



Opportunities and Constraints for Wide Adoption of RFID in Agri-Food¹

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ABSTRACT

RFID is a pervasive technology, which provides appealing opportunities for improving supply chain management and security in the agri-food sector. All over the world, food safety is considered a requirement, and in several countries the traceability of food products is mandatory. Therefore, several studies on traceability management have been conducted both by industrial and academic research communities, especially on not traditional technologies as RFID. The aim of this article is to analyze and to describe the most relevant results on RFID-based systems for agri-food traceability. The RFID technology seems to be able to bring great opportunities to agri-food, nevertheless, not negligible constraints are slowing its adoption. This survey may provide readers with an exhaustive overview on opportunities and constraints for RFID wide adoption in agri-food. [Article copies are available for purchase from InfoSci-on-Demand.com]

Keywords: Agri-Food; RFID; Traceability

INTRODUCTION

Traceability is considered today a crucial factor for the agri-food sector. An effective traceability system brings many benefits, such as increasing the security of customers, and so their confidence, and controlling the effects of commodity withdrawal. Furthermore, in many countries traceability is a mandatory require-

ment for the agri-food sector. In EU, the food traceability is strictly regulated, and businesses in food sector shall be able to identify the origin and the destination of each food product, and the food shall be adequately labeled (The European Parliament And The Council, 2002).

The Traceability in the agri-food sector is often managed by systems that employ labels or barcodes for the commodity identification. However, the new requirements of accuracy and

efficiency have promoted the research of more efficient and effective solutions for traceability management. One of the most promising alternatives to traditional solutions is represented by the Radio Frequency Identification (RFID) technology. In general, RFID tags used for traceability management are passive ones, so they have no battery and acquire their power from the external RF communication; this characteristic allows reducing tag costs as much as possible in order to make it almost disposable. Another common architectural choice in RFIDs is related to its memory; it should be large enough to hold the tag identification number. The well-known EPC96 identification number has 96 bits, however a tag may have up to several kilobits of capacity. Indeed, some applications may require a large user memory in order to record relevant information about the good, or to add redundancy to the system by backing up database information included into the tag. Many research projects have been developed to evaluate if RFID technology can be properly exploited for agri-food traceability activities. However, the RFID application is more widely studied for Supply Chain Management (SCM) than for Traceability Management (TM).

TM aims at detecting and recording the path and the history of items (ISO 9001:2000); similarly SCM aims at improving the production chain, so SCM can manage the traceability of products, but it is only an optional intermediate step to reach business improvements. Furthermore there are issues that characterize agri-food sector, and that affect both TM and SCM: (a) the management of perishable products requires special solutions like controlled storages in refrigerating rooms; (b) The Out-of-Shelves problem (Corsten & Gruen, 2004) is a threat for all kinds of brands and in particular for perishable products (Kranendonk & Rackebrandt, 2002), producing direct losses to retailers and manufacturers, such as lost sale, brand switch, and store switch. Therefore many research projects provide data about SCM and Automatic Identification and Data Capture (AIDC) that concern activities comprised by TM.

New traceability systems based on RFID technology are starting to be effectively employed, but small and medium companies, which represent a large part of the agri-food enterprises, are wayward to invest in technologies that are not conventional. Hence, it is evident the importance of studies that investigate the properties of the RFID technology application. The aim of this article is to provide readers with a clear overview of studies about agri-food traceability characteristics and about how RFID technology can be applied to traceability activities. The results obtained by state-of-the-art research projects will be compared in order to identify benefits and drawbacks of the exploitation of RFID technology for agri-food traceability.

The remaining of the article is organized as follows. The second section will introduce the traceability management. The features of traceability and its relations with SCM will be detailed, then the characteristics of traceability systems employed in agri-food sector will be shown. The third section will present to the reader a state-of-the-art overview for RFID traceability applications. Results from studies about different topics, which pertain to RFID applications and which can bring important information about RFID benefits and drawbacks for traceability applications, will be shown. The forth section will present a set of benefits and drawbacks for the employment of RFID technology for traceability management in agri-food sector. Finally Section 5 will present reached targets and open issues for the near future.

AGRI-FOOD TRACEABILITY

RFID technology is used for different kind of applications. This section aims at providing the background necessary to analyze RFID-based agri-food traceability systems. In the following a short background about agri-food sector is presented, and the characteristics of agri-food traceability systems are detailed.

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