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## **Environmental management from an ecological modernisation and innovation perspective**

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## 1. Introduction

In this paper, I would like to present a draft of the first chapters of my PhD thesis. In my research, I investigate the role of regional actors and networks which influence the diffusion of EMAS – the EU standard for environmental management - in the regional system of innovation in the State (Bundesland) of Saxony, Germany.

The study concentrates on the role of regional actors and their learning processes pushing the implementation of EMAS in firms in the regional waste and recycling industry. In Saxony, state and private actors stemming from different regional networks that deal with knowledge infrastructure and environmental policy are actively promoting EMAS. I would like to find out how these actors have developed co-operation, have co-ordinated their activities and, thus have provided long-term and credible incentives and opportunities for firms by influencing knowledge diffusion, environmental re-regulation and public demand.

Up to now, researchers from German speaking countries have mainly investigated the implementation of EMAS at the firm level and thus, have tried to explain its diffusion (Steger 2000, Bundesumweltministerium/Umweltbundesamt 2000). My paper aims to extend the content and the methodology of these studies. In the chapters to be presented, I have looked at EMAS from two different perspectives: 1) ecological modernisation and 2) innovation research.

The content of studies about EMAS shall be extended by explaining the importance of EMAS for the German environmental policy strategy. The main focus of that strategy is ecological modernisation. For me, ecological modernisation theories are a normative trajectory for my analysis i.e. assessing policy options from an ecological modernisation perspective. In recent years, ecological modernisation theories and innovation studies have stressed the importance of innovations for ecological restructuring. In addition to that, I would like to show that EMAS is an organisational innovation and thus an important part of ecological modernisation strategies.

On the one hand, ecological modernisation aiming at promoting eco-efficiency and especially at technological innovation has become a key concept in German environmental policy. This is expressed in the governmental agreement of the current Red-Green Government (Koalitionsvereinbarung 2002). On the other hand, German research on environmental policy has focused on the innovation orientation of policy such as the FIU project 1996 - 1998 (Klemmer /Lehr /Löbke 1999) and the FONA project since 2000 (<http://www.fona.de>). The EMAS- firm studies have not intensively dealt with the political importance of EMAS or its embeddedness in environmental policy strategies. The innovation-oriented studies concentrate on the innovative impact of instruments at the firm level (<http://www.ina-netzwerk.de>). Therefore, I would like to go a step back and explain the political importance of EMAS as a part of ecological modernisation strategy before I want to investigate the diffusion of EMAS in my PhD thesis.

The German ecological modernisation strategy aims at promoting innovation. I want to make clear that EMAS is an eco-innovation at the firm level. Keeping in mind this innovation perspective, studies that concentrate on the firm level are not sufficient to explain the diffusion of EMAS. I conclude that an innovation system approach – a meso level approach -

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might be appropriate to explain the diffusion of EMAS. That is how I would like to extend the methodology of the existing studies.

The paper is divided into four chapters. In the first chapter I present EMAS – the European standard for environmental management. In the second chapter, recent approaches of ecological modernisation theory are presented. The importance of environmental management systems for ecological modernisation theories is explained. Additionally, the importance of environmental management systems for ecological modernisation strategies is explained. In the third chapter, the focus is on the concept of innovation. Further, EMAS is investigated regarding its potential as an organisational eco-innovation. In the fourth chapter, conclusions are drawn for my further research.

## 2. What is EMAS?

This chapter is a summary of the introductory chapter of my PhD. First the concept of environmental management is presented, then the most important characteristics of EMAS are described. The diffusion of EMAS in Germany is presented. Finally, the effects of EMAS in firms are assessed.

Environmental management is defined as the planned and systematic implementation of environmental targets and strategies set by the firm. It comprises of corresponding measures and instruments at the firm level to reduce the environmental impacts of the firm without affecting the economic success (Jänicke, Kunig, Stitzel 1999: 290). Environmental management consists of the following seven elements:

1. Analysis of the environmental effects and impacts,
2. Defining the environmental policy,
3. Setting environmental targets and strategies,
4. Defining an environmental programme,
5. Establishing an environmental management system,
6. Conducting an environmental audit,
7. Environmental communication (Dyllick 1999: 5ff).

Environmental management in an organisations such as firm can be standardised or non-standardised. The most important forms of standardised environmental management are EMAS – the EU Environmental Management and Audit Scheme and the private standard ISO 14001. EMAS is an EU-regulation providing a standard for environmental management which organisations voluntarily can adopt.

EMAS aims at:

- 1.the establishment of an environmental policy, an environmental programme and measures and instruments to implement them,
- 2.the regular systematic and objective evaluation of the performance of these instruments,
- 3.the information of the public,
- 4.an continuous improvement process (EMAS II 2001).

Firms implement new organisational structures for setting environmental targets, implementing of measures and instruments and finally checking the results. Environmental

management systems are process-oriented and directed at the continuous improvement of the firm's environmental performance – firms aim to develop a process of continuous improvement of the firm's environmental performance. Firms disclose information about their environmental performance and activities in environmental reports.

From an environmental policy perspective, EMAS can be seen as a standard for organisational changes at the organisation level; an instrument of indirect regulation that aims to give incentives for enterprises to voluntarily improve their environmental performance. Firms voluntarily adopt the standard. Further, EMAS is a preventive approach because firms create the organisational preconditions to prevent environmental damages. It is also a media spanning approach because it includes all environmental media air, water, soil and waste which are dealt with separately in environmental regulation.

The explicit target of EMAS is that a continuous improvement process in the enterprise is established. The enterprise shall learn how to set targets beyond environmental law and how to implement these targets by measures and instruments. These process can be regarded as self-regulation. The firm sets its own environmental targets and policy, taking over tasks which have been conducted by environmental policy makers and authorities up to now.

The EU-EMAS-regulation was adopted in 1993 and was extended in 1997. It was revised in 2001 (EMAS II). Firms can register under EMAS since 1995, all other organisations since 2001. Germany has the highest absolute numbers of EMAS registered companies within the EU (about 2400 out of about 3800 in June 2002).

The diffusion of EMAS in Germany presents the following chart:



**Figure 1 EMAS- Registrations of sites/ organisations in Germany until October,31<sup>st</sup>, 2002 (DIHT 11/2002)**

The absolute number of EMAS registered firms steadily rose until 1998 and still remarkably rose until December 2000. The low increase of EMAS validated firms in 2000 might be caused by delayed revision of EMAS I. Firms might have waited with the introduction of EMAS until the regulatory base has been clarified by the implementation of EMAS II in 2001.

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Since 2001, the absolute number of EMAS registered organisations has decreased. The drop-out rate has been alarming since 2001. The figures show that firms do not aim at a second registration after the first EMAS cycle. The exits out of the system have been higher than the monthly entrances into the system - in total about 3000 participants have been registered at least one time, but only 2413 organisations have remained in the register. The distribution of EMAS certified firms varies between branches of industry and the German regions (Bundesländer).

European researchers have conducted numerous investigations about the effects and impacts of EMAS at the firm level using different methodologies and criteria for evaluation which can not be presented here. Further, the effects and impacts of EMAS are firm-specific. Therefore, I try to present a small summary of results which are common to all projects. Firms have proved that they are able for self-regulation (Steger 2000). They set environmental targets which go beyond legal requirements and establish an environmental policy. Firms also establish reporting and controlling mechanisms for their environmental affairs which meet the standards set by EMAS. Introducing EMAS for the first time, firms concentrate on organisational measures in order to meet the standard which might not have a direct environmental effect.

The ecological short-term effects of EMAS mainly are caused by measures searching for ecological and economic win-win options – reduced energy and material flows. These win-win options contribute to eco-efficiency in the firm. The ecological long-term effects are difficult to assess because most firms have not been registered for a longer period. A Germany research project showed that EMAS contributes directly and indirectly to technological and organisational innovations in some firms in the long run (Ankele / Hoffmann 2002).

### **3. Environmental management as a part of ecological modernisation strategies**

#### **3.1. Introduction**

To my mind, environmental management is a crucial part of ongoing environmental modernisation strategies because it promotes ecological efficiency and to a lesser extent innovation at the firm level and self-regulation of firms.

Ecological modernisation theory as a “normative trajectory for environmental policy” (Mol 2001) provides normative devices for environmental policy. The German environmental policy strategy aims at fostering ecological modernisation. Therefore, I would like to use these normative devices from ecological modernisation theory as a base to show the importance of environmental management within environmental policy strategies.

Ecological modernisation theories assume that economic development and environmental protection are compatible. They focus on identifying and analysing positive relationships between these two spheres. Environmental management, inter-active environmental policy, cleaner technologies and greening of institutions are the core elements of this theory (Mol 1995, Mol 2001, Jänicke 2000). This theory claims that at least in Western European

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Countries prevailing societal institutions in politics and markets may be able to transform in an environmental benign way.

Case studies have been conducted to show how environmental rationalities trigger social institutions as well as policy and market institutions. The environmental rationalities change discourses, lead to a development and application of new technologies and foster innovation (for an overview see Mol 2001 and the Nordic environmental research conference 2001).

EMAS enables new organisational structures at the firm level which 1) establish organisational structures supporting environmentally-oriented efficiency and technological innovation and 2) at the same time, represent changing regulation modes. Both aspects of EMAS within environmental modernisation strategies are elaborated on in the following subchapter. First, the background and the two main streams of concepts of ecological modernisation are presented. The focus will be on the role of technological change leading to eco-efficiency and institutional modernisation. Then, the implications of ecological modernisation on environmental policy strategies are drawn, i.e. promoting innovation and eco-efficiency, regulatory reform and the use of market mechanisms. Finally, the role of EMAS within ecological modernisation strategies is evaluated.

### **3.2. Ecological modernisation strategies**

European researchers have developed two different streams of ecological modernisation theory. The first stream originates from environmental policy and sociology and focuses on techno-economic aspects (Jänicke 2000). The second stream has a wider focus and bases on social modernisation theory (Mol 1995, Hajer 1995, Mol 2001).

Despite the two streams of theory, ecological modernisation theorists have some things in common. First, they conceive the current environmental deterioration as a challenge for economic-technological and institutional reform rather than a consequence of the prevailing institutional structures. Second, they emphasise the need to reform and transform existing modern political and institutional structures, markets and policies. Third, both streams of theory rely on sciences and technology (see Mol 2001).

The first stream was developed in Germany since the 80s (Jänicke 2000). This policy – oriented approach restricts the concept of ecological modernisation to economic-technical solutions for environmental problems. Modernisation refers to the change of the direction of technology development towards a more environmental benign way. This stream is oriented towards ecological efficiency by continuously improving processes and products, in terms of innovation studies by incremental innovations. Innovations are mainly understood as technological innovations. These arguments for an increased eco-efficiency in the economy are supported by concepts such as the famous “factor 4” (Weizsäcker, Hunter, Lovins 1997) pledging for an increased efficiency in material and energy.

Firms shall reduce their environmental effects by applying and developing cleaner technologies. This technology development occurs along system-compliant lines. The focus of political activities is on promoting marketable technologies using market mechanism as a driving force for technological change. This concept distinguishes between ecological modernisation and structural change. Structural change is characterised by the decrease of industries with an heavy negative impact on the environment.

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Environmental protection should also lead to the improvement of the economic performance of firms. Firms can explore the so called “win-win options” by reducing their environmental effects and impacts on the one hand and improving their productivity and competitiveness on the other hand. Porter & van der Linde (1995) very persuasively presented these arguments. A recent study of the German “eco radar” (Ifo Institut 2002) project based on a firm survey shows that firms that take environmental issues seriously are more competitive.

The role of policy in this concept is crucial, but its emphasis changes from standards-setting to promoting innovations. The institutional dimension of technological change is not in the core of the concept. Jänicke (2000) underlines that political and social innovations (such as leasing or contracting) are supporting the emergence and diffusion of environmentally benign technologies. But the relationships between incremental and radical innovations and technological change are not explored. The relationship between institutional and technological change is neither fully explored. Although this relationship is emphasised by evolutionary economists (being the “scientific specialists” for technological change).

The second stream of ecological modernisation theory originates from sociological theory. It focuses on social-institutional transformations and does not deal with economic-technical aspects of environmental problems.

It bases mainly on reflexive modernisation theory (Beck, Giddens and Lash 1994). I will not talk about the central ideas of the reflexive modernisation theory at this point, but only concentrate on the ecological modernisation theory derived from that theory.

This stream of literature was mainly developed in the Netherlands and Scandinavia (Mol 1995, Mol 2001, Hajer 1995). This concept comprises changes of the following areas: life styles, consumption patterns, institutions and discursive paradigms. These authors of this stream have a somewhat wider view on ecological modernisation and refer to social and institutional modernisation. The core features of the ecological modernisation theory is the on-going ecological process of re-structure in modern societies. These societies constantly restructure themselves. Restructuring refers to processes of reforming and transforming institutions and policies due to changing environmental discourses, perceptions and communication (Mol 2001). Increasingly, environmental concerns trigger institutional transformations in modern societies i.e. environmental issues are widely taken into account in central institutions of modern societies, in social practices and institutional developments.

This theory develops the concept of the growing independence / autonomy of the ecological sphere from spheres of society. Ecological and economic rationalities have their own realm and legitimacy. Environmental issues emancipate from the economy in ecological modernisation processes. Ecological rationality triggers economic practices and redirects economic progress and developments according to ecological criteria and goals (Mol 1995). Economic practices in production and consumption are increasingly judged and assessed as well. Further, they are designed and created from both an economic and ecological point of view.

The key of this theory is the concept of institutional reflexivity. Modern societies conceive their environmental problems and their regulatory and market opportunities by the institutionalisation of doubt. Existing practices and problem-solving mechanisms are constantly questioned. The actors in modern society attach specific meaning to environmental

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problems, reflect on the social conditions of their existence and build specific institutions to change them. The ways problems are perceived as well as the institutions to solve them are reflected (Mol 1995).

The environmental problems caused by modernisation are solved by developing modern institutions. Ecological modernisation theory claims that modern societies undergo a process of institutional reflexivity and develop an institutional capacity to handle their ecological crisis. Ecology is institutionalised in social practices and production/consumption patterns (Mol 1995).

Mol (1995) identifies five core lines of institutional transformations:

- 1) The changed role of sciences and technology which is integrated in proactive schemes of the industry: Science and technology are valued for curing and preventing environmental damages, not only blamed for causing them. Technological and organisational innovations take environmental concerns seriously.
- 2) Increased importance of economic as well as market dynamics and economic agents: Producers, consumers, procurers, banks and business associations turn into carriers of environmental innovations, reform and restructuring.
- 3) Changes in state-industry relations – changed role of regulation. First we can observe a trend towards more decentralised, flexible and consensus-based styles of policy (Jänicke 2000). Second, non-state actors (such as NGOs or business associations) take over the traditional role of the state.
- 4) Changed discursive practices with reference to sustainability: Actors see neither the total neglect of environmental concerns within the economy nor the fundamental counter-positions of ecology and economy as legitimate. Firms can gain public legitimation by including environmental or social concerns into their decisions.
- 5) Modification of position, role and ideology of social movements: Social movements are increasingly involved in state decision making processes and to a lesser degree in markets.

Both streams of ecological modernisation theory underline that markets are crucial for ecological modernisation. The dynamics of markets facilitate the emergence and the diffusion of new environmental technologies. Economic actors assume responsibility for their actions and develop new practices for environmental protection.

The first stream of theory stresses that technological innovations are important for relieving environmental burden in the industry. These technological innovations shall lead to an increased eco-efficiency – delinking use inputs such as material, energy or soil from economic outputs at the firm level. It is also recognised that the emergence and diffusion of technological innovations are linked with policy or institutional innovations (Jänicke 2000). That means firms or policy makers have to create or transform institutions and policy in order to facilitate technological innovation. How these policy transformation occurs is worth conducting detailed case study based analysis. At this point the second stream of ecological modernisation theory provides more insights how and why such a transformation of policy or institutions takes place. These stream undelines the importance of socio-economic

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transformations and institutional reflexivity. These institutional reflexivity shall not be investigated in my study.

To conclude, both streams of ecological modernisation theory pledge for analysing change processes at the meso-level, investigating how policy and institutions transform towards including the environmental dimension into policies and institutions. Neither an analysis at the macro level of the whole economy nor a pure firm-based analysis can provide insights into these transformation processes.

### ***3.3. Why is environmental management a crucial part of ecological modernisation strategies?***

To my mind, environmental management plays a central role in ecological modernisation concepts. EMAS represents new organisational practices in firms as it is shown above if its purpose and possible scope are taken seriously by firms and policy makers. I would like to pursue two arguments in order to show that environmental management and thus EMAS is an integral part of ecological modernisation strategies:

First, EMAS relates to incremental technological change and innovation in firms. EMAS creates the organisational structures in firms to continuously improve their environmental effects and impacts by setting and implementing environmental targets. Its focus is on eco-efficiency which goes beyond the compliance with existing environmental standards. Furthermore, EMAS might promote incremental technological innovations or other innovations in firms. EMAS provides incentives for firms to learn more about eco-efficiency. This can lead to innovations or new routines in firms.

Second, firms implement EMAS on a voluntary basis. We can regard EMAS as a measure of self-regulation of the firm. This represents the political dimensions of EMAS. Firms set environmental targets and check their compliance with these targets by an audit. These targets are directed towards at least full compliance with all environmental standard or go beyond these standards. Firms self-regulate their environmental effects and impacts.

This new practice in firms represents a kind of institutional change. Said in other words: New governance-structures are established because there is a change of relations between industry and state - Industry takes over responsibility for their environmental effects and establishes measures of self-regulation by an EMAS. In the case of EMAS, the state still regulates the environmental management system via a system of auditors and through a register of companies. Firms become actors in environmental policy by developing and pursuing new practices for environmental protection at the firm level.

To conclude, one can see that EMAS is a crucial part of environmental modernisation strategies because it helps to create new organisational structures in firms that can lead to eco-efficiency and related incremental technological change. Additionally, EMAS represents a mode of self-regulation of the industry. At a more theoretic level of analysis, environmental management represents for Mol (2001) the inclusion of environmental rationality in economic practices – a profound institutional change in the economic domain.

## 4. EMAS as an eco-innovation

### 4.1. Introduction

From an innovation research point of view, EMAS is an environmental and organisational innovation at the firm level. As it “only” creates organisational preconditions for eco-efficiency and innovation and builds upon existing knowledge about environmental protection in the firm, it is an incremental innovation. It also has a political dimension because of the self-regulation aspect. First, I would like to give an overview about how innovations are defined, then I would like to present the concepts of organisational and eco-innovations. As innovations are based upon knowledge I would like to present a classification of knowledge which can be used for defining innovations. Finally, I would like to show that EMAS is an eco-innovation in a more detailed manner.

### 4.2 Defining innovation

Innovation is an ubiquitous phenomenon of modern societies. Innovations are new creations of economic significance –brand new or combinations of existing elements of knowledge processes (Lundvall 1992). Innovation can be classified regarding the following criteria:

Criteria	Dimensions
Dimension of change	Radical Incremental
Level of Analysis for whom is it new?	Firm, Industry, Institutional field Policy Society

**Table 1 Classification of innovation**

Most definitions of innovation follow the Schumpeterian tradition, defining innovation as new processes i.e. technologies and organisations and new products i.e. goods and services (Edquist 2001:23). This Schumpeterian tradition includes also institutional innovations such as new markets and social innovations such as new forms of consumer organisation. These innovations are normally left out in the discussion within innovation studies (Klemmer/Lehr/Löbke 1999, Meyer-Kramer 2001). It is not always possible to distinguish clearly between different forms of innovation: a product innovation of one firm is a process innovation in another firm; a new organisational solution implemented in one firm might be sold as a new product for another company by a consulting company.

Incremental innovations improve the efficiency and / or change some aspect of products and processes. Some very critical observers might even not regard them as innovations because they do not correspond with the widespread idea of “innovation” which has to be brandnew or even groundbreaking.

Radical innovations are characterised by discontinuities and are unexpected or not foreseeable outcomes of the innovation process. They partly or totally make previous investments of an enterprise or an innovation system in knowledge obsolete. Therefore, radical innovations construct or lay the base for new paradigms.

Most incremental and radical innovations occur in firms and are not restricted to R&D intensive sectors (Lundvall 1992, Edquist 2001). Innovation is a complex process due to the division of labour in the generation and application of knowledge. The idea of a distributed innovation process (Andersen/ Metcalfe/ Tether 2000) is one of the main outcomes of the innovation studies literature. The division of labour is related to the specialisation in the generation of complementary forms of knowledge by different processes in different organisational contexts. Specialisation entails the co-ordination of different knowledge generating activities which are valued for their different contributions to the innovation process and leads to outcomes which depend upon the interrelatedness of the different kinds of knowledge.

Andersen/Metcalfe /Tether (2000) present an underlying perspective on the innovation process. They distinguish the four following characteristics of the innovation process:

The <b>opportunity</b> to innovate in terms of the acquisition of knowledge	The distribution of <b>incentives</b> to innovate
The distribution of <b>resources</b> available to invest in innovation	The <b>capabilities of the relevant organisations</b> to form innovation strategies and manage the process of innovation

**Table 2 Characteristics of the innovation process** (Andersen / Metcalfe / Tether 2000)

Innovations emerge through complex processes concerning the emergence, diffusion and combination of knowledge and its translation into products and production (Edquist 2001). Innovation processes are characterised by the emergence and diffusion of knowledge elements (scientific and technological possibilities) and the translation of knowledge into products whereby feedback mechanism and interactive relations work. The innovation process is a complex path involving interactions and feedback mechanisms involving science, technology, learning, production, policy and demand (Edquist 1997:1). Innovation has gradual and cumulative aspects, it is characterised by path-dependence.

Innovation processes are uncertain. They are clouded by ignorance and acts of faith and thus are particularly sensitive to changes in sentiment and expectations (Andersen, Metcalfe, Tether 2000). To express it in other terms: cultural, political or institutional factors such as

expectations about future profits, political values or beliefs, habits play a role in innovation processes.

### 4.3 Organisational innovations

Organisational innovations can be regarded as a special form of process innovations. They can be defined as new combinations of knowledge to solve perceived organisational problems or to explore organisational opportunities.

In terms of evolutionary economics, organisational innovations change or create new routines in firms. Routines are stable patterns of firm behaviour. Their main purpose is organising the division of labour and co-ordinating the dispersed knowledge in the firm. Their main purpose is the organisation of the division of labour and the coordination of the dispersed knowledge in the firm. Organisational innovations can be seen as new combinations of knowledge of how to produce, identify and co-ordinate knowledge about organisational routines. Organisational innovations are difficult to identify, describe and communicate because they involve *tacit* knowledge.

Organisational innovations can be defined in merely two ways (Coriat 2001):

- 1) Using well-known and well-defined *forms* of organisation or practices near to them. These concepts correspond to clearly identified organisational forms: quality circles, kanban system, just-in-time production, team work, decentralisation, integration of responsibilities and certification such as ISO certificates.
- 2) Using specific organisational *traits* of the innovation firms such as flexibility. The innovating firm is a flexible firm. These traits allow the firm to adjust to changing environment. This definition pays less attention to the forms making flexibility possible.

Due to their multidimensional character organisational innovations are difficult to identify. They can be defined as a joint group of attributes. Innovative practices can be captured through: Patterns of division of labour in the firm or the way tasks are co-ordinated between actors. Co-ordination encompasses the following three domains: information, knowledge and interests. A third way is a combination of both types of attributes.

Despite the fact that organisational change is a source of productivity growth and competitiveness, it has been not been recognised until the 1990s. Major organisational innovations have been not only the invention of R&D labs in companies, but also lean production or just-in-time production. To underline the importance of organisational innovations, persuasive arguments can be found. Edquist refers to the higher productivity in Japanese than in U.S. auto assembling plants due to a better firm organisation (1997: 23f). These advantages of Japanese firms originated from a number of organisational innovations, product design and inter-firm relations (Coriat 2001).

Edquist (1997) points out that organisational changes are important process innovations; vital for the development and use of technological innovations. Organisational and technological change is closely related and intertwined in the real world. Organisational change is a requirement for technological process innovation that means, that either organisations have to adapt to new technologies such as information processing technologies (SAP might be a

famous example) or technologies have to adapt to organisations (IT in the public sector, at least in Germany).

All technologies are created by human beings, they are socially shaped. Innovation takes place within the framework of specific organisational forms. For that reason, organisational changes are a determinant for technological changes. Organisational forms to be analysed may have a national, firm-based or international character. Edquist and Johnson (1997) explain the relationship between organisations and innovations. Organisations are the main vehicles for technological innovation - public and private organisations create innovations. Firms are organisations where innovation plays an important role as a precondition for profit. Organisations are engaged in the production, distribution and regulation of knowledge. Organisational change comprises of a changing organisational matrix and the character of existing organisations. It is often necessary for technological innovations in firms and is an important source of productivity growth.

Edquist (1997:24) calls for much more systematic knowledge about the emergence and diffusion of organisational innovations and their socio-economic consequences.

#### **4.4 *Eco-innovations***

The definitions of innovation presented above are neutral regarding the normative importance i.e. their impact on humans society. Following these definitions it does not matter for what purpose an innovation serves, nuclear weapons or AIDS-drugs both imply both new knowledge.

On the contrary, Eco-innovations have a clear purpose. They contribute to improve the environmental quality (Klemmer 1999:29). Some kind of environmental impact assessment has to be undertaken to prove if an innovation can be regarded as an eco-innovation. It can be done in two ways:

1. Assessing the environmental impact directly: Eco-innovations decrease environmental burdens caused by humans contributing to the following targets:

- Reduced use of energy and raw material,
- Reduced use of soil,
- Reduced emissions and waste,
- Maintenance of biodiversity and landscapes (Klemmer, Lehr, Löbke 1999).

2. Assessing the environmental impact more indirectly: Eco-innovations are innovations that contribute to ecological targets within sustainability strategies set by environmental politics or the society (Rennings 2000, Klemmer, Lehr, Löbke 1999).

In a German research project on eco-innovations, called FIU – Forschungsverbund “Abschätzung der innovativen Wirkungen umweltpolitischer Instrumente (Klemmer, Lehr, Löbke 1999), innovation is defined in a very broad sense as technical, organisational, institutional and social innovations. Technical (products and processes) and organisational innovations are summarised as technical-economic innovation. They might appear in the following forms shown in the table below.

Type of innovation	Example
product innovation, extraction innovation	developing and marketing of new products, new inputs and other resources for existing products
process or resource innovation	Development and implementation of new processes in the production of goods and services and the use of natural resources
organisational or strategic innovation	Changes in the organisation of firms, firm strategies and corporate cultures
Institutional innovations	Changes in property rights, market structures

**Table 3 Defining eco-innovations** (Klemmer 1999)

Institutional innovations represent new combinations of knowledge within the society about how to arrange relationships between their members, such as property rights (e.g. car sharing or leasing instead of buying a private car) or structures of consumption and production.

In the German research project mentioned above, it is pointed out that many eco-innovations have emerged outside firms and markets. The determinants of eco-innovations are changed values, beliefs and institutions such as environmental policy which lie outside market processes. In this research project, it was also stated that technical-organisational innovations can be classified as preventive or end-of-pipe.

#### **4.5 Innovation and knowledge**

Innovations are new combinations of knowledge. They the result from interactive learning. Change in the form of technical and organisational innovations is rooted in a process of interactive learning. New combinations of different pieces of knowledge emerge by the interaction of individuals and organisations.

At this point I would like to make a between information and knowledge. Knowledge is a wider concept than information, the distinction can be made due to the tacitness of knowledge. Information is often referred as non-tacit knowledge. The difference between tacit knowledge and non-tacit knowledge (information) was recognised by Polanyi (1967): tacit knowledge is ill-defined, unpublished, un-codified, differs from person to person (idiosyncratic), can not be fully expressed and can only be shared with people having a common experience. Information can be codified and easily transmitted and published.

But what is economic knowledge? I would like to use the classification of economically relevant knowledge by Lundvall & Johnson (1994: 27 ff). They distinct between four types of knowledge:

- know-what,

- 
- know-why,
  - know-how and
  - know-who.

Know-what refers to knowledge about facts such as the number of firms in one region or the financial characteristics of a firm's clients. This kind of knowledge is close to information. It is codifiable because it can be broken down into bits, stored and transferred.

Know-why refers to scientific knowledge such as principles or laws in natural sciences or in the society. Especially knowledge from natural sciences has been extremely important for technological progress in certain areas such as biotechnology, electronic industry or the chemical industry. Know-why is often directly associated with knowledge, because R&D intensive industries, so-called knowledge intensive industries, base upon know-why. The production and reproduction of know-why is to an important degree organised in highly specialised organisations for example universities or research institutions. This kind of knowledge is also close to information because it can almost fully be written down, stored and transferred.

Know-how refers to skills – the capability to do something at a practical level such as crafts. This knowledge can not be easily written down, stored and transferred by ICT.

Know-who refers to knowledge about expertise. It includes how special social relationships or special expertise are formed. Know who does not mean to know that A is a certified consultant in area X, but to know what he is able to do, what is his/ her special expertise and how does he / she organises his / her consultancy job. This peculiar knowledge was introduced by Lundvall and Johnson (1994) because they perceive learning as an interactive process.

To this category Lundvall and Johnson add know where and know when. This knowledge is merely knowledge about markets. This kind of knowledge should not be underestimated: The access to key persons might be more important to the success of innovation than exact knowledge of scientific principles. Markets prove if an innovation is successful or not because it has to be profitable. Therefore it is important to know where and when to introduce a new product or even a brand- new technology. The know-how knowledge is far from to information because it can not be simply broken down to bits and stored and transferred. It is rooted in persons or organisations such as specialised consulting firms or departments.

#### **4.6 EMAS - What type of innovation is it?**

EMAS can be classified as an incremental organisational eco-innovation innovation in firms following the points presented above.

EMAS is an organisational innovation in the firm following the classification presented by Coriat (2001) because EMAS as a process of certification is a new standardised form of organisational practices. Implementing EMAS, firms change their organisational structure, set environmental targets and apply new organisational routines such as audits. These changes refer mainly to the environmental management system, such as defining responsibilities, checking and ensuring compliance with environmental laws (audit) and the environmental declaration. These organisational measures are undertaken if a firm implements EMAS for the

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first time (Steeger 2000). For EMAS, the firm needs new knowledge to implement the system.

EMAS is an incremental innovation because it builds upon existing practices and structures. It neither changes existing routines dramatically neither requires totally new knowledge. Most firms have some kind of environmental routines and structures such as checking compliance and setting technical targets before they implement EMAS as a certified environmental management. Therefore, German firms often replied in a survey that they often undertook measures after implementing EMAS which they would have undertaken anyway (Steeger 2000).

EMAS can be regarded as an eco-innovation because it systematises environmental protection efforts in firms and requires environmental target setting in the firm. EMAS contributes to the society's sustainability target because firms voluntarily internalise their environmental costs and prove it with the certificate and the environmental declaration. The specific environmental effects and impacts of EMAS in an organisation are difficult to assess.<sup>1</sup> The numerous firm surveys show that EMAS lays the ground for an increased eco-efficiency and contributes directly and indirectly to innovations. The management approach is also new at the firm level because EMAS requires environmental media (water, air, soil, waste) spanning environmental protection. Up to now, environmental regulation enforced enterprises to comply with specific laws for water, air and soil protection and waste management. The environmental declaration is also new for most of the firm. Up to now, firms in Germany are only required by law to publish data about their environmental effects or activities and many do not disclose information voluntarily.

Standards for environmental management at the firm level are also new for environmental policy. These standards can be seen as policy innovations because they represent a new form of regulation i.e. an innovation at the policy level. EMAS has also been new for actors from public and private organisations in Germany such as policy-makers, public servants, NGOs and the engineering community.

Management approaches had not been popular in German firms until the beginning of the 90s. They have become policy-relevant in the German environmental policy only recently by introducing environmental planning in some Federal states. The prevailing technical approaches seemed to prove to be successful.

More specific, the standards for environmental management such as BSt 7000, ISO 14001 series or EMAS I and EMAS II are new policy instruments. They can be dealt with as policy instruments because they represent a standard for the self-regulation of organisations, up to now mostly firms. Organisations voluntarily undertake environmental protection efforts beyond the level required by laws. These standards have a hybrid character i.e. they have neither a full public or a full private character because they can be set by public (EMAS) or private authorities (ISO 14001).

As the above mentioned definition of innovation stresses the knowledge dimensions innovation I would like to show which new knowledge is needed by implementing EMAS in

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<sup>1</sup> The problems of evaluation an EMS have been dealt with in the chapter about the effects of environmental management in firms.

an organisation. Implementing of EMAS firms have to learn how to improve their environmental effects and impacts. EMAS ensures the organisational provisions for complying with environmental laws and continuously improve the firm's environmental impacts and effects. This requires a complex knowledge base which is always firm-specific and sector-specific. What knowledge has to be built up for the adoption of EMAS firm? At this point I would like to distinguish between knowledge which is mainly necessary for internal and external purposes. This knowledge refers to technological and organisational knowledge needed for establishing and maintaining an EMS. Knowledge for external purposes refers to knowledge needed for communicating the effects and impacts of the firm's EMS to its stakeholders.

To my mind, new knowledge is mainly needed in the following areas:

- Knowledge for internal purposes: 1) Technological, environmental and organisational knowledge: Media coverage of environmental effects and impacts and deriving environmental targets from this evaluation, 2) Meet the EMAS standard, create a living system, not only write handbooks,
- Knowledge for external purposes: environmental declaration.

Technological, environmental and organisational knowledge: With EMAS, firms need to assess their environmental effects and impacts. Therefore firms need to develop technological and scientific knowledge in the form of know-why and know-how. For complying with environmental regulations, firms need knowledge about these norms, how to comply with them. This know-how is extensive and constantly changing. Relevant knowledge has to be stored in management handbooks.

To comply with environmental norms and target-setting beyond environmental norms requires a different knowledge. For complying with norms firms have to know the mainly technical norms provided by the environmental authorities and "simply" implement them. Going beyond compliance with existing laws, firms have to gather knowledge about what environmental targets they can set and how they can improve them. For this purpose they have to assess material and energy flows in the firm. For the analysis of material and energy flows, a different technological and scientific knowledge is needed. Analytical tools like life cycle assessment and material flow analysis are used. Firms have to develop these knowledge gradually. Consultants possess these highly specialised forms of knowledge on which firms can rely. Therefore they need know-who how to select a consultant meeting the firm's need.

Know-how for organisational change: Firms also need to develop organisational knowledge: "How can we follow the standardised procedures required by the norms ISO 1001 and EMAS? How can we organise the process of target-setting and implementing? How can we involve employees? How can we organise the EMS structure, assign responsibilities to employees and implement the audit? The main task is to ensure that the management system lives and does not only exist in the form of management handbooks.

Finally, firms need knowledge about how to communicate their efforts and results to their clients in an environmental declaration. The effects and impacts of an environmental management systems within the enterprise are difficult to communicate and therefore difficult to perceive by customers. Product label are known better by clients: a customer is interested in an eco-car - a car is labelled as an eco-car if the car uses less petrol, a car which is produced

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with less energy and material is not perceived as an eco-car. That makes it difficult to communicate the effects of EMAS. But not only clients have to be addressed: If firms want to improve their relationship with regulatory authorities they have also to communicate to environmental authorities. They must communicate that their commitment towards voluntary environmental protection is credible.

These arguments show that EMAS does not only create preconditions for innovations in the firm, but itself is an incremental organisational eco-innovation. In my research, I would like to concentrate on EMAS as an eco-innovation at the firm level. EMAS as an eco-innovation has two dimensions: 1) a technological dimension oriented to eco-efficiency or even innovation and 2) a regulative dimension – the self-regulation of the firm beyond the level of environmental protection demanded by the state.

## 5. Conclusions

From an ecological modernisation perspective, EMAS is a crucial part of ecological modernisation strategies because it supports ecological efficiency and related technological change and innovation at the firm level and represents self-regulation of firms. From an innovation research point of view, EMAS is an incremental organisational eco-innovation at the firm level.

As I explained in the introduction of this paper, ecological modernisation theory shall serve as a normative device for assessing environmental policy measures. My PhD shall contribute to understand which policy options exist in relation to promote voluntary actions of firms for environmental protection i.e. the adoption of EMAS. I try to show that EMAS is a crucial part of ecological modernisation strategies in the first chapter of my PhD. My first conclusion relating to the policy relevance of EMAS is that EMAS as an organisational innovation is not considered in the German ecological modernisation strategy. This strategy is more technologically-oriented. Therefore, I recommend that organisational innovations shall be included into the policy concepts. I would like to ask the following questions for my analysis at the regional level: Does this national ecological modernisation strategy play a role at the regional level? Is EMAS included in the regional strategy?

After having identified EMAS as an organisational eco-innovation, I proceed in my PhD in the following way:

- Searching for an analytical framework which explains factors influencing the diffusion of EMAS and the linkages between these factors,
- Analysing the EMAS-related literature identifying and explaining the single factors,
- Developing a model explaining the main factors and their relationship.

Both approaches, ecological modernisation and innovation studies are meso level or institutional approaches. Looking at EMAS from these institutional perspectives might serve a good basis for elaborating a framework which can identify and analyse institutional factors influencing its diffusion. Therefore I plan to conduct an analysis at the institutional level. From an ecological modernisation point of view it is worth to take the following institutional factors into consideration: the changed relationship between the state and the industry, the role of markets and changing regulations. For my research it would be interesting to investigate two points of ecological modernisation in a more detailed manner. The first

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point is: Which role play economic actors and markets? How does the relationship between the state and the industry changes? The second point is related to the changing relationship between the state and the industry - how regulation changes or transforms in order to cope with these changed relationships? These still very general questions I would like to refine developing an analytical framework for my study.

Taking EMAS as an organisational eco-innovation, a suggestion would be to use an innovation system approach as an analytical framework to analyse the diffusion of EMAS. I would like to ask if and how actors and institutions of the regional innovation system have influenced the diffusion of EMAS. In my research I would like to use the characteristics of the innovation process identified by Andersen, Tether & Metcalfe (2000) for analysing the diffusion of EMAS. They identified four factors: opportunities, resources, incentives and capabilities of firms to form innovation strategies. I would like to ask which regional actors and institutions have provided resources and incentives for firms to adopt EMAS as an organisational innovation.

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