Exploring a Case of the Eco-Innovation Journey in the UK Food Processing Sector

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Abstract

The eco-innovation journey can be defined as deliberate shifts undertaken by firms to move away from unsustainable practice (Ehrenfeld, 2008). Such shifts might include changes in technologies, and ways of thinking about these to improve environmental performance e.g. resource productivity. The Literature on innovation provides rich accounts of the factors which might stimulate the development of eco-innovations and the consequences of implementing new technologies. However, there is relatively little literature which considers the process of how eco-innovations might unfold over time. This paper reports results from a study on the eco-innovation journey in the context of food and sustainability. Although literature on this particular topic has largely concentrated on farming and the behaviour of consumers, little is known about the intermediate actors e.g. food processors and manufacturers who provide a critical link in the food supply chain. This paper presents research from a firm in the UK food processing sector to help address these two gaps in knowledge.

The paper draws on innovation and organization literatures to frame a concept of 'eco-innovation journey' as a socio-technical and messy process, which include power struggles and interplay of many actors. The method identified to explore the construction of eco-innovation process within a UK food processing firm was a longitudinal case study undertaken through action research (AR). Ethnographic methods were adopted involving participant observation and qualitative data were collected via reflective diary and semi-structured interviews. Findings were analysed using clustering methods. The provisional findings shows that *practice* provide a useful element to explore the micro-processes of the eco-innovation journey. Building upon the work of Giddens (1984), practice is more than what people do, and include structures of rules and resources to explain behaviour within a community. An additional element is *information* in terms of trigger signals from both the selection environment, and from sources inside the firm. The final element is measures, which are identified and adopted by the firm in response to environmental impacts. The eco-innovation journey was found to be a messy process of interplay among many actors. The dynamic processes of power struggles and negotiations are critical factors that influence on the nature and direction of eco-innovations. Overall, the study shows that emergence of new environmental practice is likely to be adopted in the Firm if they are congruent with the regime.

1. Introduction

The environmental challenges of food production and consumption are substantial (Lang, 2010; Pretty, 2002). This was noted in the Stern Review (Stern, 2006), who addressed the issue of climate change: *"climate change will affect the basic elements of life for people around the world – access to water, food production, health, and the environment. Hundreds of people could suffer hunger, water shortages and coastal flooding as the world warms".*

Hence, the food production and consumption system need to develop capabilities to adapt to the underlying environmental conditions and mitigate its environmental impacts (Green and Foster, 2005). The food system include a number of actors e.g. agricultural production, food processing and manufacturing, retailers and end-consumers who are interlinked in a food system (Yakoleva, 2007), which are shown in Figure 1. The food system has a number of environmental impacts, which includes:

- environmental impacts associated with agricultural practice including among other things soil erosion and loss of biodiversity (Tillman *et al*., 2002);
- escalating use of factor inputs e.g. pesticides and fertilisers (Soate *et al*., 2001;); the growing transport impacts of agriculture's globalised system (Smith *et al*. 2005; IGD, 2008);
- the socio-economic impacts of food consumption in terms of human health and well being are expressed in terms of food security, food safety and food nutrition's (Westgren, 1999);
- the amount of waste generated by the food production and consumption system (WRAP, 2007).

Research concerned with innovation in food sectors in the context of sustainability has largely focused on the ends of the food system – on the role of agricultural practice (e.g. Lowe *et al*., 2008; Pretty, 2002), and trends in food consumption (e.g. Singer and Mason, 2006; Lockie *et al*., 2002). However, there is relatively little work that considers the intermediate actors e.g. food processing and manufacturing, who provide a critical link in the food system. This stage generates environmental impacts and is also the link through which environmental pressures from each end of the system are mediated. Food processing actors play an important link with actors in the food system and in the context of the growing ready meal[1] market in particular, as shown in figure 1.

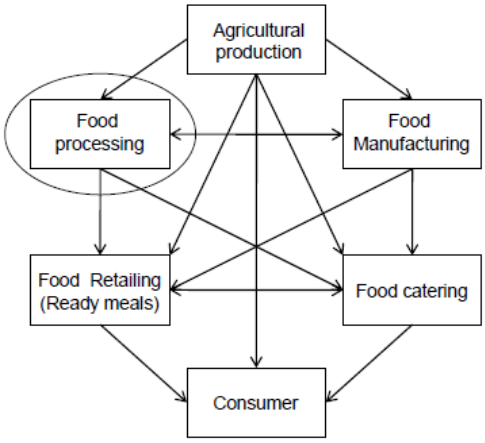

Figure 1: The food system and the position of food processing actors (Adopted from Yakoleva, 2007:76)

This paper reports the provisional findings of a longitudinal case study concerned with an eco-innovation journey undertaken by a UK food processing firm. As such, it explores the environmental issues raised in the preceding paragraph. The paper is structured as follows: a review of selected innovation and organizational literatures in the context of sustainability is presented in section 1.1 and 1.2. The research method is described in section 2. A number of provisional findings are presented in section 3; these are drawn from projects undertaken in the firm. A discussion and conclusions are outlined in section 4 and 5 respectively.

[1] Ready meals are pre-packed meals which require little preparation and contains substantial elements for a single serving meal

1.1. Eco-innovation process

Innovation is a core business process that involves changes in products, services and the way these are created and delivered (Tidd *et al*., 2005). In recent literatures and in the context of sustainability, the concept of eco-innovation can be thought of as responses developed by firms to address environmental impacts (Erenfeldt, 2008). These responses might include changes in technologies- and ways of thinking about these to improve the environmental performance of products, services, and the way these are created.

The innovation literature provides rich accounts of the factors stimulating eco-innovation process, and cleaner technology concepts. For example, Paulraj (2008) suggests the following drivers for eco-innovations: more stringent environmental regulations, market opportunities and ethical considerations. How organizations respond is often categorised (Mulder, 2007), as:

- end-of pipe solutions and compliance (e.g. retrofitted scrubbers on chimney stacks);
- pollution prevention and resource efficiency (e.g. minimising or alternating natural resource consumption); and
- sustainability, are proactive approach in which firms incorporate environmental and social considerations throughout its business process (Robins, 2001).

However, little is known about the process this eco-innovation and how it unfolds over time.

Geels *et al*. (2008) suggests that literature on eco-innovation pays much attention to technological changes, but has failed to incorporate aspects of social and cultural change in organizations. To address these limitations, the authors suggest a socio-technical approach that involves the dynamics of both social and technical systems. This socio-technical perspective on transition was conceptualised as the multi-level perspective (MLP), and is based on a combination of science, technology, and evolutionary economics (Rip and Kemp, 1998; Geels, 2002). The framework suggests that transitions constitute both the development of technical innovations and the selection and adoption of new technologies in practice.

According to the MLP, things and their use are central to the exploration of how the material, social and cultural changes interact in the sustainable innovation journey (Grin et al. 2010). The MLP includes the following conceptual levels and characteristics:

1. **Technical niche**: This is where small social network of actors are working on entrepreneurial initiatives. The conditions are often unstable and precarious, in which rules in terms of search heuristics and guidance are diffuse and activities involve some degree of uncertainty and fluidity.
2. **Socio-technical regime**: Social network are larger and embedded in more stable configurations of artefacts, regulations, markets and infrastructures. Rules are clear and have structuring effects
3. **Socio-technical landscape**: Form the broad exogenous environment that actors cannot influence by short term action. This include both infrastructures (energy supply) phenomenon that change slowly (e.g. industrialisation or climate change), but also rapid shocks (e.g. oil prices).

A transition occurs as a result of interactions between processes at the different levels described above. Kemp et al. (1998) suggest that emerging technologies can be developed in niche environments which provide a protected space for experimentation and demonstration of novelties. The diffusion of such niche-innovations towards a wider adoption in the socio-technical regime requires pressure from the external landscape which creates windows of opportunities in the regime. Although the MLP provide a useful framework to analyse transition at the macro-level, it give limited insight to explore how the innovation process unfolds in a firm.

1.2. Micro-processes of innovation in a firm

The micro processes of innovation in a firm include the development of new ideas and implementation of these into practice (Van de Ven *et al.* 1999). However, Beveridge and Guy (2005), argue that the generic literature on innovation has failed to incorporate the ‘messiness’ of the innovation process and

the interplay of many actors. In their view, innovation: "*is a messy process in which arrangements are built between actors to support the innovation in very specific time and space contexts"* (Beveridge and Guy, 2005:675). The authors suggest that innovations are shaped by social processes of power struggles and negotiations between many actors that set the stage for innovation. In similar vein, Van de Ven *et al.* (1999) describe innovation process by using a journey metaphor as an exploration into the unknown by which novelty emerges.

The innovation journey framework seeks to map the sequence of events that unfolds as the innovation develops over time. This suggests a non-linear and dynamic model of the innovation process, defined as: *a sequence of events in which new ideas are developed and implemented by people who engage in relationships with others and make adjustments needed to achieve desired outcomes within an institutional and organizational context"* (Van de Ven et al., 1999:181). In recent studies, Edwards et al., (2005) suggests that innovation process in a firm includes the connections of inner and outer structuration. In other words, the individual human agents in a firm are both influenced by pre-existing forms of structuring, but are also creative agents who make interpretation to undertake future action.

2. Method

The approach to explore the micro-processes of an eco-innovation journey is a longitudinal case study. The case is a particular UK food processing firm referred to here as the 'Firm' to ensure anonymity. The Firm is medium sized with around 250 employees and operates in the UK fresh produced sector. The main activities of the Firm include the sourcing of raw materials (e.g. onions, peppers and potatoes) from growers in the UK and over-seas. These vegetables are processed in the firm's factory into a variety of products, which are then sold to customers in the ready meal market. The purpose of the project is to help the Firm to develop and implement new environmental practices.

The method adopted for this case study (Stake, 1995) includes a combination of action research and participant observation. The project begun in Autumn 2008, and will continue to Autumn 2011 and is sponsored by the Firm. The relationship with the Firm presented an opportunity for the researcher to engage in daily activities and facilitate the eco-innovation process. The AR process can be defined as a cyclic process of action and reflection to facilitate learning and knowledge creation (Greenwood and Levin, 2007). A description of the process was developed by Bassey (1998), which includes

1. Defining the issues at hand;
2. Develop objectives and success criteria;
3. Develop an action plan;
4. Implementing the action plan, and
5. Review change and decide what to do next.

Methods for data collection were taken from ethnographic approaches and include semi-structured interviewing (Kvale, 2007), reflective diary (Jackson, 1985), and participant observation (McDowell, 1995). The data that were sought for this research is qualitative and consists of words and participant observations. The data were analysed using clustering methods to interpret and make sense of data, to generate what Geertz (1973) calls 'rich' or 'thick' descriptions about the eco-innovation journey in the Firm.

3. Exploring the eco-innovation process in a food processing firm

This section will present provisional findings from the research. In this, a description of a particular set of environmental practices in the Firm is explored. These are concerned with a water management project. This enables a discussion of environmental practices and the eco-innovation journey is presented too.

3.1. Environmental practice – the case of Project Water

Water is a critical resource to the Firm and is used for cleaning vegetables and food processing equipment. The Firm has developed its own infrastructure for water, which includes a borehole, pipes, pumps and distribution system to provide the factory with clean water appropriate for food safety standards. After being used, the dirty water leaves the factory to an on site water treatment plant

(WTP). Water use by the Firm is a subject to both legal liabilities and constraints in terms of abstraction and treatment.

The Firm owns and run a water treatment plant, which has evolved along with the business. The knowledge about the water management and infrastructure in particular has developed within the Firm's engineering community. The engineers have developed practises to monitor water flows and water qualities, and to make sure that sufficient water is available in the factory as well as within the constrains of the treatment plant. However, on a number of occasions the Firm has worked to the limit of the WTP, as described by the effluent plant supervisor: "*we have hit the limit now; we can't have any more water. What we got is what we got".* The problem regarding water was defined in terms of the volumes of water being used, and the pressures it put on the WTP.

The measures considered at the time include the following: (1) increase the capacity of the WTP, (2) constrain water use in production, and (3) change attitude and behaviour among water users. The first two groups of measures are largely techno-centric as both include adding a technical device to existing infrastructure. For example, the effluent plant could use an additional balance tank to even out the flow of dirty water from the factory to the WTP. The idea of constraining water use in production included attempts to reduce pressure on pumps, reduce access to water by removing redundant water hoses, amend leaks and introduce water guns. By way of contrast, the third kind of measure focuses on the social behaviour around water use in the factory to use water more responsibly.

The third option's social aspect of water use suggests an expansion of ownership around water, beyond the engineering community in the Firm. The large water users were identified as production and hygiene in the factory. The production community is operating under intense conditions to "*get products through the door"*, in which factors such as product throughput and labour are critical. The production community focus largely on the linear flow (input-output) of products, and gives less attention to additional factor inputs such as water and energy. Project Water was initiated to raise awareness and improve understanding about water use in terms of abstraction and treatment facilities. People from production were taken on 'guided tours' to the borehole where the water is abstracted, and then to the process of treating the dirty water as it leaves the factory. The latter included the WTP and all the equipments of sieves and centrifuges for mechanical treatment, and big tanks for the biological treatment.

Additional measures identified to expand ownership of water to include the water users, was a shift in the monitoring of water use on daily basis. The engineering community are in strong favour of water metering, as reasoned by one of the engineers: *"If you can't measure it, you can't manage it".* The new practice developed around water management included communication of volumes of water used in the factory on a daily basis. This new practice appears congruent with the production regime and their method approach to manage daily performance in particular. The managers involved with the production process meet every morning to address issues and review performance. This micro-management cycle was described by the planning manager: *"it is very much about, ok, very quick, very snappy, what were the issues yesterday, more importantly, going forward what are we doing to make sure today is going to be better and tomorrow is better still".* Building upon this management cycle, the planning manager reflects upon the new form of water management: *"Now we have an environmental officer, and that is good. He reports on the water usage to production on a daily basis which is one of the KPI's"* (Key Performance Indicator).

The expansion of ownership in water management beyond the engineering community to include the production regime has yet to be realised in the Firm. Project Water gives an example of a set of practices in a firm, how issues are defined and different measures were considered. The dynamics of the eco-innovation journey thus includes practices, and the emergence of new practices.

4. Discussion:

The example of Project Water describes how micro-processes of the eco-innovation journey include a complex interplay of human and non-human actors in the Firm. Although this analysis acknowledges the concept of multi-level perspective and socio-technical regimes in the Firm, it further suggests that practices provide a critical element worthy of exploration. The concept of socio-technical regime suggests that rules and routines are shared between groups of people and underpin the pattern of

behaviour in a firm and others in the regime (Nelson and Winter, 1982). According to the multi-level perspective, the regime is influenced by the landscape factors that create windows of opportunities in which novelties emerge from niche environments (Geels, 2002). However, the micro-processes within the regimes can also be described as practices, which are embedded within the socio-technical configurations that work.

The concept of practice is based on Giddens (1984), who suggests that practice is more than what people do, and is configured by structures. The concept of structures includes the rules and resources, shared within the Firm, and with actors from the outside. Rules constitute particular cognitive routines which guide people in the Firm to behave in certain ways. The resources include the allocation and control of money, things and people. Practices are thus embedded and reproduced in the Firms socio-technical structure. According to Pantzar and Shove (2010), practice exists as reproduced patterns of behaviour, which can persist, disappear, or be replaced by new forms of practices.

The way practices are reproduced can be described as a co-generative process of actors and structures (Giddens, 1984). The actors draw upon structures of rules and resources to produce action, and structures configure actors in terms of guidance and resource positions. The eco-innovation journey can be described as an iterative process, depicted in Figure 2, which includes three critical elements:

1) information in terms of trigger signals from internal and external sources to the Firm;
2) environmental practices, which consider socio-technical structures and power;
3) measures, which include the response identified by actors.

These elements are detailed in the framework presented in Figure 2. The central section of the framework considers ‘Practices’, and the emergence of new practices in particular, were found to be a central theme of the eco-innovation journey. Practices persists and emerge as a result of the complex interplay of a number of entities, including:(1) the socio-technical configurations of rules and routines, which reflects activities in terms of what people do, and the technologies they use; (2) agency, which include actors who negotiate practice through action and interaction, by defining problems, and responding to these in certain ways; (3) the visions, which are based on the expectations of what actors perceive as successful and meaningful; and (4) the selective attention, which constitutes the interests articulated by people, and explain particular search activities.

The four entities of practice described above are somehow brought to life, or compelled through power, knowledge and learning. Power constitutes the ability to influence a specific process, and can embody individual agents, groups or organisations (Giddens, 1984). The notions of power include a matter of who has power, and how power is exercised (Flyvbjerg, 1998). For example, the production community is a very powerful domain in the Firm, and the way it works is highly influenced by customer expectations and food safety standards. Power is strongly associated with knowledge and learning. Knowledge is embodied in people, but can be codified and communicated between groups and organizations. Knowledge, as a way of understanding, is tied in to the activities in the Firm, and gives direction to what people do in specific situations, and communities (Powell and DiMaggio, 1991). Knowledge is a result of learning processes, which in turn and can arise as a result of people that acquire information that is new to the Firm. The knowledge about the Firm’s water infrastructure was found largely embodied with the engineering community, and not among the water users. The search activities undertaken by the engineers tended to be techno-centric such as increasing WTP capacity, or reducing pressure on the water supply.

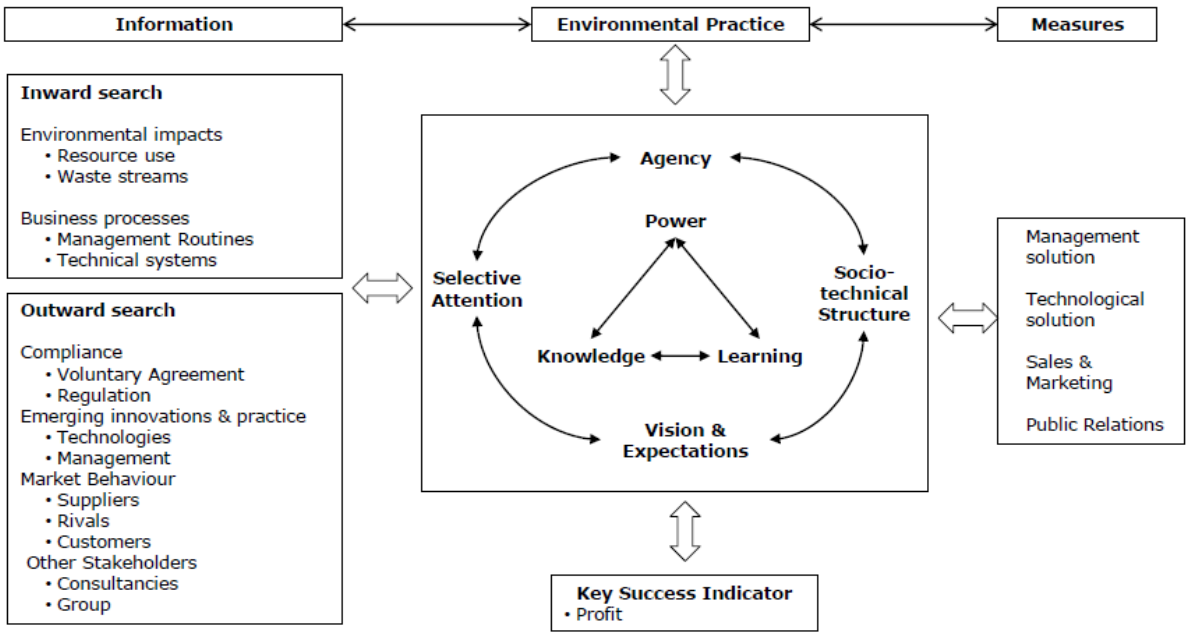

Figure 2: A framework developed to explore the eco-innovation journey

The ability of actors to influence and change the way practices are reproduced involves inevitably power struggles. The conflicts and power struggle that may arise as a result of selecting alternative methods of practice may constitute tensions within the structures, and between actors (Hoffman, 1999). For example, tension can arise as a result of mismatch between different kind of rules or from variation in the expectations among social groups and actors with different ideas, perceptions and interests. For example, the regime developed in production acknowledge production throughput over water use, where as the engineers sought ways to improve water performance. Hence, reducing water use was in conflict with the rules of production.

Additional elements that were found necessary to explore the eco-innovation journey are *information* and *measures.* Information includes the trigger signals from the selection environment (Van de Ven et al. 1999, Vickers and Cordon-Hays, 1999) and inward search activities to understand the unique set of routines and capabilities developed in the Firm. For example, the rules and routines developed in the Firm were found influenced by powerful actors outside the Firm, in particular customers, suppliers and environmental regulators. Additional influences are embedded in relationships with shareholders. The measures on the other hand, include the responses identified by actors and adopted within the socio-technical configuration. These measures include changes in practice such as new management routines, new technological solutions, or shift in commercial position. Although the participants of Project Water often identified new forms of technical solutions, they also adopted new management routines. However, some events where found to be are just 'one offs', where as others persisted. For example, the monitoring routine of daily water use is still going on, but the educational routine of guided tours has for the moment disappeared.

5. Conclusion

The longitudinal case study presented here, which explore the eco-innovation journey in a firm from the UK food processing sectors show that practice is a useful unit of analysis. Building upon the work of Giddens (1984), practice is more than what people do, and includes the configuration of actors and socio-technical structures. The structures refer to rules, which guide behaviour of actors in the Firm, and the allocation of resources in terms of money, things and people. The socio-technical structures are embedded in a regime in which rules are shared within and between the regime actors. The findings show that there are distinct set of practices developed in the Firm, which are influenced by the regime.

The emergences of new practices within the Firm give rise to power struggles. Some actors are more powerful than others to influence on the regime. For example, the Firm's customers have strong influence on practices in the production in terms of production qualities and food safety standards.

However, the emerging practices of water management in production were found difficult to persist. The iterative process of defining the issues, selecting appropriate measures and adopting these into practice can thus be described as a messy process. In particular, the interplay of many actors, internal and external to the Firm, shapes the nature and direction of the journey. The findings also suggest that emerging practices and the search activities to address issues are more likely to persist if these are congruent with the regime.

The framework developed in this research was found useful to explore the micro-processes of the eco-innovation journey undertaken by a firm. The framework is based on theory of evolutionary economics and relates to existing models such as the MLP. In conjunction with the MLP, this detailed exploration of an eco-innovation journey can thus provide a more detailed understanding to innovation process in general, and for transition to sustainability in particular. The framework developed to explore the eco-innovation journey will be further considered in projects with the Firm to explore the emergence of new practices.

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