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Interactions in Ireland's Food Innovation System

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**Paper prepared for presentation at the 1st International European Forum on
Innovation and System Dynamics in Food Networks**

**Officially endorsed by the European Association of Agricultural Economists
(EAAE), Innsbruck-Igls, Austria**

February 15-17, 2007

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Introduction

This paper presents an analysis of the Irish food innovation system. The research was conducted as part of a larger project aimed at developing a *research commercialisation toolbox* to assist public research organisations and universities improve technology transfer and commercialisation of publicly funded food research. Ireland's food innovation system (FIS) is discussed for the first time to identify key actors, agencies and knowledge flows that contribute to food innovation nationally.

Following a section in which a FIS is defined, an overview of the food industry and its research activities are presented to provide context for the current research and the discussion that follows. The methodology adopted for this research is then outlined with identification and discussion of the key actors in the FIS the focus of the next section. The main findings of the research are then presented, followed by conclusions and an outline of future research to be conducted on the Irish FIS.

Background

Carlsson et al. (2002) described the function of an innovation system as that which produces, diffuses and uses technology. Definitions of an innovation system are widespread in the literature, ranging in focus from the broad national level (e.g. Freeman, 1991; Lundvall, 1992; Niosi et al., 1993; Pontikakis et al., 2005) to the specific sectoral level (e.g. Nelson and Rosenberg, 1993; Malbera, 2004). The focus of this paper is on a specific sectoral innovation system, i.e. a food innovation system. While the national innovation system is of relevance to the food industry, analysis at the sectoral level is important as innovation varies considerably across sectors. For the purposes of this research the food innovation system is defined as:

“The various actors, the environment in which they operate, along with their interactions, that operate in the food industry, and participate in innovation activities that produce and/or transfer economically and/or socially useful knowledge.”

The food innovation system (FIS) is thus a set of interrelated actors which create a system whose performance is decided both by the performance of each specific actor and the way in which they interact as constituents of a combined system. Edquist (2004) suggests three criteria that must be met if an innovation ‘system’ can be said to exist. The first criterion is that there is an array of organisations and their relationships in a region or nation form a *coherent whole* and that their arrangement identifies feedback systems or loops, common developmental trajectories and complementary competencies between agents. The second criterion is that the system has identifiable objectives or aims to which all of the elements contribute – i.e. the system has a *function*. This might be evident in social partnerships (either formal or informal), agreed objectives and vision. The third criterion is that it must be possible to discriminate between the sy-

stem and the rest of the world; i.e. it must be possible to identify the *boundaries* of the system. This could be geographic but may also be sectoral or technologically based. This paper is based on a sector, food, which has been pre-defined by the researchers according to the NACE¹ categorisation of food manufacturing industries. While the authors acknowledge that non-food specific technologies (biotechnology and pharmaceuticals, for example) are having an increasing impact on the food industry and on research and development activities in particular, they are not included in this study to keep the research question clearly focused.

R&D Activity Supporting the Irish Food Sector

The Irish food sector makes an important contribution to economic and social development in Ireland. It is dominated by SMEs with only 6% of companies classified as large (CSO, 2005). The majority of companies are Irish-owned but foreign-owned companies are significant in terms of gross value added (GVA). In 2003, 94% of the enterprises operating in the food, beverages and tobacco industries were Irish-owned whilst 6% were foreign-owned. Their contribution to GVA was 24% and 76% respectively (CSO, 2005). While the sector is continuing to grown in terms of output (GVA tripled between 1993 and 2003) and numbers of enterprises (increased from 577 in 1993 to 652 in 2003), its declining relative importance as reflected in its declining share of total manufacturing gross output (declined from 19% in 1993 to 14% in 2003 (CSO, 1998; 2005)) is cause for concern.

A number of sectoral reviews have been undertaken in recent years, each of which highlighted the important role that research and innovation plays in the sector. The most significant national research policy document in recent years, the *Strategy for Science Technology and Innovation*, prioritises building a “knowledge economy in agri-food, so as to provide a scientific foundation and support for a sustainable, competitive, market oriented and innovative agriculture and food sector”. The report notes “many Irish companies have underdeveloped R&D infrastructure and are therefore dependent on the public research system... Driving industry up the value chain is a major challenge and is predicated on greater industry R&D involvement, which will require the support of public funded knowledge generation and expertise”.

Business expenditure on research and development (BERD) amounted to €29 million in 2003, down from €34 million in 1993 (pers comm., Stockman, 2006). This low level is explained by the large incidence of SMEs in the sector, which do not have the resources, background or culture to engage in R&D. The share of overall national BERD accounted for by the food sector declined from 10% in 1993 to 3% in 2003 despite a 13% increase in the number of food companies (pers comm., Stockman, 2006). This occurred against a backdrop where there was substantial investment in publicly funded food research and development. Between 2000 and 2005, €63 million was spent on food research under the Food Institutional Research Measure (FIRM), which is funded through the Department of Agriculture, and Food under the National Development Plan (Coppinger and Byrne, 2005). Additional funding is also available from Enterprise Ireland for commercialising research and in-company research infrastructure. EU funds are also available. Under European Framework Programme 6, Irish researchers received almost €9.5 million for food quality and safety research, representing 1.25% of the budget figure allocated to the food safety and quality thematic area under FP6 (pers. comm. Lambkin, 2006). The higher education sector was the main beneficiary of funds allocated under FP6, accounting for almost three-quarters of the funds allocated. State research organisations received 14% of FP6

1. Classification of Economic Activities in the European Union

funds, while the activities of Irish-owned private industry accounted for almost 12% of FP6 funds allocated to Ireland (ibid). Further details on these actors in the FIS are provided below.

The current low level of R&D in the food sector (at 0.2 to 0.3 per cent of sales) coupled with a growing recognition that companies need to look to knowledge sources outside as well as inside to successfully innovate, highlights the importance of publicly funded food research and its exploitation through successful technology transfer. Current policy in Ireland recommends a two-pronged approach to improve technology transfer. It involves strengthening the IP/commercialisation functions within the higher education institutes and where relevant supporting these by a central source of specialist expertise. And secondly, developing measures to establish collaborative links between industry and academic researchers.

Methodology

The research on which this paper is based involved three sequential steps. First, desk based research supplemented by key informant interviews were used to prepare a preliminary description of the FIS. Second, feedback was sought from a panel of experts representing industry and state agencies involved in the FIS to refine the original descriptive review of the system. In the third stage, four focus groups were conducted with researchers, research managers and technology transfer specialists to further refine and prepare a more in-depth analysis of the Irish food innovation system. Separate discussion groups were held for the different groups. They were held in two different locations to achieve higher levels of participation. Lists of potential participants were drafted using lists from RELAY¹ and incorporated additional information from websites, KOMPASS Ireland database and Bord Bia (the Irish Food Board). These lists were amended following discussion with a group of key stakeholders that has been specifically convened for the duration of the project. The focus groups were moderated using a guide which addressed issues such as: actors and interactions in Ireland's FIS; cohesiveness and consistency of the FIS; relationships between research organisations and industry; industry research and development activities; and the nature and level of technology transfer in the food sector in Ireland. Each focus group lasted approximately 2 hours and all discussions were recorded.

Findings: FIS Actors and Interactions

Pontikakis et al. (2005) classified STI actors into five groups according to their capacities and roles within the national innovation system: policy makers, policy enactors, technology producers, technology users and technology lobbyists. This classification was adopted for the current study.

Policy makers provide direction and funding to other actors in the innovation system. In the context of the Irish FIS they include the Department of Agriculture and Food and the Department of Enterprise, Trade and Employment. Other government departments provide policy decisions in matters such as environment, health and rural development that can have an impact on the food industry.

Policy enactors are responsible for policy implementation. In the context of the Irish FIS, these organisations include IDA Ireland, Enterprise Ireland, Shannon Development, Údarás na Gael-

1. RELAY is the national dissemination service responsible for communicating the results of publicly funded food research to the Irish food industry.

tachta, Science Foundation Ireland, Food Safety Authority of Ireland, *safefood*, Central Fisheries Board and Bord Iascaigh Mhara.

Technology producers carry out research and development activities in a variety of organisations in Ireland, including both private industry and public research organisations. The science base in food research in Ireland is mostly concentrated in public research institutes (i.e. Teagasc) and the universities and to a certain extent the institutes of technology, with some research being undertaken in the private sector.

Technology users are the consumers of the innovative outputs and results developed during the research process. Lyall et al. (2004) identified four types of research end-users, depending on the relationship each has with the technology producing research organisation: upstream end-users, collaborators, intermediaries and downstream end-users.

Technology lobbyists are those actors who implicitly or explicitly interact with organisation governance to provide information for institutional change. Key lobbyists include farming and food industry representative groups, e.g. the Irish Farmers Association and the Irish Business and Employers Confederation.

However, as important as the actors themselves are, the various interactions that exist are of central importance. The innovative performance of the companies in a country is determined by the relationships and interactions among the knowledge organizations of the country (Nelson, 1993) and the efficiency of these ties in uniting the dispersed elements of a collective system of knowledge creation and use is critical (Lundvall and Johnson, 1994; Stevens, 1997; Archibugi and Lundvall, 2001). Inzelt (2004) considered interaction and partnership among firms and other actors (such as universities and R&D institutions) as paramount to successful innovation. Collaboration between firms and public research centres represents a strategic effort towards innovation in the public sector and towards the realisation of improved planning and resources set aside for public sector research (Ballesteros and Rico, 2001).

The key actors and the main linkages in the Irish FIS are illustrated in Figure 1.

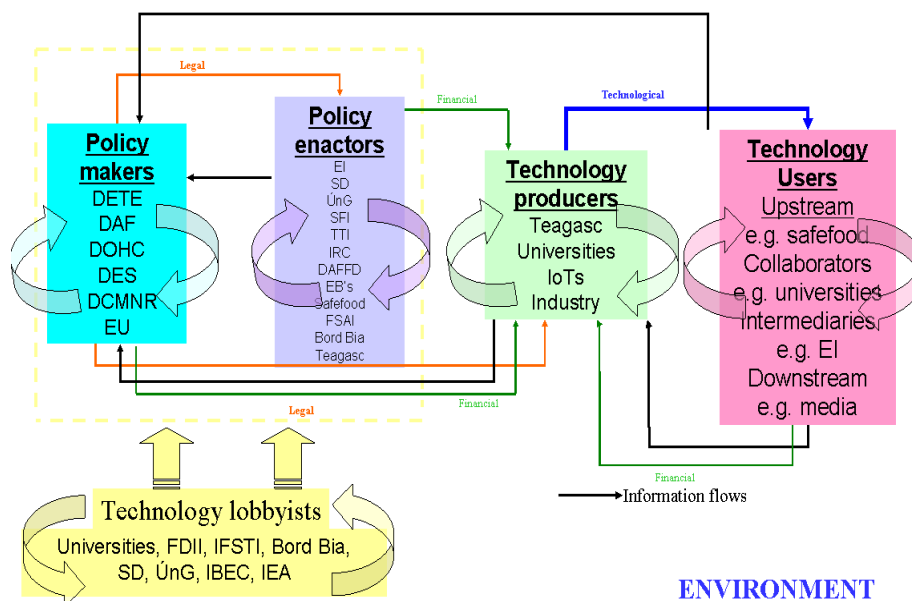


Figure 1. Key actors and their linkages in Ireland's food innovation system

In the context of the Irish FIS a number of important observations were made during the interviews with key informants and focus groups with FIS members. These are summarised as:

1. Within publicly funded food research projects there appears to be an emphasis by policy makers towards food safety research rather than research that may be interpreted as having the potential to have a greater impact in terms of creating value (e.g. new technology or process optimisation). Food safety research remains a significant activity within FIRM funded research and is the dominant research activity funded through Framework Programme 6 for Irish researchers.
2. In terms of the structure of research funding, a number of key initiatives have been developed by policy enactors in recent years to close some of the perceived R&D funding gaps. However there has been an underperformance by public and private food researchers in winning research funding from national and EU funding programmes compared to other sectors (e.g. ICT). This means that there remains a reliance on food industry specific research.
3. Amongst the technology producers, research is carried out at a significant scale at relatively few public research centres and is highly concentrated. For example, University College Cork, University College Dublin and Teagasc account for 80% of FIRM funding. There has been a significant decline in private funded R&D activity despite continuing calls for increased activity at this level and the already relatively low research intensity of the Irish food industry.
4. There remains a relatively low level of collaboration and interaction between public researchers and industry. Various reasons have been provided for this including challenges relating to the type of research and time-scales. It has also been noted that traditionally there have been relatively low levels of R&D in the food industry and that industry absorption capacity may be hindering effective interaction with public researchers. Obstacles relating to the ability and motivation of researchers to engage more effectively with industry may also exist.
5. Researcher interaction with industry appears to be related to firm level factors (e.g. ownership of companies (greater interaction with foreign owned companies than indigenous companies) and company size (greater interaction with larger companies); research factors (e.g. greater interaction with projects of more applied, rather than basic science, nature); and research institute factors (e.g. greater interaction with public research institutes than universities).
6. Differences in the level of investment in R&D and innovation between technology producers and technology users lead to a sense of imbalance. Differences in organisational agendas also lead to a disconnect between the public and corporate sectors. The result is a lack of producer-user links and a mismatch between the type of knowledge being generated and demanded.
7. Some researchers do not consider technology transfer to be a major part of their role. They largely see the nature of their research to be basic or applied, and tend not to engage in commercial research. There appears to be a gap in the research chain between the point where researchers complete their involvement in the research and the point where food companies, given the relative low level R&D infrastructure of the industry, have the capacity to absorb the technology developments. Researchers indicated that they considered that the technology transfer offices should be able to take their technologies to the market place, often without further involvement of the researcher.

8. At the same time, technology transfer specialists indicated that their role was to facilitate the researchers transfer knowledge rather than take full responsibility. This raises clear indications that there may be role definition issues pertaining to who is responsible for technology transfer – the researcher, the technology transfer officer or the company?
9. The technology transfer support structure at local levels (i.e. in universities and public research centres) remains relatively underdeveloped. Within the universities food research is not a priority in terms of technology transfer investment compared to other research areas (e.g. ICT and biotechnology). Teagasc, the largest public research centre, is in the early stages of developing technology transfer supports. There remains a need for significant investment in technology transfer infrastructure and there are plans for further investment by government in this infrastructure.
10. Informal interactions are very important at all levels of the Irish FIS including between policy makers and enactors, between policy enactors and technology users, and policy enactors and technology producers.

Conclusions

The FIS comprises a range of actors with different remits and roles, some of which occasionally overlap. In general these actors work well to ensure that research is conducted along the spectrum from basic to applied research. However further work is required to ensure efficient and effective linkages exist to achieve optimum research commercialisation and technology transfer. There is a need for research on the nature of the linkages between the different actors in the FIS. In particular, greater understanding of the role of informal links is required. Interaction between researchers and industry is also of particular interest.

The FIS in Ireland has undergone considerable change in recent years. For example, additional research centres have initiated food research programmes, while increased multi-disciplinary activity has seen diverse specialist areas (e.g. biotechnology and pharmaceuticals) enter the system from existing research organisations. In addition to changes in its boundaries, its range and intensity of activities have changed, and the relative importance of public and private research has changed. However perhaps the most significant change is the increasing recognition of its impact on competitiveness of the food industry and the national economy and the need to support it in the long-term.

Reverting to Edquist's (2004) criteria for a system, it is concluded that the Irish FIS is not yet functioning as a system. Whilst it has quite distinct boundaries and a function, the system does not function as a coherent whole, largely due to barriers in terms of feedback systems and interactions. Nonetheless, it is acknowledged that it may take decades for this to happen (Bergek et al, 2005) and considerable progress has been made in the recent past.

Future Research

This paper presents the findings of the early stages of a larger project aimed at developing a toolbox to enhance the level of technology transfer from publicly funded food research in Ireland. It is envisaged that the Toolbox will provide a range of techniques, approaches and management frameworks that will support researchers in their endeavours to transfer technologies developed through publicly funded research activities to industry. The next stage of the research will survey the public research community in order to assess the coherence and effectiveness of the food innovation system and their role within this system. In parallel, industry will also be surveyed to generate an understanding of the influence of publicly funded research on industry R&D pro-

grammes. Industry absorption capacity will also be examined. International best practice will be examined later through completion of a series of case studies. The main part of the research will then be to prepare case studies on a large number of Irish public food research projects in order to ascertain determinants of success and failure in technology transfer from publicly funded food research projects.

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