Protecting the Brand While Gaining Operational Efficiencies with Item Level Identification

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Abstract

Supply chain efficiency and brand protection are increasing trends and affecting more and more the functionality of packaging. The role of packaging has widened from protection of goods to include informational and interactive functions, thus creating new demands for packaging materials, package manufacturing and other packaging related processes. Moving from production batch to item level identification is opening new horizons for both packaging and the usage of the item level information. This article introduces the recent development of item level packaging identification and discusses the trends for future development. Special attention is paid to brand protection and product authentication, and the main focus is in supply chain cases.

Introduction

The role of packaging has long been concentrating on protecting the goods inside the package. Logistics functions like numbering, coding and grouping have been added on transport packaging levels to increase the supply chain efficiency. Marketing and branding have influenced the item level packaging increasingly, as the brand owners want their products to differentiate from competition in the retail shelves. This trend has increased the quality demands of both the packaging materials and printing methods, and also the package structure design process has had an enormous impact. The packages have taken a role of silent salesmen.

There can be seen three forces that have influenced the recent development of item level identification and the use cases described later in this article.

Demand from especially the retail sector for improved logistics has forced the brand owners to develop and introduce new features for packaging identification. Efficient inbound and in-store logistics are crucial for today's retailers for generating sustainable profits. Therefore the need for standardized and efficient identification techniques is very understandable. However, the slow speed of standards development combined with the urgent need from the retailers has lead to retailer-specific solutions, forcing the brand owners to adjust their processes to support several specifications.

Technology development has introduced new possibilities for packaging identifications. Labelling, digital printing, finger-print type solutions as well as RFID (Radio Frequency Identification) are offering countless possibilities for adding information on packages from item to transport packaging level. These technologies – some not so new – are in various development stages, and the rapid development poses challenges to wide implementation.

Brand protection has become very important for more and more products and sectors. The brand itself often has a high value to its owner, but the increasing problem of counterfeiting has forced the brand owners to take stronger initiatives in order to fight it. This has increased the need to find reliable, robust, but still edge-of-the-technology solutions for identifying the authentic products and their packages. As marking of the products is not often a feasible solution, the importance of the package has increased.

Identification methods and techniques

This chapter discusses some selected identification methods and techniques in more detail. The choice has been made to include the relevant ones for the packaging sector. In general the identification methods can be divided into two categories; ones that provide marking that can be interpreted with human eye and ones that require a reading device for making the interpretation. The use cases often dictate the choice between these two.

Printed Identification

Traditionally markings on packaging have been made during the printing of the package. Using conventional printing technologies, like flexography and offset, limits the usage of variable information. The use of inkjet and other digital printing technologies has opened new possibilities for adding more detailed level and even unique information on packages. Inkjet labels are the most common way to add a unique code (like barcode) or other type of identification, providing a fast and easy-to-apply solution for packaging lines.

The usage of digital printing for packages – meaning the whole package, not just a label – is steadily increasing. The low production speed together with cost and quality issues have kept the pace in a moderate level. However, the possibilities to use variable content together with the cost-efficiency of small orders offer tempting business cases for digital printing. When using digital printing for the package graphics, the additional cost of adding unique identification is next to none, and this opens new horizons for itemizing the packages at the printing stage.

The printed identification is usually a code, and the usage of barcodes has exceeded the usage of number/letter combinations. Linear barcode standardisation has made implementation easier, and currently the infrastructure of barcode readers and back-end system usage is worldwide. As the information capacity of linear barcodes is limited (within reasonable length), 2-dimensional barcodes have been introduced. The lack of common international standards is limiting the usage of these codes in wider cases, but already some national level standards exist. The possibilities of having more information in the barcode opens new use cases and at the same time offers possibility to utilize the barcode reader infrastructure.

The printed code can also be hidden inside a graphical image. This makes it more difficult to misuse the information – like copying the code for pirate products. In order to be able to read and interpret the code, one has to know where the code exists and what kind of reader to use.

The reading device can also be a digital camera, capturing the code as image for further interpretation. The possibility to use camera-equipped mobile phones is opening totally new areas for implementation. The mobile phone can transmit the reading result without the need for an additional transmitter, and the results or reply can be viewed in the phone display. Consumer based use cases also become possible. The limitation today is the quality of the camera phones together with the sensitivity of the reading event; a successful reading requires correct angle, distance, lighting and contrast.

The development of using printing to produce conductive markings is progressing. The usage of conductive materials like silver in printing inks and toners has been researched and some commercial solutions are being developed, but larger commercial applications have not been published yet. The cost of the materials is still relatively high.

Embossing and Holograms

Embossing of production batch information, best-before dates and other similar information is very common in package filling lines. It offers the possibility to differentiate the batch only at the point of filling and thus decreases the demand for printing variability. Embossing usually produces information for human eye inspection, and this limits the efficient usage in supply chain solutions. For example picking of expired packages in retail shelves by human eye inspection is very time consuming and prone to errors.

Holograms have long been used for brand authentication needs. Together with the visual appearance they provide possibilities for identifying the product brand in an efficient way. As the technology has become widely used, also the counterfeiters have found it, and often the counterfeited holograms are fancier than the original ones. Some hologram producers have developed holograms with embedded technologies that are close to impossible to copy or forge. Hologram usage is limited to visual inspection use cases, like brand authentication, and is not feasible for supply chain use cases.

Quite recently new technologies have been introduced for making holographic effects with embossing technology. This kind of hologram production can be for example included as a process step in the printing machine, providing either visible or invisible holograms with micro-scale embossing. The usage of hidden marking (only visible for example with a certain wavelength light) provides same possibilities as with printed

codes hidden in a graphical image. The limitation for embossed holograms come from the variability level; in order to make the production efficient the embossed holograms can vary in the same way as conventional printing content.

Laser Marking
Using laser in marking information on packaging has been used especially in the filling and sealing processes. Typical information marked with a laser is batch number, production time, best before date and similar; very similar use cases as with inkjet labels. Two major laser types used are CO_2 and YAG laser, depending on the surface of the package.

The advantage of laser marking is that it doesn't ass any material into the package (like a label), and that it cannot be erased easily. The investment cost of a laser is relatively high, but the variable costs in using it are very low.

Adding a computer system to manage variable information makes it possible to use laser for marking unique information like identification. The production speed of making a laser based identification like a barcode is highly depending on the physical size of the code, but can be adjusted to be sufficient for normal packaging lines.

Radio Frequency Identification

Radio frequency identification is an emerging technology enabling efficient identification of several items at a time without a line of sight. It requires specific readers and tags to operate, and is relatively costly still – especially the variable costs. Also setting up the infrastructure so that the reading accuracy and speed is stable requires some effort. The main use cases today come from high value goods, large transportation units or closed systems.

There are two main categories for the wavelengths used; High Frequency (HF) for near distance readings and Ultra High Frequency (UHF) for longer distance readings. The standardization work has progressed in UHF area more; due to the work of EPC Global (Electronic Product Code) organization and the mandates set by retailers like Wal-Mart in U.S. for the suppliers.

There are some limitations to the usage of RFID. Metal in packaging or in the product itself might prevent the reading, and the same problem exists with liquids. Also there are some country specific limitations to the usage of certain wavelengths for RFID applications. As the tags include metal particles, they are not as easy to recycle, which prevents their usage in certain packages.

The main benefits of using RFID come from the logistics efficiencies and the ability to read and write the information in the tags' memory chips several times. The latter causes big challenges for the standardization work, because the more heterogeneous the information in the chips is, the harder it is to create large and multi-entity implementations in supply networks. This again means slower pace in the adaptation of RFID.

Fingerprints

Using the term fingerprint in this article refers to technologies that are interpreting information from some particular features in the item surface, without adding any additional material or marking on it. All surfaces have unique structures, when viewed in enough detail.

The usage of laser bean diffraction has been researched, and some commercial applications have been developed. The basic idea in these solutions is that the diffraction exhibits a certain pattern which is stored in the first reading. The following readings compare the interpreted structure to the one of the first reading. The prerequisite is that all the readings are done from exactly the same place and position.

Fingerprint technologies require specific readers and a well-organized process. Their logistics efficiencies come out only in closed, well predefined environments. The main benefits are that no additional material is added, and that the fingerprints cannot be copied. The key issue in a secure fingerprint based system is to guard the first reading step carefully.

Use cases

Logistics Efficiency

Item level identification in logistics can be understood in many ways. The definition of an item depends on the interests of each party involved; the transportation companies' interest may be focused on pallet, container or vehicle level, whereas the retailer might like to follow each consumer package. To be able to reach this with a standardized fit-for-all solution is very difficult, even impossible. The problem is two-fold; the processes managed by each party in the supply chain vary very much as do the values of the "items" they are following in their processes. On the other hand the need to share logistics information upstream and downstream in the supply chain is common.

Following four examples highlight the different points of view for the need of item level identification in logistics efficiency cases.

1. Wholesaler / Transport example

Logistics efficiency is crucial for the success of a wholesaler. Managing incoming and outgoing goods as well as the inventories requires that all goods are identified in detailed enough levels. Also as the good are coming from various sources and going out to various receivers, the identification needs to be understandable and universal enough. Also the existing infrastructure like readers and information systems needs to be on a level that minimizes the manual input and manipulation of information.

Linear barcodes are currently the main method for identification. Increasing usage of RFID – especially UHF – on pallet and case level increases the logistics efficiency significantly, and at the same time reduces the possibility for human error. Using gate readers in warehouses makes the registering of goods' movements almost an invisible task.

The role of the wholesalers and logistics providers is to apply and use the techniques and methods selected by the manufacturers or more often the retailers. Some logistics companies use their own software solutions for showing tracking and tracing information to their customers, but they still have to support the customers' identification method selections. The need for standardized techniques and information structures is therefore understandable as well as the hesitation of these companies to change from existing barcode systems to something else – unless mandated.

The meaning of item level for the wholesalers and logistics companies is usually a pallet or a transport box, also in some cases a vehicle, wagon or container.

2. Retailer example

Major international retailers – with Wal-Mart as the spear head – have shown growing interest for emerging technologies like RFID. The main reason for this is the potential in increasing logistics efficiency in their back-store operations. The usage of RFID tagged pallets and cases in the inbound logistics provide instant on-line inventory information, helping the retailers to avoid excess or obsolete inventory, but also out-of-stock situations. The retailers have especially been interested in UHF RFID technology, because of the ability to read from longer distance.

Moving from barcodes to RFID has a significant impact on the manual labour need for registering the incoming goods. By learning to use and implement RFID the retailers are also gaining expertise for expanding the RFID towards the in-store functions. Reader-equipped shelves enable on-line monitoring of the goods movements to and from the shelves. Item-level identification opens totally new areas and possibilities for inventory accuracy, first-in first-out management as well as reverse logistics (discussed in more detail in example 4). The importance of the item-level identification is higher with expensive goods than daily grocery products, but has also a big impact for the in-store logistics in special retail stores like pharmacies.

3. Consumer example

The consumers would benefit from – and also accept to use – item level identification of products, when they could identify the products with equipment they already possess. Even though the mobile devices are becoming everyone's normal daily life, the user experience when using for example a mobile camera phone for reading a

two-dimensional barcode is not good enough. Basically the technology exists, but it hasn't reached a sufficient level of user friendliness or standardization to provide a basis for customer logistics use cases.

Visually readable identification codes and case specific systems exist, a good example being the follow-up system provided by Federal Express, UPS and other similar logistics companies. With the lack of global standards these cases remain provider or case specific, and the consumer needs to know which provider's system to use.

Looking the consumer examples from another point of view shows that as there aren't very many use cases offered for the consumer area, the technology adoption has not progressed faster. There are not very many consumers who would like to buy an RFID equipped mobile phone in order to wait if an interesting use case appears.

4. Reverse logistics example

Reverse logistics may not seem like the primary reason to implement item-level identification systems, but in certain end-use segments it may be a very critical business process to manage. Pharmaceutical products are a good example of a segment, where the goods return process needs to be controlled well, both with expired products as well as in cases where the manufacturer needs to call back the goods. Another example segment is consumer electronics, where for example defective batteries might cause danger to the consumers and need to be called back. Without item-level identification the manufacturer needs to claim back the whole production batch – including maybe also non-defective items. Warranty cases with cars have similar problems.

Item-level identification enables a more controlled way to tackle the reverse logistics issue. However, the whole supply chain needs to be involved in order for the manufacturer to know where the defective goods have been delivered. This again requires standardized methods, techniques and processes as well as open but also controlled information exchange between the supply chain partners.

Anti-Counterfeiting

Anti-counterfeiting is a growing phenomenon, affecting more and more product segments. Having started from copying of brand labels it has progressed to a global industry possessing sophisticated production systems, tools and methods, and causing increasing losses to brand manufacturers. Also from the society point of view the problem is significant; customs and other officials have an increasing workload when detecting the authenticity of the transported goods, and in pharmaceutical sector the counterfeit drugs are causing serious health problems and expenses to health authorities worldwide. PIRA has evaluated that while the world's economy grows by 3-5 per cent annually, the counterfeit economy grows by tenfold.

The brand manufacturers have protected their goods with various kinds of identification methods, some visible, some covert. The counterfeiters are very fast in copying the visible identifications like holograms, and can sometimes produce fancier figures in them than the originals were. Scanning the graphics of an original package provides an easy way to have the pirate goods packed in original looking packages. Only an expert can sometimes tell is the package is fake or real. This causes challenges to the supply chain, as most of the parties there are not experts in detecting the origin of goods, but are mainly relying on the documents provided by the previous party.

As discussed earlier with the identification methods, the lack of global standards means that there are several manufacturer or end-use segment specific systems in place, very few of them being in tight control. Systems requiring manual labour or human evaluation of the authenticity of the codes are vulnerable and cannot provide full control. Some brand authentication systems are built to include only the manufacturer and the final customer, disregarding the supply chain in the middle. These kinds of systems leave a significant part of the distribution process without inspection, and cannot provide a full proof of the origin of the goods. Involving the supply chain in the process provides the goods a proven supply chain, and at the same time offering tools for better logistics process management.

Conclusions

This paper has presented some identification technologies and methods and also some use case areas for them. The main finding is that the implementation speed will only increase when there are strong enough and globally

accepted standards existing. Another way to accelerate the adoption rate is to have the main supply chain players set their demands, meaning that the standard will be built from the commercial point of view. This may not lead to the best standard, but could be a faster way for global implementation.

As written earlier in this paper, all the identification technologies and methods have their strengths and weaknesses. Therefore using several technologies and methods in parallel might provide a more comprehensive system to cover the needs of all the supply chain parties. Using RFID on pallets and transport boxes gives the logistics efficiencies, but would be too costly for item-level with certain products. Combining a low-cost technology on the retail item level and RFID on the logistics level would increase the flexibility and lower the threshold of cost. The management of different packaging levels plays a crucial role in this kind of scenario. This means that when reading a pallet tag, the tag having a relationship with the items inside it, all the items would be "marked" as having passed that certain node in the supply chain. The management also works backwards – if one consumer package is identified as false and defected, tracing its "family members" from the pallet is easy.

In order to implement an authentication and tracking and tracing system including the package level management, an information technology system is also needed. In other words, the identification methods cannot operate by themselves without a back-end system managing the information content, but also managing the exchange of the information. Furthermore, clear rules are needed in establishing and implementing the system – rules for code id management, access rights, and responsibilities.

In 2006 Stora Enso together with a pharmaceutical company Orion made an operational pilot in order to gain experiences in item-level identification. The pilot involved also a retailer Oriola and several pharmacies in Finland and Estonia. The pharmaceutical packages were marked with HF RFID tags providing them with a unique identity. The transport boxes carried UHF RFID tags, and the back-end system managed the relationships between these levels. Also barcodes were used in parallel to ensure the participation of supply chain partners not having RFID readers. The tagged products were distributed through the supply chain among non-tagged items. The main results of the pilot were that RFID as a technology is more mature than the participants assumed, the HF technology provided new possibilities for in-store logistics at the retailer and that the increased supply chain visibility offered tools for better inventory management.

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