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Using RFID traceability solutions for building confidence in Romanian food industry – a possible solution to survive in the economic crisis context*

Zoltán Kató

University of Economic Studies, Bucharest, Romania
kato_zoltan@yahoo.co.uk

Abstract

In recent years, the food market has become highly dynamic in our country. In the past 15 years, a "battle" took place on this market between modern agriculture and food industry from developed countries (ie high concentration of farms and processing factories and integrated supply chains / outlets connecting producers and consumers) and local agriculture and food representatives (generally fragmented and strongly competed by imports). Originally, food traceability was correlated with the origin or geographical region these products came from (Mozzarella, Cognac, Tokaly, Pleşcoi). Later the concept was expanded to the food safety, the right of consumer to be informed about: the country of origin, the animal breeding or products harvesting conditions, the genetic composition and / or their environmental characteristics, etc. From recent crises all EU member states must verify through the DNA tests conducted from March 1, 2013, if the data on the label of a meat product corresponds the content and simultaneously will be improved the legislation. So in the coming years food traceability becomes a prerequisite and necessary for business success in this industry. We can state that product traceability has become a prerequisite for business success in the food industry. As a modern solution, RFID technology can be useful for tracking applications related to perishable food products made with rewritable RFID tags. The

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purpose of the present paper is to study the main traceability requirements, to examine how RFID technology can fulfill these requirements and presents a research regarding the knowledge and acceptance of such solutions by the Romanian companies.

Keywords: traceability, RFID tags, supply chain

MSC: 03H10

1. Introduction

The intensification of agricultural production on an industrial scale, the harmonization of national legislation with the European legislation after our accession to the European Union, the increased competition in the food market, and consumer's demands to be ensured by fresh, tasty, nutritious and safe edibles, raised a new challenge for manufacturing and processing, occurring the need to ensure the traceability of goods supplied "from farm to fork". Providing consumers traceable foods refers to offering security for consumers and other interested parties about the origin, location and history of a product, such as assistance in crisis management in the event of a breach of safety standards and quality.

The objectives of the present study/research were: deepening theoretical issues of food traceability and testing an empirical traceability model using RFID technology (Radio Frequency Identification Device) with passive rewritable RFID tags. The research methodology was composed of documentation of national and international literature in order to identify features and the effect of using RFID technology in traceability of goods; to determine the perception of the proposed model for monitoring traceability of products in Romania, through a questionnaire-based survey distributed electronically.

2. Food safety – a problem always present

Food crises in the early 90s - UK BSE crisis which peaked in 1993 with 1,000 new cases per week (Brown et al, 2001) or those of the recent years as avian flu pandemic (Rijswijk 2008), or swine flu (Cicia et al, 2010) had a great impact on the food industry. Deficiencies of foodstuffs have led not only to contamination (accidental or intentional), but also in some cases, even to illness or death of consumers (Brown et al, 2001).

In the 2004–2008 pandemics avian flu, swine flu in 2011, the cucumbers crisis created by the hysteria produced by the possibility of infestation the cucumbers with bacteria Escherichia coli (E. coli), or horse meat latest crisis (Stone 2013), and the milk crisis contaminated with aflatoxin (Danone 2013) had a first consequence the dramatic decline in sales.

For example: a) the "cucumbers crisis" from spring 2011 caused losses of about 9 million EUR for the Romanian vegetable producers. Although the European

Commission has approved compensation of 100% for the affected vegetable producers, the amount allocated for Romania was 3,745,035 EUR (out of a total of 227 million euros at the European level, ie 1.65% of total European compensation). The initially estimated damage only in a proportion of 41.6% could be documented to the European Commission, as required for compensation. The beneficiaries of compensation awarded was an association that is recognized nationally and six other private producers, who are those who have registered MARD (Ministry of Agriculture and Rural Development), the APIA (Agency for Payments and Intervention in Agriculture) and fulfill all the conditions to be compensated" declared the Minister of Agriculture at that time. The remaining producers were unable to prove the damages as required by the European Commission and left with the damage.

b) "horse meat crisis" erupted in January 2013, when it was confirmed detection of horse meat in products and cooked, labeled as beef, in the UK and Ireland. Romania was initially shown as the possible guilty for this crisis, but on February 14, 2013, the French authorities confirmed the guilt of a French company. That company imported the horse meat from Romania and then re-labeled it, as beef. In France, horse meat scandal caused immediate loss of over 1 million EUR. Bucharest officials said that they would seek compensation from the European Union following the horse meat scandal.

The French company Spanghero which triggered the horse meat scandal in beef lasagna, was sued at Frankfurt for damages 1.8 billion EUR and is put up for sale after bankruptcy. (Mediafax 2013)

c) The "milk crisis" contaminated with aflatoxin, breaks out on March 7, 2013 when over 13,000 liters of milk suspected of being contaminated with aflatoxin (a carcinogen) were withdrawn from the market by the Danone Romania Company. The representatives of employers announced that around the problem "was created a hysteria, and some retailers have tried to remove uncontaminated batches of milk off the shelf" and that the whole scandal leads to removal of the consumer (Agerpres 2013). Following the scandal, the sales of milk have declined by 20-25% during March-May 2013 compared to the similar period of last year.

These are just a few examples that highlight the vulnerability of Romanian food industry and how poor quality or only alleged food contamination can affect not only the physical health of the consumer, but also the commercial health of the business sector.

At the European Union level, traceability is governed by Directive (EC) 2001/95 regarding General Product Safety (integrally transposed in national legislation by Law no. 150/14.05.2004 concerning food safety, regulating obligations to Romanians in this direction) and Regulation (EC) no. No 178/2002 on General Food Law, applied from 15 January 2004 and 1 January 2005 in all EU member countries (Kelepouris 2007).

In the following years food traceability is a prerequisite and necessary for business success in this industry.

3. RFID technology and traceability requirements

RFID is an automatic identification and wireless data collection technology. Radio frequency fdentification (RFID) is an important area for the development of the data support, with next-generation systems and products that offer considerable potential and low costs for data applications (RFID Journal 2013).

An RFID system consists of four components: the antenna, the readers (each consists of transceiver, decoder and antenna), the RF tags that is electronically programmed with unique information and the computers network [1].

The antenna emits radio signals to activate the RFID tag and to read and write data to it. The reader emits radio waves, and when the RFID tag passes through the electromagnetic area it detects the reader's activation signal. The reader decrypts encrypted data in the RFID circuit and the data is passed to the host computer for processing.

RFID solutions can be used both by producers and distributors or retailers since it can provide a huge amount of data collected automatically and wirelessly, can work at temperatures up to 200°C, the tags can store additional information that can be taken over in a database. Systems based on RFID solutions also operates in modern armies. For example, were used to oversee the logistical operations during the war in Iraq.

The fields of application of RFID systems would be inventory management, asset tracking, supply chain security, using smart cards: in banking, the management of public transportations, as flights and ski tickets, electronic access control, in managing cross-border rail transport, in international containerized freight management, in managing gas cylinders and containers for chemicals, in waste disposal management, in animal identification, in organization and proper management of large-scale sporting events, in burglar and electronic immobilizer, in automation of industrial manufacturing and others. (Finkenzeller 2010).

The significant advantage of all types of RFID systems is the invisible nature of the technology, that they work without contact. Tags can be read through a variety of substances and environments, such as snow, fog, ice, paint, crusted dirt and other conditions what altered the visibility and difficult environments, where barcodes or other machine readable technologies would be useless. Another significant advantage of an RFID system in interactive applications is the ability to read / write, which means that RFID tags can be read in challenging circumstances at remarkable speeds (as in the work in process tracking and maintenance) in most cases less than 100 milliseconds. Although it is an expensive technology (compared with barcode), RFID has become indispensable for a wide range of operations for automatic data collection and identification applications that would not otherwise be possible.

Disadvantages would be limitations or scheduled conditions imposed, which means costs often too high compared to the financial capacity of certain types of businesses, especially in the food industry. Another significant disadvantage is related to the protection of privacy and confidentiality. In case of using improperly

the marked products with this technology, can track and monitor people after leaving the store. Therefore, the personal data and the privacy of customers may be at risk, the purchasing anonymity being reduced or eliminated thus threatening the civil liberties.

RFID data collection is very accurate (accuracy often over 99 percent), which can help prevent errors of picking orders and for shipping, affecting the agro-food industry (Pleşea et al, 2007). RFID technology can guarantee that the right products are delivered to the right place at the right time and in the right conditions. It can enhance the quality of service and the goods security.

4. Level of knowledge and acceptance of RFID solutions by the employees of Romanian firms

This material presents the results of research performed on this topic in our country, on a traceability model, of tracking goods tested during June to September 2014.

Hypothesis: It presents a logistic model using RFID technology, with rewritable RFID tags, with enough memory to allocate each item a unique identification number plus other information, and enough memory to store these information. This model could be a modern and useful solution for food traceability applications. Labels would be equipped with sensors to record the main conditions of storage, updated time stamps and recording transactions to create electronic genealogies. Through the method of questionnaires were collected data about the usefulness of logistic model.

As a sampling method, the stratified random method was used. The subjects included in the survey are employees from all the counties of Romania. Initially the target group was the management of food production, distribution and trade firms. Later, due to the low level of responses were surveyed the employees who responded to the request. The questionnaire was written in Romanian and was sent to approximately 1,600 people.

4.1. Results

The working area of respondents (Fig. 1): Production 42.57%, 10.89% distribution, trading 12.87% and others 33.66%.

To the question if there is a traceability system, to track the goods in firms which they work (Fig. 2): 44.55% of the respondents said yes, 48.51% had a negative response and 6.93% of respondents said that this question is not applicable in their case.

The questionnaire examined the respondents' opinion, regarding the traceability logistics model, using passive rewritable RFID tags, with questions at the different phases of the process.

The "Reception of products without RFID tags" (Fig. 3) 30.69% of respondents believe that the proposed model, in this phase of the process might be applicable, 21.78% considered to apply something similar, but without RFID tags, 13.86%

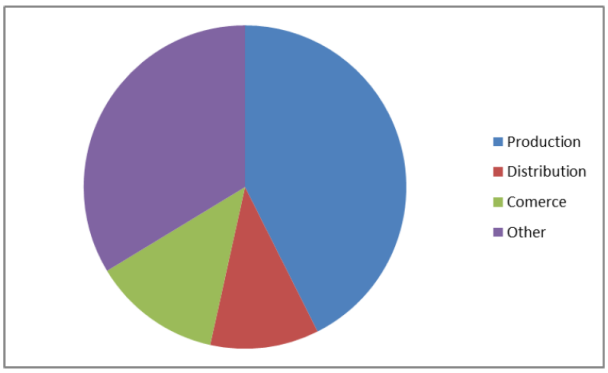

Figure 1: Business operation area of the employer

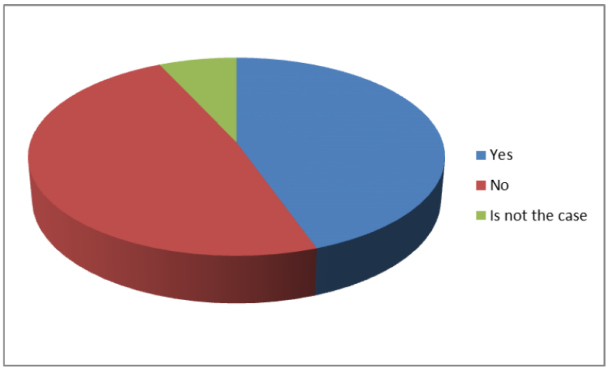

Figure 2: In the company in which you work, are there a traceability system?

consider that it can't be applied, at 2.97% exists a traceability system with RFID tags, 11.88% considered the model complicated but applicable, and 18.81% had other answers.

At the "Storage" (Fig. 4) 35.64% of respondents believe that the proposed model, in this phase of the process might be apply, 19.80% considered to apply something similar, but without RFID tags, 11.88% consider that it can't be applied, at 1.98% exists system of traceability with RFID tags, 12.87% considered the model complicated but applicable, and 17.82% had other answers.

At the "Technological and manufacturing processes" (Fig. 5) 34.65% of respondents believe that the proposed model, in this phase of the process might be applicable/ might be applied, 7.92% considered to apply something similar, but without RFID tags, 18.81% consider that it can't be applied, at 0.99% exists system of traceability with RFID tags, 16.83% considered the model complicated but applicable, and 20.79% had other answers.

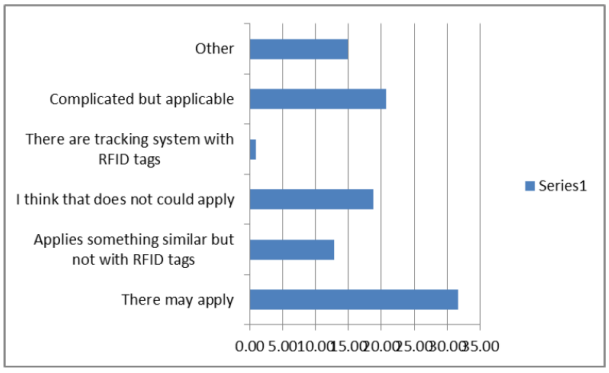

Figure 3: Reception of products without RFID tags

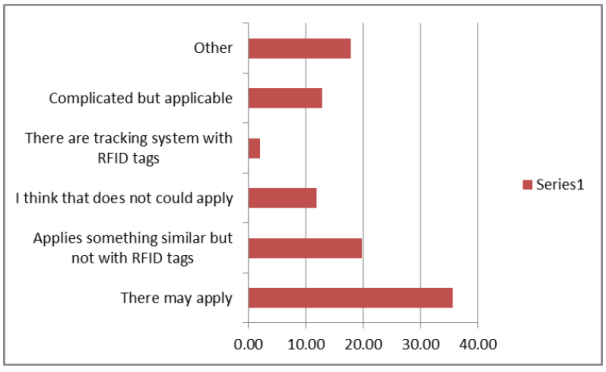

Figure 4: Storage

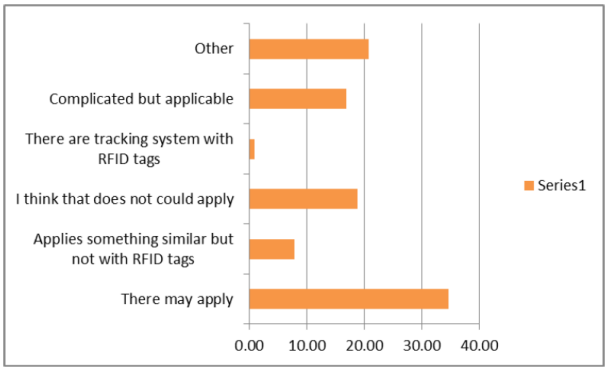

Figure 5: Technological and manufacturing processes

At the "Delivery" (Fig. 6), 32.67% of respondents believe that the proposed

model, in this phase of the process might be applicable, 10.89% considered to apply something similar, but without RFID tags, 17.82% consider that it can't be applied, at 0.99% exists system of traceability with RFID tags, 17.82% considered the model complicated but applicable, and 20.79% had other answers.

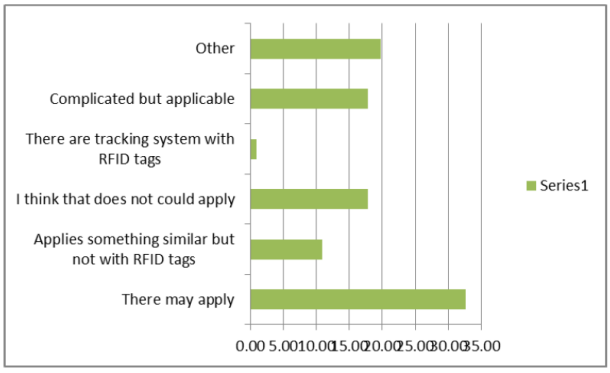

Figure 6: Delivery

4.2. Conclusions

In the Table 1, column A shows the percentage the respondents who agree to some extent with the proposed model (answer could apply, apply something similar, but without RFID tags, exists system of traceability with RFID tags, complicated but applicable) and column B shows the percentage of respondents who believe that the model one can't be apply or have other answers.

Operation	**A**	**B**
Reception of products without RFID tags	67.33	32.67
Storage	70.30	29.70
Technological and manufacturing processes	60.40	39.60
Delivery	62.38	37.62

Table 1

In conclusion to all phases of the traced process, the majority of respondents appreciated positively the presented model in the questionnaire. Such modern models for traceability of goods, especially of food products with RFID tags could be applied in the Romanian food products market. Using such systems for tracking the emergence of the first suspect, and in a few hours the possible causes could be detected, avoiding the outbreak of "scandals" concerning the marketed food and thus might be avoided material losses and image of the food market in Romania.

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