds who encourage exchange about ideas across systems
- Third party gatekeepers: science partners such as universities, but also consultants and trade associations, who provide access to expertise and act as neutral knowledge brokers across the network
- Financial leverage: access to investors via business angels, venture capital firms and corporate venturing which spreads the risk of innovation and provides market intelligence
- Proactively managed: participants regard the network as a valuable asset and actively manage it to reap the innovation benefits



For firms, access to i-works offers a potent source of new ideas and competitive advantage. Fostering relationships with such networks should be seen by firms as a **critical capability**.

The research also points to the need to encourage the formation of and participation in i-works. More research is required to understand the full implications for firms and policymakers.

The Porter Report and the DTI Innovation Review highlighted weaknesses in the UK's competitive position. In particular, they identified low productivity compared to other major developed economies. At present, for example, the UK trails rivals like the US, France, and Germany on a number of important measures including:

- Output per hour worked in key sectors including financial and business services and distribution³
- Business R&D expenditure per worker⁴
- Business investment as a percentage of GDP⁵

One way to increase the rate of innovation is through better networking.

To close the gap, both reports concluded, the UK must move from being an economy that competes on low cost to one that competes on high value. Higher levels of innovation are a prerequisite to making this transition. Innovation allows companies and countries to benefit from the technological and scientific advances that are changing the world more rapidly than ever before.

But on two vital indicators of innovation, business R&D and patents, the UK trails the US and is falling behind other international competitors. Overall, R&D spending as a percentage of UK GDP declined from 1.5% of GDP in 1981 to 1.16% in 1997. And by 2003 it had risen only marginally to 1.83%.⁶

Where the UK does score highly is with its strong science base. Using a measure of scientific papers published, adjusted for population, it is well ahead of its international rivals including the US, Germany, France, Canada and Japan.⁷ What is clear, however, is that the UK is failing to convert its scientific research advantage into products and services. One way to increase the rate of this conversion of ideas into profitable products and services is through better networking.

The power of networks

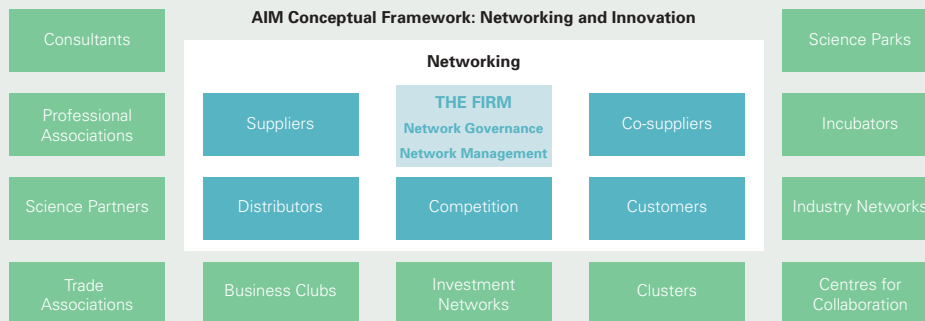
To gain a better understanding of how business networks in particular affect innovation, AIM asked a team of scholars to examine what research has been carried out in this area.

The findings confirm that networks are an essential part of modern economic life. As technologies increasingly converge to create new products and entire new markets, the knowledge required for such innovations is increasingly scattered within and among organisations. As a result, innovation processes are becoming more extended and more complex. Harnessing these pockets of knowledge requires firms and individuals to collaborate in more interactive ways. Networks play a vital role in facilitating this collaboration.

As the diagram opposite shows business-to-business networks are complex.

Networks provide important benefits including:

- Access to external knowledge
- Risk sharing
- Access to new markets and technologies
- Faster time to market
- Pooling complementary skills



Yet many questions about how networks support innovation remain unanswered. For example: How should firms position themselves within networks? What kinds of networks contribute most to innovation?

While more research is required to explore these issues, the AIM research did identify that networks with certain characteristics are more likely to foster innovation.

The power of networks – the biotech industry

The biotechnology industry highlights the value of networking. Biotech companies translate scientific discoveries into commercial technologies and new medical products. To do this they need, among other things: large amounts of capital to fund costly research; assistance with management and clinical trials; and later on, experience with the regulatory approval process, manufacturing, marketing, distribution, and sales.

The technological and scientific knowledge required to stay on top of such a field is diverse. The industry is complex and changing rapidly. Many new areas of science are converging or have become inextricably intertwined – from genetics, biochemistry, cell biology, general medicine, computer science, even to physics and optical sciences. Modern biotechnology is a set of technologies relevant to a wide range of disciplines and industries.

As all the necessary skills and organisational capabilities needed to compete in the industry are not readily available under one roof, biotech firms enter into a wide array of alliances to gain access to different competencies and knowledge. These alliances may be with larger pharmaceutical companies, for example, that provide a set of organisational capabilities that biotech firms are lacking, or they may be with research institutes and other specialised firms to stay abreast of the latest technological and market opportunities. Ultimately, however, success in the biotech industry depends on a firm's ability to access knowledge and skills located beyond its organisational boundaries. Without access to the appropriate network partners and the skills to manage the process of networking a biotech firm would be unable to compete and survive.⁹

characteristics of innovation networks (i-works)

Research suggests that the following network characteristics are critical for fostering innovation:

- Partner diversity
- Third parties, science partners and institutional mechanisms
- Networked approaches to investment – through co-investment
- Proactive management of networks and networking processes

Partner diversity

Innovation occurs more effectively where there is an exchange of knowledge between systems. This may be between different industries, regions or countries, even between science and industry. In this context the diversity of relationships in networks has a significant impact on innovativeness and is a critical focus of research.⁹

Innovation processes benefit from the clash of ideas and approaches between different disciplines and sectors. Diversity provides access to a range of knowledge, behaviours and ways of thinking. These lead to communication between people with different information, skills and values, increasing the chance of unforeseen and new combinations of knowledge, leading to discovery.

The more diverse the network partners, the greater the prospects of groundbreaking innovation. Business customers are the most common innovation partners, followed by suppliers. Firms are often reluctant to co-operate on innovation beyond these boundaries even though this may limit the innovative capacity of firms. Embracing diversity in networking requires a leap of faith as there are inherent risks involved. Traditionally, companies have sought to protect their R&D investment through patents and intellectual property lawyers. This position may be changing as firms embrace a more collaborative approach to innovation – something known as open innovation.¹⁰

As the name suggests, open innovation may involve many different organisations and individuals. The benefits associated with it include:

- More ideas are generated and a broader base of expertise accessed leading to improvements in the cost, quality and speed of innovation
- Licensing new innovations to third parties may provide a needed stimulus within the organisation to make more use of internally generated ideas
- Exported ideas may receive more intense scrutiny and so a more rigorous test of the economic viability of the idea¹¹

The power of open innovation is highlighted by the success of the Linux computer operating system developed by Linus Torvalds and the Open Source movement. However, there are also dangers associated with open innovation – in particular, knowledge spillover. (Knowledge spillover occurs when R&D undertaken by one firm benefits another without any benefit to the first firm).

Embracing diversity in networking requires a leap of faith as there are inherent risks involved.

One method of extending the innovation boundaries while limiting unwanted knowledge leaks could be to use gatekeepers. Knowledge spillover can be minimised by dealing with a special type of actor within the network: the gatekeeper.¹² Gatekeepers are prolific technical contributors who work and communicate with many people, within and across disciplines and organisational boundaries. These people are well connected in their particular technical field. As such they are aware of the competitive risks involved in any networking activity.

Third parties, science partners and institutional mechanisms

Other networking partners can play an important role in promoting innovation particularly for smaller firms. They include consultants and other professional service firms such as accountants, as well as professional associations and trade associations. They also include institutional mechanisms – publicly funded bodies designed specifically for the purpose of facilitating innovation such as technology transfer centres.

The research highlights a number of characteristics of this type of third party relationship. In particular these types of networking partner are useful when they act as independent or neutral knowledge brokers. They also build trust and confidence across networks, and act as a channel for development of informal relationships.



Although the research focused on business-to-business networks it is clear that science partners – universities, research institutes and independent research and design laboratories – play a crucial role as independent network brokers allowing different business systems to meet, by acting as a trusted and neutral link. They are especially useful when radical innovation is required, as they enable firms to develop thinking outside their specialist field.

In some cases, however, third parties may actually hinder innovation. For example, where trade associations operate with exclusivity they do not foster the trust, confidence and openness necessary for the network to prosper.

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Co-investment

Finance networks – including business angels and venture capital firms – provide an important element of i-works infrastructure. A critical strength of venture finance networks is that they provide the opportunity for co-investment. Co-investment is beneficial for venture capital firms as well as providing firms with better quality and larger funds.

Finance networks also support innovation in other ways. For example, they act as knowledge brokers within technology and innovation networks – making introductions between firms.

In summary, networked approachers to investment:

- Spread risk
- Engage more people around the venture, assisting learning
- Encourage larger funds to be invested in appropriate ventures
- Create greater network opportunities
- Enable entrepreneurial firms to grow more quickly

...the emotional support that an entrepreneur receives from their network can make the difference between continuing and giving up.



Start-ups and established firms both benefit from a networked approach to investment.¹³ For example, the emotional support that an entrepreneur receives from their network can make the difference between continuing and giving up.¹⁴ Investment networks also enable entrepreneurs to tap into talent and market information. Small businesses and start-ups can also obtain access to R&D that they would never be able to access alone by engaging in joint R&D ventures.

Proactive management of network capability

A firm's innovative capacity is linked to its networking competence and capability. The degree to which firms learn about new opportunities depends on the extent of their existing participation in networks.^{15 16} However not all firms are able to create and manage their collaborations to maximum advantage. Both experience and the ability to absorb new technologies and ideas are critical skills a firm requires when exploiting its relationships.¹⁷

The management of network relationships is inherently difficult. Knowledge of how to collaborate accumulates over time through experience, reflection, and interpretation. Striking the right balance involves managing informal and formal agreements, while at the same time establishing trust.

Firms need to learn network competencies, for example:

- Whether agreements need contracts or can be based on good faith
- If friendship or reputation plays a role in the identification of partners
- Milestones or interventions needed to ensure a project stays on course

Unfortunately many firms do not appreciate the need for network management skills. One study of owner-managers of printing electronic firms in the UK, for example, revealed that the need to manage networks was widely ignored. Although there was plenty of contact in the sector between small and large firms there was a lack of active management of these relationships.

In particular:

- Contact tended to be one-off and intermittent
- There was a lack of long-term relationships
- Contacts tended to be haphazard rather than via strong local networks
- Firms put little effort into promoting and maintaining them networks
- Networking was conducted via a few key employees within the firm. When these employees left or were absent then the firm's links with the network was broken

Worryingly the owner-managers did not see the value in networks and only 20% saw any value in introductory services. This is a problem because the general evidence supports the view that networks are more effective at leading to innovation where they are both long-term and relatively stable. Fortunately firms can develop network capability. It is also clear than some networks are intrinsically more dynamic than others.

The research has a number of important implications for business practitioners.

It confirms that networks play a crucial role in innovation through: access to external knowledge; risk sharing; access to new markets and technologies; accelerated time to market; and pooling complementary skills.

The findings also suggest that a particular type of networks, i-works, have greater innovation potential.

i-works display the following characteristics:

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- Proactively managed: participants regard the network as a valuable asset and actively manage it to reap the innovation benefits

Companies should therefore:

- Proactively manage their networks and networking activities
- Actively seek out and participate in i-works
- Collaborate with third parties such as trade associations, consultants and science partners who can act as neutral network brokers
- Recognise that venture finance networks offer more than just funding

The first step, however, is for senior managers in the UK to realise that networking is a critical capability for their organisations – and should be managed as such. Companies need to manage knowledge spillover, but they also need to recognise that no company is an island. The failure to develop networking capability is a self-limiting strategy.

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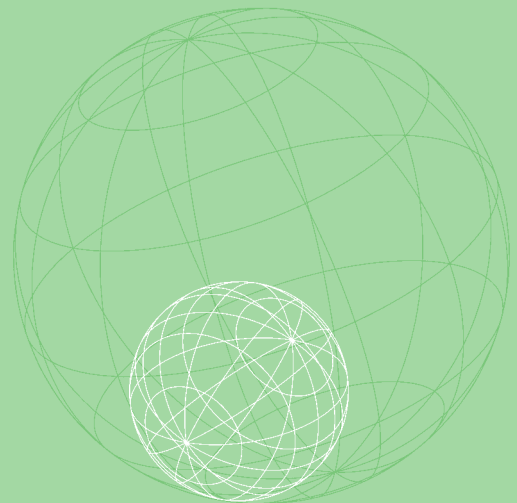
Implications for policymakers and researchers

The AIM research also has a number of important implications for policymakers and researchers. In particular, policy makers should consider a range of measures to stimulate the formation of i-works, including:

- Establishing centres for collaboration in priority areas
- Fostering the diversity of partners, e.g. actively promoting local SME networking, pump priming funding for foreign research collaboration
- Establishing more network intermediaries in universities and colleges
- Strengthening the role of business angel networks on a local (sub-regional) level
- Encouraging syndicated investments to improve the quality and the quantity of investment in entrepreneurial firm

However, more research is needed to understand how these issues might impact on policy. Possible areas of research include:

- More research into what makes i-works more dynamic in the innovation process
- The large firm-small firm collaborative process, e.g. is it used as a device by large firms to reduce R&D costs?
- The role of third parties such as university researchers, consultants, trade and professional associations in networks – and their ability to mitigate knowledge spillover
- How and to what extent networking supports entrepreneurial endeavour
- The management practices that support effective networking



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Luke Pittaway is a Lecturer in Entrepreneurship at Lancaster University. He was recently involved with securing a number of European Regional Development Fund (ERDF) projects at Lancaster which are supporting enterprise and developing working relationships between the University and its local business community. As part of his outreach activity Luke was the founder of a Venture Network Club for local high growth firms and has assisted a number of University spinouts including ventures from the engineering and computer sciences departments. Dr Pittaway's main research foci are entrepreneurial behaviour and enterprise in larger organisations, including corporate entrepreneurship and corporate venturing. He has several PhD students focusing on issues related to small business and entrepreneurship and has led a number of research projects. Dr Pittaway teaches all aspects of entrepreneurship and is the course leader for the venture planning and franchising courses.

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Maxine Robertson is a Lecturer of Organisational Behaviour in Warwick Business School. Maxine is a founding member of IKON (Innovation, Knowledge and Organisational Networks) Research Centre at Warwick Business School. Her research interests include the management of knowledge workers and knowledge intensive firms, the management of knowledge in organisations and interactive innovation processes. She has published extensively in all of these areas in a range of journals including *Organization Studies*, *Journal of Management Studies*, *Organization and Management Learning*. She is also co-author of *Managing Knowledge Work* published by Palgrave (2002) and principal investigator on a £500,000 jointly funded (EPSRC and ESRC) research project: The evolution of biomedical knowledge: Interactive innovation in the UK and US.

Dr David Denyer, Cranfield School of Management

Dr David Denyer is a Senior Research Fellow at Cranfield School of Management. With industrial funding he has developed an early specification and prototype methodology for developing evidence-informed management knowledge using systematic review. He is an associate of the Evidence Network and frequently contributes to the seminars and workshops. This work has also been presented at several conferences including the European Academy of Management Conference and the British Academy of Management.

Dr Kamal Munir, Judge Institute of Management Studies

Kamal Munir earned his PhD from McGill University in 2001. In 2000, he was appointed as a University Lecturer at the Judge Institute of Management, Cambridge University, where he is still based. Kamal's research interests include technology management, product innovation and national competitiveness. He has presented his work in several international conferences and published it in many leading journals including *Organization Studies*, *Journal of Engineering and Technology Management*, *Journal of High Technology Management Research*, and *Human Relations*. He is currently a principal investigator on a Cambridge-MIT Institute (CMI) funded project aimed at studying the social, technological and competitive dynamics surrounding technological discontinuities. Kamal has taught executives from leading high-tech companies including NTT DoCoMo, Philips and BT.

Professor Andy Neely, Deputy Director AIM Research

Professor Andy Neely is Deputy Director of AIM, the Advanced Institute for Management Research, Chairman of the Centre for Business Performance at Cranfield School of Management and a Visiting Professor at London Business School. Previously he has held appointments at Cambridge University, where he was a Fellow of Churchill College, Nottingham University, where he completed his PhD and British Aerospace. Andy's research interests cover productivity, innovation and business performance measurement. He chairs the Performance Measurement Association, an international network for those interested in the performance measurement and management and has authored over 100 books and articles, including *Measuring Business Performance*, published by the Economist and *The Performance Prism*, published by the Financial Times. He sits on the Treasury's Performance Information Panel and the Accounting Standards Board Advisory Committee for the Operating Financial Review.

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