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The use of TIC's as a managing tool for traceability in the food industry

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Abstract

Food safety has become an important food quality attribute. Both food industry and authorities need to be able to trace back and to authenticate food products and raw materials used for food production to comply with legislation and to meet the food safety and food quality requirements.

PaniGest is a user-friendly computer package designed to manage traceability and help in the quality control and production improvement. This application was developed in Visual Basic language over an SQL database and its main features are: to register quality control parameters of raw materials, in-course products and final products; to manage reception, production and expedition orders; to analyse production costs, productivity, raw materials and products' consumptions; to trace products during the food chain. It runs on a personal computer over Windows 95/98 or Windows 2000/XP operating system. The program also uses common Internet Browsers to make information available to users.

Keywords: Food safety; Traceability; Visual basic; Technology of information and communication (TIC)

1. Introduction

In the recent years, new policies regarding food safety and food safety management were adopted by Governmental Authorities and Food Industry as a consequence of several food incidents and scandals. These incidents caused serious loss of confidence of the consumers that started to demand for high quality food, food integrity, safety guarantees and transparency. To answer these consumers requirements, quality assurance has become a cornerstone of food safety policy in the food industry that started to implement integrated quality and food safety management systems. These systems include all steps in food production chain namely the supply of raw materials, food manufacturing, packaging, transportation and logistics, research and development, maintenance of production equipment and training and education of staff. Increasingly, food quality is associated with a proactive policy and the creation of requirements to maintain a safe food supply (Beulens, Broens, Folstar, & Hofstede, 2005).

Global food safety policies were adopted by Governments and a new series of regulations were created and adopted all over the World, with particular incidence in EC (European Community). One of the concepts introduced by these new legal documents was traceability. EC/178/2002 defines traceability as the ability to trace and follow food, feed, and ingredients through all stages of production, processing and distribution. This regulation is applied to all food industry. The Regulation contains general provisions for traceability which cover all food and feed, all food and feed business operators, without prejudice to existing legislation on specific sectors such as beef, fish, GMOs, among others. The requirement for traceability is limited to ensuring that companies are, at least, able to identify the immediate supplier of the product in question and the immediate subsequent recipient, with the exception of retailers to final consumers (one step back/one step forward). Traceability is the ability to track back a product and its history through the whole, or part, of a

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production chain from harvest through transport, storage, processing, distribution and sales or internally throughout the production stages. Traceability is a generic issue, as its fundamentals are independent of the type of product, production and control system it serves (Kim, Fox, & Gruninger, 1995).

Traceability and Food Safety Management systems can work properly based on pen and paper versions but they are time and resource consuming which makes them difficult to implement in small and medium companies where the resources are scarce. Moreover, the International Standardization Organization (ISO) also started to work on the adaptation of the Quality Management Systems standard to the food industry ISO22000, which is currently on the final draft.

The use of new technologies of information and communication to support and facilitate the practical implementation of these complex systems is very recent and, until now, it can be found only in larger food production units. The development of adequate computer packages to reduce the paperwork involved in the management system can be extremely helpful for SME's.

In the baking industry, the traceability process is very complex due to the diversity of raw materials used and the large number of different products that a single batch can generate. Moreover, at the end of production process, there are several finishing raw materials used in the product that, usually, are not controlled or even traced back to the supplier. Therefore, the development of a computer application, using a user-friendly interface, specially designed for small and medium food companies, was pertinent. PaniGest was created to respond to these needs integrating some legal requirements such as traceability with quality control, production management, raw material and finished products stock control, consumptions, production costs and HACCP systems.

2. Materials and methods

2.1. Database development

Planning the database structure is one of the most important tasks when developing a computer application once all the information required will be stored in and related by the database. Depending on the model used, the information can be related in different ways. Early models included the hierarchical model (where files are related in a parent/child manner, with each child file having at most one parent file), and the network model (where files are related as owners and members, being that each member file can have more than one owner). Relational databases offer many advantages over unstructured forms of data storage (Codd, 1970; Harrington, 2002). Through the use of indices and other optimizing devices, speed gains for searches may be considerable. Moreover, redundancy and therefore storage space are minimized. Also, data is handled by a single computer which is easily backed up and/or mirrored by a second computer (Bradley, Mascarob, & Santhakumara, 2004). Another important advantage of relational databases is the ability to rapidly summarize data with a small number of commands, usually using the structured query language (SQL). With a few of these commands, one rapidly obtains a comprehensive overview of a data set, something that could otherwise take many hours programming. But, perhaps the most important advantage of relational databases is that they impose a consistent data format (Bradley et al., 2004).

The major issue in database development is to find a database structure that is broad enough to be applicable in several industries and, at the same time, adequate to consistently structure data. The relational database model was a huge step forward, because in order to relate any two files or records, they simply need to have a common field, which makes the model extremely flexible. The relational database model, being a table-based structure, naturally groups data conditions according to type or product. For example, there might be tables containing lists of products, raw-materials, users, formulations and quality control data. One or more additional tables would store production data, and a final table would serve as a hub linking production data to product and raw-material data. By means of cross references, the complete traceability of raw-materials to final clients as well as users actions associated with any production could be derived from the database, without reference to external sources.

The production stages and the records needed during the production process under analysis (baking process) had to be studied in detail in order to develop the database that records all the relevant information to achieve total traceability of the product and, simultaneously, manage paperwork. Fig. 1 presents the production flowchart that was used to develop the database.

The conclusions of the production flowchart analysis were that the traditional baking industry produces a wide range of products (bread and cakes), ready to be sold, based on the same batch of ingredients. This process becomes even more complex when more than one of those batches is made during the day. Moreover, the difficulty increases during expedition of final products to the client because different ready to sell products originating either from the same batch or from different batches are very often delivered to the same client and, in many cases, the client is the final consumer.

The developed database is a relational database and Fig. 2 exemplifies some of the multiple relationships established between tables.

For example, the field "Order" in "Table_RM_Orders" table is related with the field "Order" in "Table_RM_Rows_Orders" table. In this particular example, the first table should hold suppliers order data and the second table records the multiple lines of the supplier order. The type of relationship is a one-to-many relationship because a supplier order could have multiple lines of different products. Multiple relations such as that described above are developed and implemented in this database.