

## **AMOR – improving inspection strategies in agri-food supply chains**

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### **Abstract**

A new development in the area of agri-food supply chains is the emergence of inspections according to the AMOR principle. AMOR stands for **A**lliances for the **M**utual **O**rganisation of **R**isk oriented inspection strategies and implies that inspections are organised in a joint collaboration between suppliers and customers. Furthermore these inspections are to be performed more intensively when the perceived risk is high and less intensively when the perceived risk is low. A survey has been performed in three supply chains: fruit/vegetable, milk and meat. The survey assesses the existence of AMOR inspections in practice. The companies surveyed have been plotted in a cross-diagram to indicate their willingness to cooperate with other companies and to establish the risk awareness of the companies. A willingness to cooperate and an awareness of risk are two of the central struts of the AMOR approach. The results show that some AMOR inspections currently exist in practice and also show the degree of willingness to perform AMOR inspections.

*Keywords:* alliances, inspection, supply chain coordination, quality management, AMOR

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### **Problem statement**

Agri-food production chains are exposed to a dynamic environment and have to adapt accordingly (Luning et al. 2006). Producing companies are further challenged by the fact that more critical consumer attitudes towards food production exist (Luning et al. 2006). This consumer influence can lead to fundamental changes in production and processes. As a result, production companies often have to incorporate additional, previously unplanned for, inspections into the supply chain to fulfil consumer demands. Additionally agri-food supply chains are becoming increasingly complex and dynamic (Brinkmann et al. 2011; Trienekens et al. 2012; Fritz and Schiefer 2009) and include numerous actors with a range of varying customer-supplier relationships (Raab 2011). However, despite the complexity, food safety and traceability has to be guaranteed at all times from ‘farm to fork’. This is supported and controlled by manifold investigations along the supply chain.

Every stage in the supply chain performs several inspections on the (intermediate) product. But often the customers in the supply chain do not know which inspections have already been performed by the suppliers and to what extent, and vice versa. Information obtained through these inspections is rarely exchanged and therefore is often only available to one stage of the supply chain. The communication is traditionally one-way from producers of raw materials to the users of the end product (Knura et al. 2006). However, a number of authors rate an effective organisation of information exchange consisting of characteristics of products, processes and manufacturing equipment between decision makers in a food producing chain today as crucial to the competitiveness of supply chains to the food retail sector (Trienekens et al. 2012; Petersen et al. 2010; Ellebrecht 2008; Schulze Althoff 2006). Until now only few approaches have existed for a coordinated inspection strategy to improve communication between customer and supplier and to achieve a sufficient information flow between the actors of the chain (Petersen et al. 2010).

The **Alliances for the Mutual Organisation of Risk oriented inspection strategies (AMOR)**, aims at closing this gap. It aims to create alliances amongst supply chain actors to mutually organise inspection strategies. These inspections are performed more intensively when the perceived risk is high, and less intensively when the perceived risk is low. Information flows in both directions and communication between the stages is assured. With this AMOR moves from a procedure-driven approach (Colbert and Alderman 1995) towards a risk oriented approach. The principle of risk orientation has been introduced to the agri-food chain by new EU legislation, for example, for the official control and for meat inspection (EC 853/2004; EC 854/2004; EC 882/2004). With a risk oriented approach, limited resources can be utilised more effectively by adapting the inspection intensity to the different levels of risk associated with particular products and batches.

### **Objectives**

AMOR builds the basis for the development of a new inspection culture where organised inspections are performed among some of the actors of a given supply chain. Such intelligent inspection strategies permit the exchange of test results as well as risk evaluation and an adjustment of in-

spection intensity adapted to the associated risk - risk orientation. These fundamental aspects of AMOR may lead to the implementation of more efficient and robust supply chains in the future. Risk orientation effectively means that inspections are adapted to the risk which is associated with a specific batch of a product. If the risk is perceived high then the inspection is performed more intense, if the risk is low, the inspection is also less intense. To determine the risk associated with a particular product requires knowledge of countless variables. It is not an area that produces fixed, constant, values or "risk". Furthermore, random events may dramatically change the risk associated with a particular product. However, inspection intensity can still be based on product risk association. This is especially true for those products where an abundance of historical quality data exists, which exhibits very few (ideally zero) instances of adverse performance/quality and where there is a long-standing relationship of trust between supplier and customer. Of course, a risk-free past is certainly not evidence of a risk-free future. However, a very low risk (ideally risk-free) past can, in some cases, permit a relaxation of inspection intensity. If a new situation (unspecified) results in an increased risk to a product, then the inspection intensity can immediately adjust/adapt to this as the infrastructure to do so is permitted under AMOR. In the case of food production, risks to product quality and especially public health are of paramount concern.

The aim of current empirical and experimental studies is to define this new methodological-theoretical approach, AMOR. In the course of research and prior to going deeper into the formal analysis of how risk oriented inspection strategies can be performed as a mutual effort between partners, the dissemination of this concept in practice in agri-food supply chains is investigated. For this reason a survey has been performed amongst companies of different food supply chains. The results of this survey are presented in this paper.

As the AMOR principle requires collaboration amongst supply chain actors reinforced by mutual risk oriented inspection strategies, this implies that actors must be risk aware in order to orient towards areas of higher risk. Therefore the survey aims to assess these two critical dimensions, collaboration and risk awareness, of the AMOR approach. The companies surveyed have been tested on the grounds of their knowledge and belief in the AMOR principles and displaying a strong willingness for cooperation as well as their simultaneous risk awareness.

## **Research approach**

The authors have chosen the sectors of meat, milk and fruit/vegetable as a representative research setting of the agri-food sector. In these three sectors trendsetters according to the authors' opinion which are ahead of their peers in terms of quality management and which are perceived as open to new developments have been selected to get information on development trends. The survey has been designed as in-depth expert interviews performed face to face and via telephone.

A questionnaire consisting of a series of closed and open-ended questions has been given to the survey participants. It has been pre-tested by academic reviewers and industry practitioners familiar with quality management and quality inspections and subsequently has been modified and sent out to the interviewees prior to the personal or telephone interview.

A total of 60 German companies have been contacted to participate in the survey: 25 each from the fruit/vegetable and milk sectors and 10 from the meat sector. A total of 22 (out of 60) companies responded to the survey. The respondents comprise: 7 experts from the fruit/vegetable sector,

7 experts from the milk sector and 8 experts from the meat sector. The companies comprise private and cooperative fresh fruit and vegetable wholesalers, dairies, livestock marketing and producers' associations, slaughter and processing companies. The breakdown of the participants as well as further characteristics such as work experience and positions in the company, ranging from managing director to representative or head of quality management is provided in Table 1.

**Table 1: Characteristics of participants in the survey**

<b>Characteristics of the sample</b>	<b>Fruit/veg.</b>	<b>Milk</b>	<b>Meat</b>	<b>Total</b>
Number of persons invited to participate in survey	25	25	10	<b>60</b>
Companies not participating	18	18	2	38
Number of respondents	<b>7</b>	<b>7</b>	<b>8</b>	<b>22 (37%)</b>
Work experience (~Ø) of participants	10 years	20 years	13 years	14 years
Head of quality management*	2	5	3	10
Quality management representative*	5	2	3	10
Managing director*	1	0	4	5

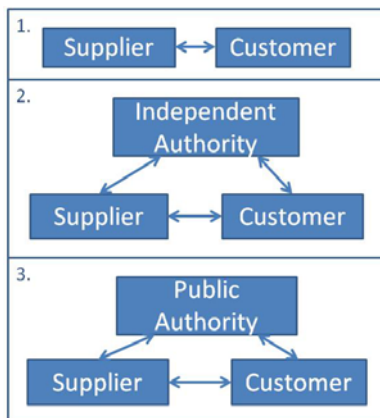
\* Multiple answers possible

For convenience the seven companies of the fruit and vegetable sector have been designated O1 to O7, the one of the milk sector M1 to M7, and the eight experts of the meat sector F1 to F8.

## **Results and discussion**

### *Categories of alliances*

From the literature review and according to statements from interviewees of all three sectors, different alliances became obvious in which inspections can be organised mutually. Alliances exist between supplier(s) and their customer(s). Agreements are directly made between both sides. Other alliances include external parties, such as laboratories and/or auditors. It is possible to distinguish alliances with external private or public parties. It has been found that there are three main categories of alliance between the different actors. These alliance categories are shown in Figure 1.



**Figure 1: AMOR alliance categories**

Category 1 applies when inspections are directly organised mutually between one or more customers and one or more supplier(s). Both parties determine the inspection strategy with its inherent elements.

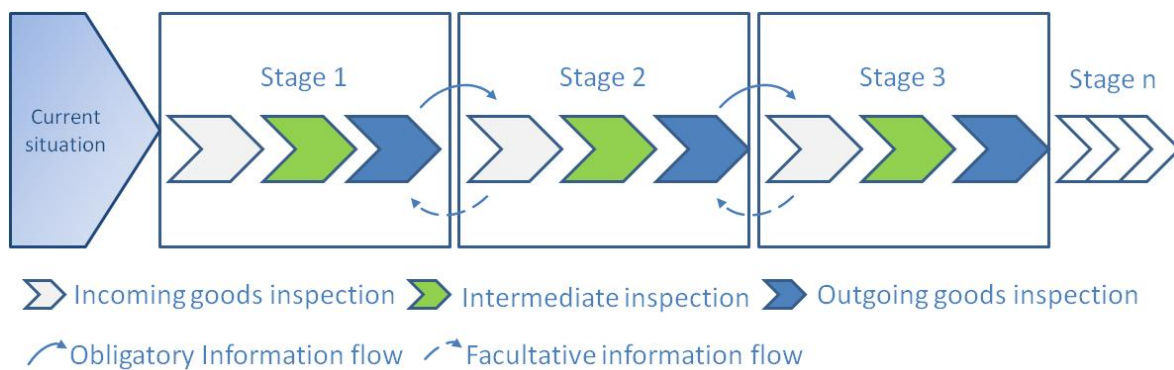
Category 2 extends category one by a third party. This is an independent authority which can be a netchain coordinator or an entity which conveys between one or more suppliers with a more powerful customer. The third party functions as a mediator which organises and performs the inspections for the other two parties and which is approved by the other parties. In this constellation it is important that the independent entity also benefits from the inspection.

Category 3 surpasses the private industry and includes a (semi-)public authority. In this alliance the public authority performs the inspection and provides the results to supplier and customer.

In general the alliances have to decide jointly on the inspection strategy. This comprises the organisational structure and risk oriented design of the strategy. Furthermore the alliance has to set mutual responsibilities and tasks and the information and communication structure has to be jointly developed for a successful inspection strategy. The benefits and costs shall be allocated onto the partners to achieve a win-win situation for all participating partners.

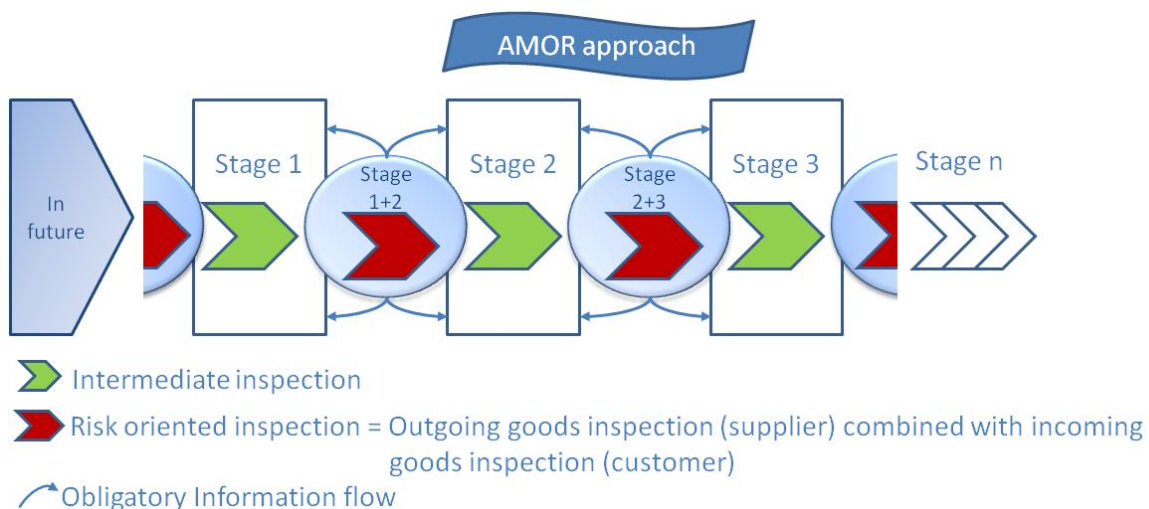
#### *Inspections to date and the potential of AMOR*

At present inspections in agri-food supply chains are mostly designed in such a way that each company of the chain performs an incoming goods inspection, (at least) one intermediate inspection and one outgoing goods inspection (see Figure 2). The information from these inspections is passed with the product from stage to stage. However, information rarely flows back to the preceding production stage. Therefore, primary production stages often do not know about inspection results. A two-way flow of information is critical to improving product quality, avoid duplication in testing and to increasing chain efficiency.



**Figure 2: Inspections at present in food producing chains**

The AMOR approach for instance, applies when an incoming goods inspection by a customer (stage 2) and the outgoing goods inspection of its supplier (stage 1) can be combined into one inspection. Referring to the entire chain inspection frequency, the amount of inspection points in the value creation process can be decreased, as shown in Figure 3. Information on safety and quality always flow in both directions due to the mutual organisation of the inspection.

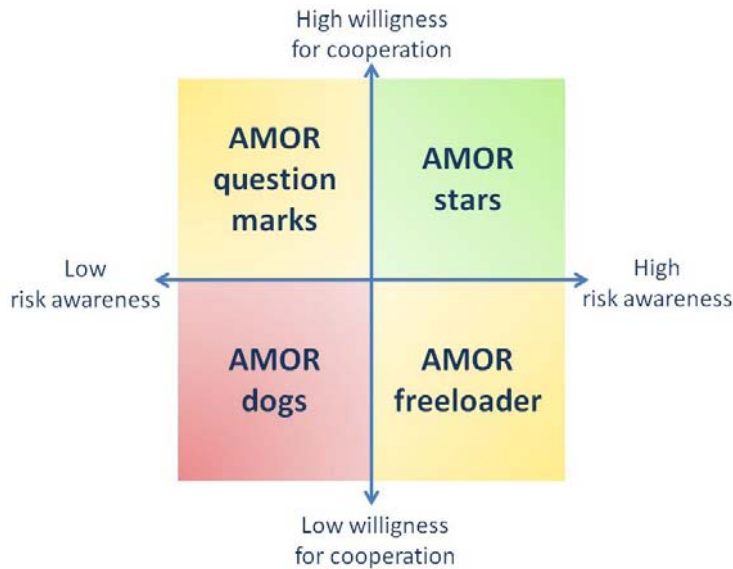


**Figure 3: Organisation of inspections in food producing chains with the AMOR approach**

### *Benchmarking of the actors*

Based on the assessment of the AMOR approach among the companies of the three sectors fruit/vegetables, milk and meat, the enterprises have been positioned in a cross-diagram (Figure 4). By modifying the Boston Consulting Group Matrix (BCG 1968), a benchmarking of the com-

panies based on their competence in adhering to and/or implementing AMOR principles has been performed.



**Figure 4: Matrix to assess companies' abilities to adhere to and/or implement the AMOR principles**

Initially the two axes of the graph have been defined. These are 'risk awareness' (x-axis) and 'willingness for cooperation' (y-axis). The x-axis shows that a company has a certain mindset regarding risks and that management of risks is more than just fulfilment of basic requirements. The company is flexible regarding risk assessment. Risk awareness is important for applying risk orientation to inspections.

To show the degree of risk awareness, five survey questions were devoted to this topic. The questions are listed in Table 2. Each question that has been answered with 'yes' results in 1 point for the company, a partial answer results in a ½ point and the answer 'no' results in no points, adding up to the highest possible score of 5 points per company on the abscissa.

**Table 2: Elements of risk awareness**

1.	Do you apply more than HACCP (Hazard Analysis and Critical Control Points) for risk analysis?
2.	Do you rely on external help for the implementation of the risk management system?
3.	Do you want to increase your competitiveness with your risk management system?
4.	Have you been influenced to optimise your risk management system through current food crisis e.g. EHEC?
5.	Is risk orientation conceivable for inspections?



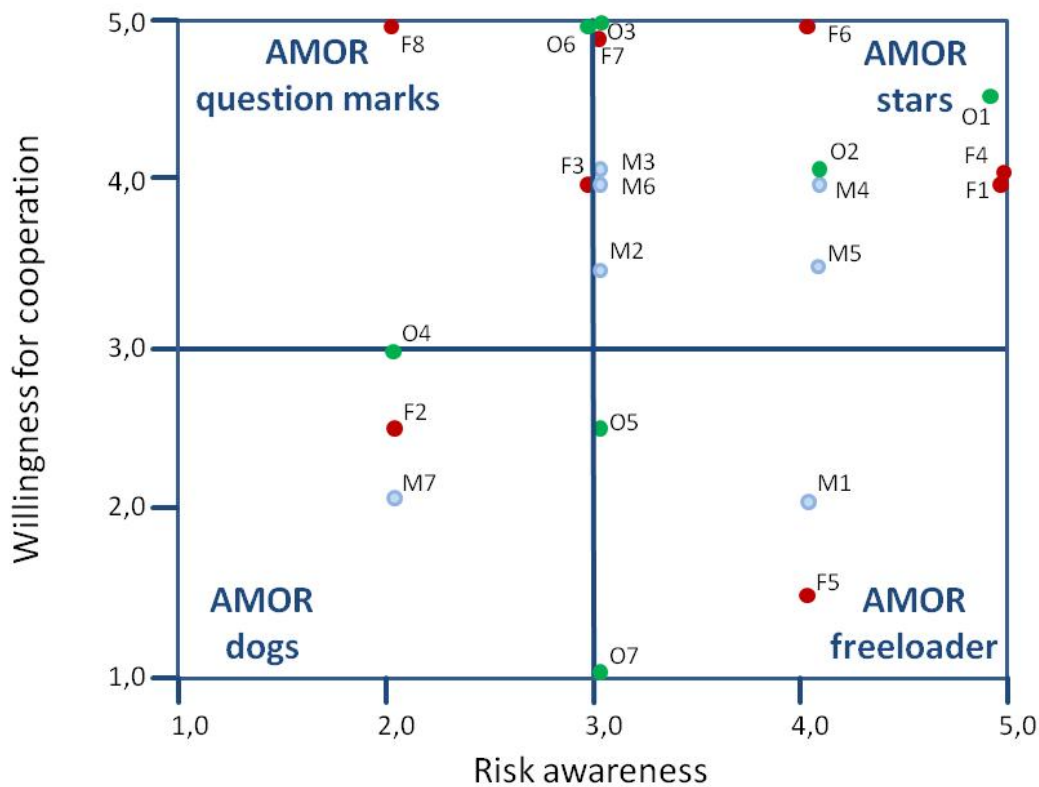
The questions in Table 2 have been chosen to achieve a broad sense of the risk awareness of the participating companies.

The ordinate (y-axis of Figure 4) represents the willingness to cooperate with other companies of the supply chain. Five questions from the interview were assigned to this part and the same rules of scoring as for the abscissa have been applied (Table 3).

**Table 3: Elements of willingness for cooperation**

1.	Is it conceivable for you to mutually organise an inspection with another company?
2.	Have you already implemented mutual inspections with other companies?
3.	Would you be willing to share relevant information with other companies for an AMOR inspection?
4.	Is it conceivable to organise a mutual inspection with an adjacent partner in the processing chain: For example could you merge your incoming/outgoing goods inspection with that of the incoming/outgoing goods inspection of your immediate supplier/customer?
5.	Do you already perform an inspection that is an outgoing and incoming goods inspection at the same time?

The companies are positioned according to their scores for risk awareness and willingness for cooperation into the cross-diagram. Four different quadrants can be differentiated. Depending on the position in the diagram the companies are referred to as ‘AMOR stars’ (high level of both), ‘AMOR question marks’ (low to medium risk awareness and high willingness for cooperation), ‘AMOR freeloaders’ (high risk awareness, low to medium willingness for cooperation) and ‘AMOR dogs’ (both results low). Figure 5 shows the positioning of the companies according to the survey results.



**Figure 5: Matrix to determine the companies' competency with AMOR**

The matrix shows that the companies are distributed within all quadrants, so there are AMOR dogs as well as AMOR stars. Seven companies are clearly in the stars quadrant, of which three are from the meat sector and two each from the fruit/vegetable and milk sector. Amongst the AMOR stars are many companies organised as cooperatives (O1, O2, M2, M4, M5 and F1). It has been deduced from the results, that in cooperatives, there already exists a strong foundation of trust and long-term relationships between actors and so these lend themselves well to mutual AMOR inspections. Most stated reasons for not cooperating with other companies for inspection strategies on grounds of lack of trust and reliability as well as often changing suppliers.

The matrix also shows that most of the actors are willing to cooperate with other companies whereas for those companies risk awareness remains low to medium. The willingness to cooperate, however, is crucial for AMOR inspections and provides a good basis on which to build for future AMOR approaches.

From the survey it has been possible to deduce (a) the extent of current mutual inspection areas, (b) the potential for future collaboration, (c) current mutual inspection areas and (d) the desired requirements for future mutual inspections. The survey has shown that the basis for AMOR inspections is given in practice. All three sectors understand the concept of risk oriented inspections and all experts questioned can as well imagine to apply this principle on inspections in their companies. Different needs exist for AMOR inspections in the different sectors. In the fruit/vegetable

sector the interviewed wholesalers stated monitoring residues and supplier rating for joint inspections. In the milk sector packaging and microbiological and chemical analysis were identified and in the meat sector animal health, risk oriented meat inspection and livestock inspection as well as additives were named and, in future, also microbiological, chemical and physical tests. In some areas the interviewees already have experience of collaboration for joint investigations.

## **Conclusions**

The results show that the majority of interviewees regard AMOR inspection strategies with risk orientation and mutual organisation as a possibility for their companies. With this the basis for the AMOR approach is clearly given in practice and examples of AMOR inspections can be found in the companies. The concrete implementation, however, varies due to different risks and different aspects of food production.

Furthermore, forms of alliances have been detected in which AMOR inspections can be mutually organised. Thus, inspections within the different food producing chains can be assigned to three basic alliances.

AMOR can be seen as a new trend in innovative supply chains. The approach forms the basis for further comprehensive research in the course of which it will be important to clarify to what extent the three categories of AMOR alliances can be transferred to inspection strategies in other food sectors and how these inspections can be performed by a mutual effort between partners. Therefore the requirements for AMOR inspections, the responsibly and tasks, cost and benefit allocation as well as information and communication structures will have to be investigated in detail. This survey provides the starting point for such investigations.

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