Expert system for food regulations in a dynamic enterprise environment

Henrik Krapp, Emanuele Novelli, Melanie Fritz, Gerhard Schiefer

Professur für Unternehmensführung, Organisation und Informationsmanagement
Rheinische Friedrich-Wilhelms-Universität Bonn
Meckenheimer Allee 174
53115 Bonn
henrik.krapp@uni-bonn.de
emanuele.novelli@uni-bonn.de
m.fritz@uni-bonn.de
schiefer@uni-bonn.de

Abstract: Policy is in charge of consumers' interests, especially concerning food safety. The implementation of policy regulations is a common tool to exert influence on the food safety status in society. However, the food control is in the hands of enterprises. To increase the effectiveness of policy making it is essential to understand enterprise compliance behaviour. This paper presents an expert system framework for policy decision aiding. The complex cause-and-effect relations of the enterprise behaviour are reduced to a step-by-step approach based on first empirical results.

1 Introduction

The globalization of food trade and the harmonization of food standards and food safety measures affect the international and national regulatory frameworks for food. There is an increasing recognition of the need to integrate and improve regulatory activities among national and international bodies to protect human health and environment [VaSp05]. Therefore, an expert system is elaborated providing decision support to achieve higher success in food policy making. To exert influence on the society's food safety status the implementation of policy regulations is a common tool. To take the right decisions on the implementation of food safety regulations appropriate knowledge of the possible consequences at all affected levels has to be gathered. [FS08] Aware that the overall problem is a multi-level problem, affecting the level of society, the level of individual actors (e.g. enterprises, consumers) and the level of a group of individual actors (e.g. industry sectors), this research elaborates a new framework for an evaluation focusing on the enterprises' effects and their behaviour as the basis of the regulation's effects on society. The presented expert system visualises the effectiveness of policy implementation in terms of enterprise compliance behaviour and aids policy in decision making, pro or contra a draft regulation, by presenting the cause-and-effect relations on the enterprise level.

2 The modelling framework

2.1 Background

In the context of environmental regulations, literature presents some insight regarding the regulations' impact on the enterprises. There are in general two oppositional perspectives of the regulations' impact on enterprise's strategy and performance. The positive perspective refers to 'first mover advantages' [Po90, PL95]. However, another view is that enterprises rarely benefit because of a negative financial return [WW94]. The relation of the regulation's impact on the enterprise and the enterprise behaviour of compliance depends on the expected economic benefit [HH98, HC99]. This shows the importance of analysing and evaluating the impacts of food regulations on enterprises.

The concept of decision support is a key element of the expert system. It must be seen as a process whose progress is punctuated by a certain number of critical points [Ro96]. "Dynamic decision making", which is characterised that a number of decisions are required rather than a single decision, decisions are interdependent, and the environment changes, either as a result of decisions made or independently of them or both [QSD08, Ed62]. Models aiding the decision maker assist in understanding, reasoning about reality, and communicate the results [Ro96, QSD08]. This step-by-step approach affects all processes of the presented expert system.

2.2 The expert system

The object of the policy decision includes all main causes and effects generated by the implementation of new food quality and safety regulations. To identify the complexity of the problem and to visualize the focal steps the processes are broken down to the most important ones. The approach to this problem is to elaborate a norm that states if an enterprise with specific characteristics, facing a food safety regulation will behave in a causal way. A line of arguments is needed to cluster enterprises, measure the changes in enterprise performance and to judge the enterprise behaviour. Clustering is used in order to elaborate a norm most applicable to different enterprises. The system depends strongly on the approach of performance measurement, information given in a regulation and access to data. As already stated there has to be at least a non-negative effect on the enterprise performance to act according to the food safety regulation. A performance measurement scheme is elaborated, which helps to understand the cause-and-effect relations and leads to improved decision making.

The further development of the framework is based on a twofold procedure. First, different knowledge sources have been used to make up a first version of the expert system. Second, this first version has been checked as a whole by experts of different fields (economics, food law, and policy) and reworked accordingly. The expert system's line of arguments consists of the following main steps:

(1) Regulation analysis;
(2) Selection of the affected enterprise classes;

(3) Enterprise behaviour analysis.

Regulation analysis - First the new regulation has to be analysed according to its scope and its requirements. This step aims to identify the regulation's information necessary to fill in the following steps of the expert system. In the following parts the information are structured and integrated in the operational procedure of the expert system.

Selection of the productive system affected - The productive system has to be clustered in single types of enterprises. Following set of arguments is elaborated to identify the affected enterprise classes: (1) Regional focus: The regional focus of a regulation may concentrate on a geographical market, a country or an international level. (2) Industry: The regulation may focus only on a specific industry sector or on several industry sectors. (3) Stage of production: The regulation may apply to a specific step of the production stage or to the entire production stage. (4) Enterprise size: The enterprises are further classified by the enterprise size, e.g. in terms of people employed.

Enterprise behaviour analysis – This step reverts to the output of the previous step and picks out each affected enterprise cluster for a detailed analysis. (1) The part 'Regulation access' analysis the enterprise's access to as well as the understanding of the regulation. The enterprise may not be aware of the new regulation or does not understand the regulation. Both situations lead to non-compliance with the regulation. If that is not the case the expert system goes on. (2) A scheme, called 'Expert Check List', is elaborated to support the evaluation of the effects of a new regulation on the enterprise. First, based on a given list, business areas (e.g. production, storage, documentation), where the enterprise has to take actions to fulfil the regulation's requirements are identified. Second, effects of these actions on the enterprise key performance indicators (e.g. production costs, product safety) are evaluated based on a scoring system. Changes in the key performance indicators illustrate the impact on the enterprise performance. Finally, the willingness of compliance of the enterprise class will be judged. The judgement is not just a defined outcome of the 'Expert Check List', but in addition it is an outcome of the entire structured reasoning process.

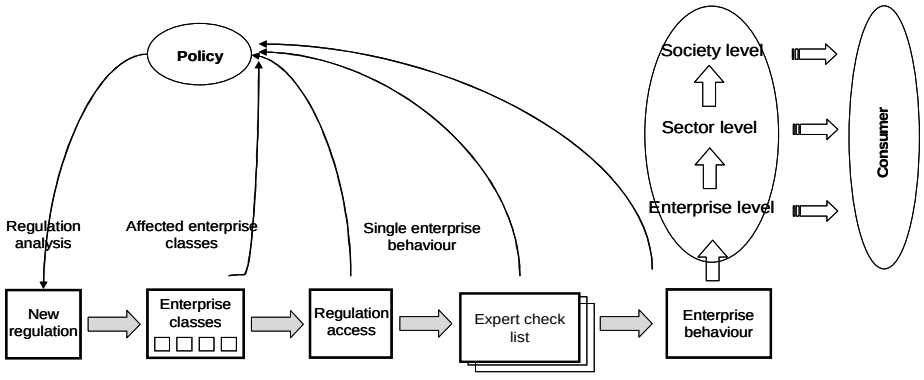

Figure 1: Expert system overview

After analysing each affected enterprise cluster, an overview is available of the enterprise types, which are willing to comply with the regulation and those, which will probably choose non-compliance.

Figure 1 presents on overview of the expert system's line of arguments and embeds the system into the dynamic multi-level problem of food policy making.

3 Conclusion

This study has been set up to evaluate an expert system exploring policy effectiveness in terms of enterprise compliance behaviour and supporting policy decision making for food safety regulations. In this problem situation the system output on the enterprise level should not be seen separated but as an input for further evaluation on the society level. The step wise approach of the expert system makes sure to reduce complexity and to keep comprehensible enabling to trace back all given information and to make policy understand the main cause-and-effect relations leading to the results. Furthermore running the expert system should take not a lot of time enabling policy to take fast decisions and react prompt on a specific food safety situation. This is of particular importance considering the dynamic interrelations between single actors, different sectors and the society. Here, further research can follow up. Based on the step-by-step approach future work can include changes of behaviour over time as well as changes caused by interrelations between enterprise classes. The sector level will be added (see Fig. 1).

References

[Ed62] Edwards, W. 1962, 'Dynamic decision theory and probabilistic information processing', Human Factors, vol. 4, pp. 59-73.

[FS08] Fritz, M. & Schiefer, G. 2008, 'A multi-level cost-benefit approach for regulatory decision support in food safety and quality assurance scenarios', Innovation: The European Journal of Social Science Research, vol. 21, no. 2, pp. 177-182.

[HC99] Henson, S. & Caswell, J. 1999, 'Food safety regulation: an overview of contemporary issues', Food Policy, vol. 24, pp. 589-603.

[HH98] Henson, S. & Heasman, M. 1998, 'Food safety regulation and the firm: understanding the compliance process', Food Policy, vol. 23, no. 1, pp. 9-23.

[PL95] Porter, M.E. & van der Linde, C. 1995, 'Toward a New Conception of the Environment-Competitiveness Relationship', The Journal of Economic Perspectives, vol. 9, no. 4, pp. 97-118.

[Po90] Porter, M.E. 1990, The competitive advantage of nations, , Free Press, New York.

[QSD08] Qudrat-Ullah, H., Spector, J.M. & Davidsen, P.I. 2008, Complex Decision Making, , Springer.

[Ro96] Roy, B. 1996, Multicriteria Methodology for Decision Aiding, , Kluwer Academic Publishers, Dordrecht.

[VS05] Vapnek, J. & Spreij, M. 2005, Perspectives and guidelines on food legislation, with a new model food law, , FAO, Rome.

[WW94] Walley, N. & Whitehead, B. 1994, 'It's not easy being green', Harvard Business Review, vol. 72, no. 3, pp. 46-52.