Collaborative Project

# ASPIRE

Advanced Sensors and lightweight Programmable middleware for Innovative Rfid Enterprise applications

## FP7 Contract: ICT-*215417*-CP

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## WP2 – Requirements and specifications

### Public report - Deliverable

### Specification of Scenarios and Trials

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## Content

## Section 1 Executive summary

ASPIRE project main objective is to implement a RFID middleware which will be applied to as many as possible European SME companies and in different application and operation fields. The ease of development and cost-effectiveness enabled by the platform will be manifested across different application domains, such as:

- Logistics and Asset Management
- Product Packaging, Tracking and Traceability
- Manufacturing and Process Management

The developments of the ASPIRE project will be validated in the scope of realistic pilot trials involving European SME. Some of the trials will be organized by the ASPIRE consortium; liaison with pilots of existing projects where partners participate will be also pursued. Innovative RFID scenarios, showcase and pilots will be built around the following axes:

- Fully automated reading and processing functionality. Applications will run without human intervention.
- Mobility scenarios involving several mobile warehouses in the scope of the supply chain.
- Measurement of added-value parameters such as temperature and humidity.

In implementing these scenarios the ASPIRE middleware will interface with legacy IT systems that are already available in SMEs and supporting their corporate services (such as ERP (Enterprise Resource Planning) and SCM (Supply Chain Management) systems and corporate databases. While this interfacing take into account the integration capabilities of these systems, the ASPIRE middleware will provide connectors supporting main state-of-the-art integration technologies such as Web Services, Messaging Oriented Middleware (e.g., via Java Messaging Service (JMS)), as well as legacy data centric integration technologies (e.g., stored procedures and database triggers).

This deliverable contains information about the RFID trials concerning the ASPIRE project. More detailed description is included in this deliverable and all the proposed scenarios and trials will be presented in the following sections.

## Section 2 Introduction

Project ASPIRE plan, organize and conduct pilot deployments of the RFID solutions using the programmable ASPIRE middleware and tools. The respective trials will cover the areas of manufacturing and process management, as well as the areas of asset management and traceability. In organizing the trials the consortium partners will establish appropriate links and liaison with other RFID projects where the partners participate (e.g. the Regional Innovation Pole of Thessaly, Greece). Furthermore, the project will plan and organize new trials based on the pool of SMEs that will be contacted for the requirements engineering process. The overall objective is to deploy and test the ASPIRE middleware as widely as possible.

The ASPIRE middleware, including all its added-value programmable features and ubiquitous sensing will be tested in the scope of realistic deployments of RFID solutions. To this end, the consortium will pursue two main directions:

- Establishing liaison with existing RFID initiatives and trials and subsequently using the ASPIRE middleware as part of these on-going pilots.
- Planning pilots business cases that will manifest the economic benefits of the ASPIRE middleware and overall the potential of the ASPIRE middleware deployment paradigm to improve business results.

As far as the first dimension is concerned the project will identify projects running RFID trials, where partners are already involved. The deployment of the ASPIRE RFID middleware in certain aspects of these trials will allow for a practical comparative evaluation of programmable royalty-free middleware with conventional solutions in terms of deployment flexibility, programming effort and overall business efficiency.

The rest of the deliverable is structured as follows:

- Section 3, presents the overview of the scenarios and the trials, the objectives, the requirements and the target industries.
- Section 4, provides more details about the Greek trial, business model, trial architecture and the key role of the ASPIRE middleware.
- Section 5, presents the French trial, business model, trial architecture and the key role of the ASPIRE middleware.
- Section 6, is dedicated to show the exposure of the ASPIRE middleware at the liaison trial which will be held in a company participating in Greek Thessaly Pole of Innovation.

Finally, the last section will conclude and summarize the most important issues of the present deliverable.

# Section 3 Overview of Scenarios and Trials

At least two trial studies will be organized by the consortium members, one in France (by PV) and another one in Greece (by SENSAP and AIT). The trials will capture the following business aspects:

1. Manufacturing and Process Management
2. Traceability and Asset Tracking
3. Inventory and ubiquitous sensing

The French trial will be focused on manufacturing and process management while the Greek one will be focused on traceability and asset tracking, both of them having sensing and control extensions. Asset tracking and traceability solutions will be completed with warehouse management and integrated with SMEs business processes. Trials will focus on:

- Applications in which there is a lot of tags and a lot of detections.
- Applications where mobility is important
- Applications that need the monitoring of physical parameters (temperature, humidity, etc.)

The scenarios of RFID trials are based on real procedures and will be enhanced with RFID technology characteristics. This real RFID platform will be a field for developing and evaluating the ASPIRE's middleware capabilities. It's important to mention that the consortium is not committed to completing the food trial but it must include trials and use cases which are appropriate for the evaluation of all the capabilities and features of the ASPIRE middleware (sensing, control). Based on the market needs, which were collected during the RFID information days, the online survey and the commitment of the companies, the consortium decided to proceed with the trials in the aforementioned industrial sectors.

## 3.1 Objectives of the Trials

The trials and the developing - evaluation of the ASPIRE's middleware are strong related and the results from each other effects the roadmap of the whole project. In relation to the overall objectives of the project, the objectives of the two trials will in general be the following:

1. To verify that the developed middleware is programmable enough to be used by SMEs from different sectors (e.g., textiles, fashion, industry).
2. To verify that there is no problem to deploy ASPIRE Middleware on SMEs commonly used IT infrastructure, as well as on low-cost hardware (i.e. to validate the lightweight nature of the middleware).
3. To verify that the ASPIRE middleware is able to work with 500 RFID tag detections but also with 500.000 tag detections (Scalability).
4. To verify the ASPIRE middleware is easy to use (based on feedback from the SMEs regarding the programmability and the difficulties to use the middleware).
5. To update releases and to correct problems that could occur while deploying or using early versions of ASPIRE middleware.
6. To verify that the use of RFID and ASPIRE middleware results in true really cost savings for SMEs.
7. To verify that the ASPIRE middleware can be effectively adapted for mobility RFID solutions with low-cost (significant lower than the cost required today).

## 3.2 Trial Requirements

Each RFID trial has special requirements and consists of different parameters and approaches. The ASPIRE consortium organized RFID information days based on different contact approaches in order to achieve the best results at each region and to collect input data for the proposed cooperative platform.

The consortium presents a survey method for the collection of end-user requirements (D2.2). Those data will be correlated with the new innovative concurrent approach model (D2.3a) and the collaborative platform will generate all the required data. Both of them will contribute in order to deliver a complete ASPIRE platform.

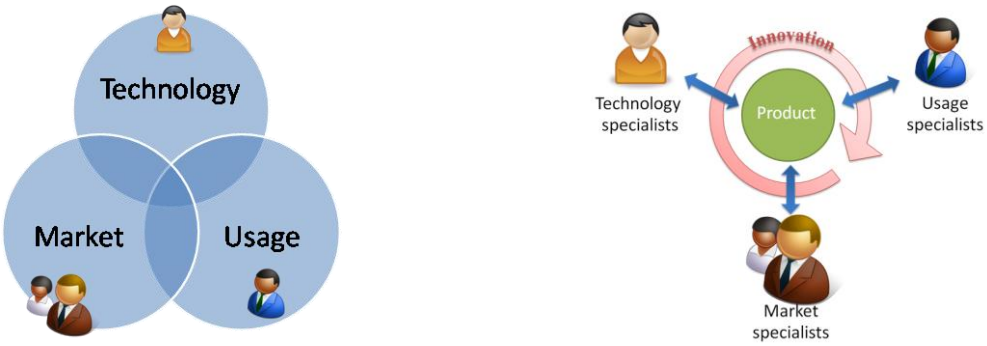



**Figure 1. Stakeholders and the new collaborative approach model.**

Note however that the above ideas will have to be crossed with the SMEs' needs so that they will be completely detailed. In defining the objectives of each pilot in detail, ASPIRE planned a survey at the beginning of the project. This survey was useful to collect users' needs but also a great opportunity to introduce the trials to the SMEs. Following this step the ASPIRE consortium was able to define more accurately the trials that will be conducted at the end of the project.

For each of the pilots the requirements are related to:

- Planning of the trial including business, IT planning, as well as planning relating to the deployment environment of the ASPIRE middleware.
- Application Development of RFID solutions pertaining to the target SMEs requirements. This development effort will leverage as much as possible the programmable features of the ASPIRE platform i.e. the library of reusable filters, adapters, event management etc. Furthermore it will be carried out based on the ASPIRE tools and development environment.
- Installation of the pilot to the real operational environments, based on close collaboration with the target SMEs. The ASPIRE end-to-end infrastructure management will be invaluable in realizing the installation through minimal effort.
- Constant communication and continuous provision of technical support to SMEs, as far as the pilot operation is concerned.
- Evaluation of the pilot in technical, business and economical terms. Financial models will be applied and comparisons with respect to legacy and competitor proprietary solutions will be performed.
- Technical and economical conclusion, as well as subsequent consulting to SMEs upon completion of the pilot.

Those parameters are the starting point in order to describe the trial requirements and to start implementing the basics middleware components to support an RFID system. The

ASPIRE middleware will be developed on those specifications in order to implement all the appropriate programmability and functionality and to be evaluate successfully in a variety of applications.

## 3.3 Target Industries

The ASPIRE's trials are targeted to specific industries. The main areas covered are related to the following sectors:

- Packaging and Logistics Sector, SENSAP's Greek Trial (Section 4)
- Manufacturing and Process Management, the French Trial (Section 5)
- Fashion and Textiles industry, Liaison with the Greek Thessaly - Pole of Innovation (Section 6)

The consortium selected to implement the trials to the above sectors after receiving the feedback from the RFID information Days and visits to companies for the RFID trials. The first selection is for the SENSAP's warehouse and come to improve a common problem of a huge number of SMEs – the warehouse inventory.

The French trial is going to cover the manufacturing sector and the related process and asset management. More precisely will work on the procedures of a textile manufacturing plant and will implement a RFID solution based on ASPIRE middleware. Finally, the liaison trial focuses the interest to a special sector for RFID technology. The Fashion industry is friendly to RFID, has real ROI and is the best application field to evaluate software and business models for all types of RFID technology (logistics, warehouse, item level, marketing tools).

The last two trials cover all the procedures and sectors of Textiles and Fashion-Apparel industry (vertical approach). This approach will provide to the consortium feedback from large-scale deployments and economics. The SENSAP trial will facilitate the warehouse inventory in order to provide a scalable and configurable expertise in warehouse inventory, procedure commonly used in all European SMEs.

# Section 4 RFID Trial in Greece (SENSAP)

## 4.1 The SENSAP Trial

### *4.1.1 Trial Scenario*

The trial is based on the business needs of a company specialized in the sector of printing and packaging consumables. The needs of such kind of SMEs are related with asset management and tracking.

The big picture of the trial is to implement a RFID technology solution in a SME company with interesting sales activity, daily logistics procedures for incoming and outgoing products and monthly based needs for warehouse inventory.

The company's warehouse stores hundreds of product codes – many kinds of material types (liquids, steel, and plastic) and some of them are sensitive in temperature variations and are stored in a special storage room. The current procedures are based on internal barcode system, which works in line with a small ERP system. The staff related with this job is three (3) people who are responsible for handling the receive/ship procedures, the logistics/order procedures and the warehouse inventory.

The scenario of the trial has the following main objectives:

- An RFID enabled warehouse for pallet and carton level inventory.
- Complete observation and tracking of tagged items.
- Dynamic representation of SENSAP's warehouse.
- Business utilization of the RFID data.
- Special handling for sensitive products (temperature)

The scenario of the SENSAP trial is based on the current procedures and implements a RFID solution which will use the ASPIRE middleware in order to automate the configurability and implementation of the RFID infrastructure. The final product will be a RFID Warehouse Viewer software with advanced capabilities, an innovative RFID hardware infrastructure and ASPIRE's configuration middleware for on the fly configurations which will be the key component in order to translate business data to a functional, standardized and low cost RFID system.

The following paragraphs present the basic procedures in the company and provide the new approach based on the RFID implementation:

***Receiving Procedure***

The company orders products from all around Europe. The pallets arrive in the warehouse and the personnel break them down in boxes or cartons. The most of the products carry the manufacturer's barcode and employees are able to scan all the received products one by one. After that the employee checks in conformance of the receiving with the ordered.

*Those steps will remain the same because SENSAP is not able to ask the manufacturers to use RFID labeling on their products.*

***Barcode and Smart Label Generation***

After the products are checked, the employee generates from the ERP the Barcode Labels for each of the products (internal barcode signage), updates the ERP system for the new volumes, slaps the labels on the products and enters them in the warehouse.

*At this step the new procedure will use Smart Labels including the RFID chip. The company will encapsulate the internal barcode scheme into a new serialized RFID based scheme. The company will investigate to subscribe also the products to the GS1 system in order to generate EPC RFID codes. The smart labels will be slapped on the items. The labels will have capabilities to be functional with all the material types (liquids – cartons, near and far field).*

***Warehouse placement***

The next step is to place the products at the proper position in the warehouse. At the moment the employee knows the position and his responsibility is to maintain the right position of the product. Only the employees working in the warehouse has the knowledge of the product placement and keeps a static warehouse floor plan in electronic format. The data described on the floor plan is basic and static.

*Using RFID technology the employee will use a portable computer or a PDA with RFID reader capabilities (ASPIRE's Low cost Reader and commercial products) in order to collect aggregation information for the system. The employee will put the products on the RFID shelves and will aggregate (addition) the products with the position (shelves' RFID tag). This new steps will inform the warehouse system for the position of the entire products in the warehouse and will show/report all the contents of the shelves and positions.*

***Product Picking and Packaging***

Every day the company's sales department receives a number of orders and many of them must be executed immediately because the company supports industrial facilities. At the moment the employee checks the availability of the product in the ERP system and knows the position to pick the product. He or She pick the product, collect all the items of the order and place them on a pallet. After this step starts to scan all the barcodes and prepares the shipment receipt.

*The RFID enabled system will have the capabilities to inventory all the items positions in the warehouse. The employee will use the warehouse Viewer to enter the order and will receive an electronic notice for item availability and position. He or She will use the portable computer or PDA with RFID reader, will have an application showing the order information (a list of the items) and will use both of them in order to collect all the items, to validate their identity and update in real time the warehouse database (aggregation events – deletion) because of the moving of a product from shelve to shipping place. The system will track also the movement of the employee and the product entering or leaving from a warehouse's room.*

***Shipping Procedure***

All the items are in place and the employee can start the shipment. He or she must scan all the barcodes, check the order and generate a shipment receipt. In case of missing products the employee can choose to wait for remain items and to postpone the shipment or to ship

the order leaving some of the requested items for a future shipment. At the moment the company doesn't generate SSCC labels or any kind of pallet level label.

*This procedure will be more intelligent using a dock door for the shipment of pallets and packs. The RFID dock door will identify the products. The employee will generate a pallet level smart label or a SSCC smart label and will pass through the portal also the pallet. The system will generate a shipment receipt for all identified products.*

***Warehouse Inventory and stock management***

The most important and also cost/time effective procedure for any SME company is the warehouse inventory and stock management. At this moment the company keeps data in the ERP system and Excel files for new and on-going orders. It's common to have problems and to lose visibility of the current status of the warehouse especially in peak load days and in case where many employees work at the same time. The only solution to improve the warehouse visibility is to start an inventory procedure in a special room or in the whole warehouse. Also, important for a SME company is the information about stock products, their ageing and especially for sensitive products the duration and the conditions in the storage place.

*RFID enabled warehouse will generate more electronic events in order to keep track of each product in the warehouse and to produce more valid and real time information for the warehouse state. In case of an inventory round it's enabled to use a mobile RFID reader to identify the products at each position in the warehouse. The tracking, sensing and timing data will generate alarms in order to avoid the denaturation of the product.*

The RFID implementation in SENSAP will provide to the personnel new tools for inventory and automated product and data handling. The new infrastructure is designed to offer new software tools and will affect the current working procedures. The sales and logistics department will have available real time data for the warehouse status and alarms about critical products (availability – condition). Finally, the staff and the director's board are going to have more valid and utilized electronic data in order to follow new marketing strategies and attract new customers.

### *4.1.2 Architecture*

The architecture of a RFID deployment is based on many factors like, business model, warehouse physical representation, software – middleware technology and hardware infrastructures. For the specific trial the infrastructures at all the levels supports all requirements and the ASPIRE project will be the connecting middleware in order to achieve the best results.

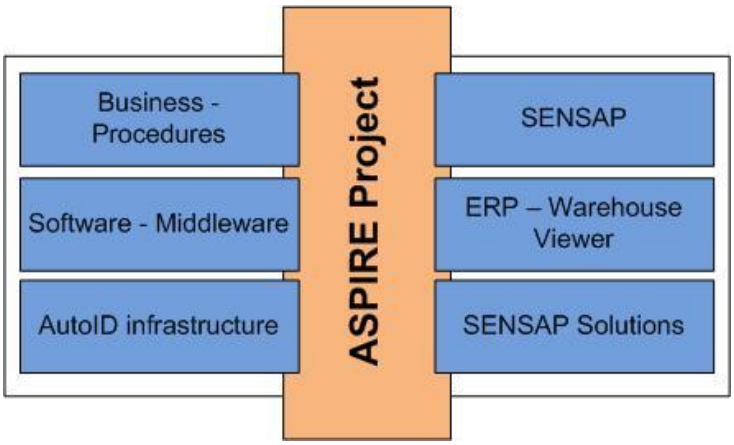



**Figure 2. The ASPIRE project and the correlation with all the System levels.**

SENSAP in order to be able to support the trial decide to upgrade the hardware infrastructure, implements a new RFID infrastructure and integrates all this deployments in a standard system architecture shown in the following figure.

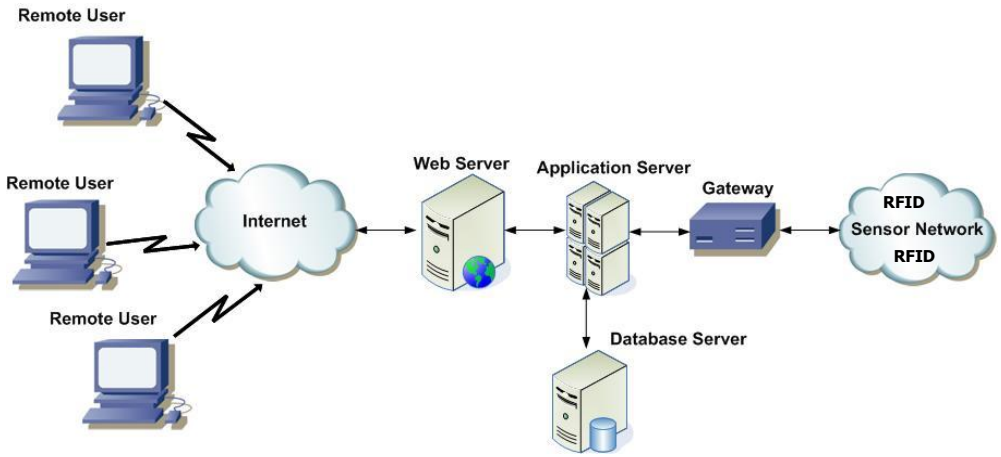



**Figure 3. A typical web based system architecture with RFID – sensor network extension.**

Based on those specifications SENSAP provides a platform to evaluate the ASPIRES's middleware which promises to provide a common interface for automated system configuration.

### *Physical Configuration*

The company's warehouse floor plan is presented in the following figure and covers an area of 250m$^2$:

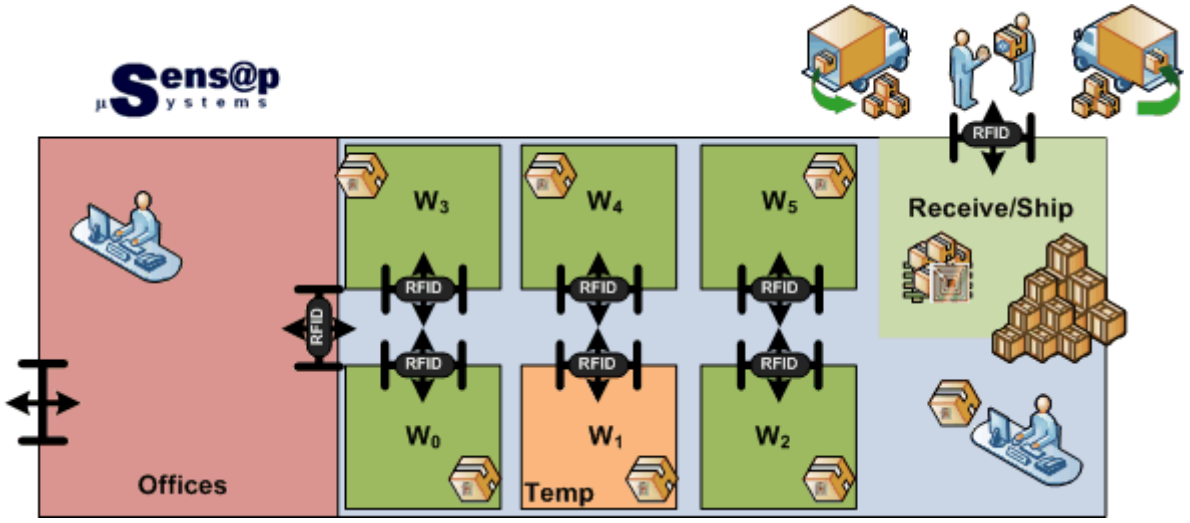



**Figure 4. The SENSAP's plant floor plan.**

**Table 1. Symbols Description (Greek Trial).**

| Symbol | Description |
|---|---|
|  | In/Out Warehouse Gate, the arrow declares the direction of asset |
|  | RFID Portal. |
|  | Data and Computer Center, RFID Printer station |
|  | Cartons with Smart RFID label on a pallet<br><br>Tagged cartons |

At the moment the company works using an infrastructure, which consists from the following hardware/network components:

- A Server machine running computer/network management software.
- An application Server with a hosted Database Server.
- 4 Desktop PC for the employees.
- 4 Laptop computers for sales and visitors.
- Wi-Fi infrastructure covering all the facilities.
- Barcode scanners and printers.

The company started implementing a RFID infrastructure (based on EPCglobal standards and certified equipment) and the technical survey demands for the best results the following hardware:

- 8 UHF fixed RFID Readers
- and 32 UHF FF and NF antennas
- 2 mobile UHF Readers (Commercial and ASPIRE's Low cost reader),

in order to implement the RFID Dock door Portals and RFID electromagnetic coverage of the warehouse. Also the warehouse will equipped with a portable RFID reader and the low cost RFID reader from the ASPIRE project.

UHF FF RFID Antenna

Fixed RFID Reader

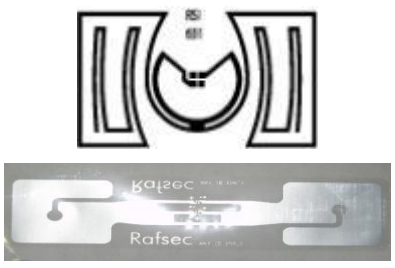
RFID Portal

Mobile RFID Reader

**Figure 5. The basic components of a RFID system.**

In detail the fixed readers will configure in order to execute the following tasks:

- 1 UHF Reader for the Dock-door Portal (Shipping/Receiving),
- 1 UHF Reader for personnel and guests tracking and
- 6 UHF Readers in order to cover the main room of the warehouse.
- The warehouse is equipped with an Ethernet UHF RFID printer and plenty of types of FF and NF smart tags and labels.




NF-FF UHF RFID tags

UHF RFID Printer Rolls


BAP UHF RFID tags


RFID smart label Printer

**Figure 6. RFID tags (Passive, Active), Rolls, and a RFID printer.**

In the warehouse are stored more than 4.000 items and in a monthly base the needs for tags will be about 500 PCs. Based on the labelling needs the company will use 4.000 UHF tags for the products and must order a number of 1.000 in a period of 2 months.

The BAP UHF RFID tags will be used in order to capture sensing data for specific products/cases/rooms. The combination in a module of an RFID identification chip and a sensor will generate added value information for the company. The specific module captures ambient temperatures in a pre-defined pattern, capture alarms when a pre-defined limit exceeds, and stores temperature data for off line applications.

The mobile RFID readers will be use in order to support mobility procedures. That equipment will be used for special identification checks, on the truck, on the shelves, alarm event driven circumstances. Also the mobile low cost reader it will be used on the company's trucks and vehicles and as a support infrastructure to big suppliers/customers.

***Logical Configuration***

SENSAP's new division is dedicated in software solutions for RFID implementations. The trial at SENSAP will use the in house software tools and the contribution of the ASPIRE middleware.

The proposed ASPIRE's architecture (as is at the moment) and define a well suited combination of all the famous available RFID software-middleware components available in open source projects and the new components of the ASPIRE middleware. The ASPIRE architecture is a dynamic combination of the most reliable and functional open source tools and the versioning of the architecture is referenced in Deliverable D2.3 (a) and Deliverable D2.3 (b).

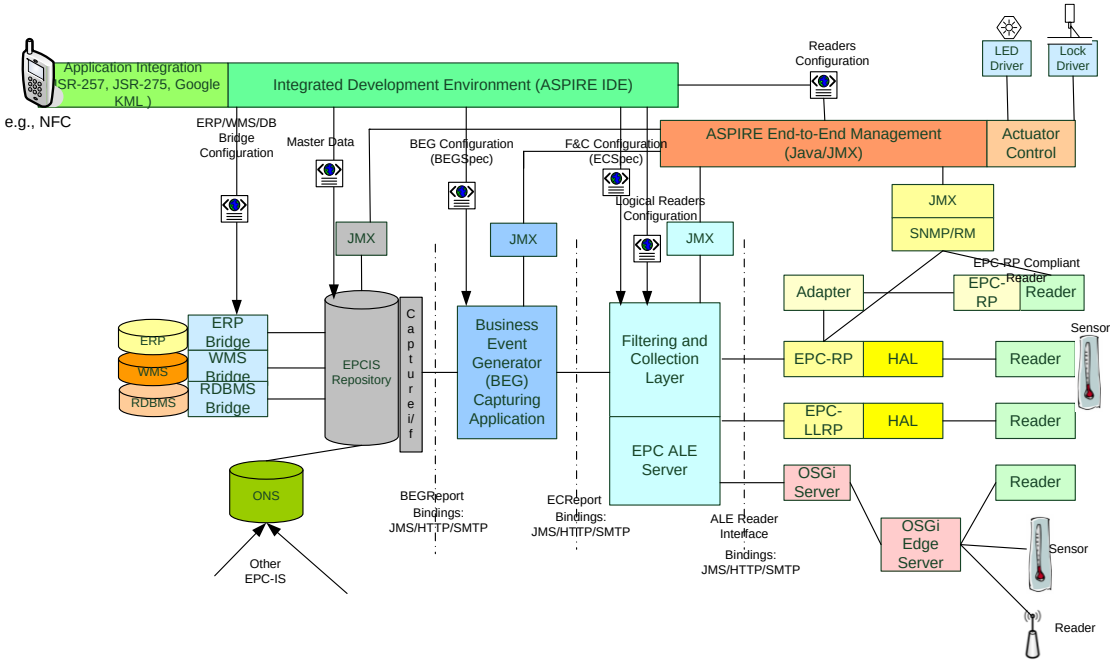



**Figure 7. The proposed ASPIRE architecture.**

The implementation of the SENSAP's trial uses the software - middleware infrastructure as described below:

- A Hardware abstraction Layer (HAL), which configures the underlying RFID readers and forwards data to an EPCglobal Application Level Events (ALE) implementation. Currently HAL can configure both RP and LLRP enabled devices, capture RFID data and forward it under a unified interface.

- ASPIRE ALE, which perform filtering and aggregation of RFID data coming from several different readers, conforming to EPCglobal ALE protocol.

- ASPIRE Business Events Generator (BEG), which translates Application Level Events into business Events, according to IS protocol, and stores those business events into a repository.

- ASPIRE middleware for producing the necessary configuration files for the underlying software components.

- ASPIRE Middleware for accessing an EPC-IS repository.

- SENSAP's Warehouse Viewer, a software package for real time data representation, with searching capabilities and customized features for new business cases.

SENSAP's trial middleware software components conforms the EPCglobal standards and implements the parts of the protocol stack as shows the following figure:

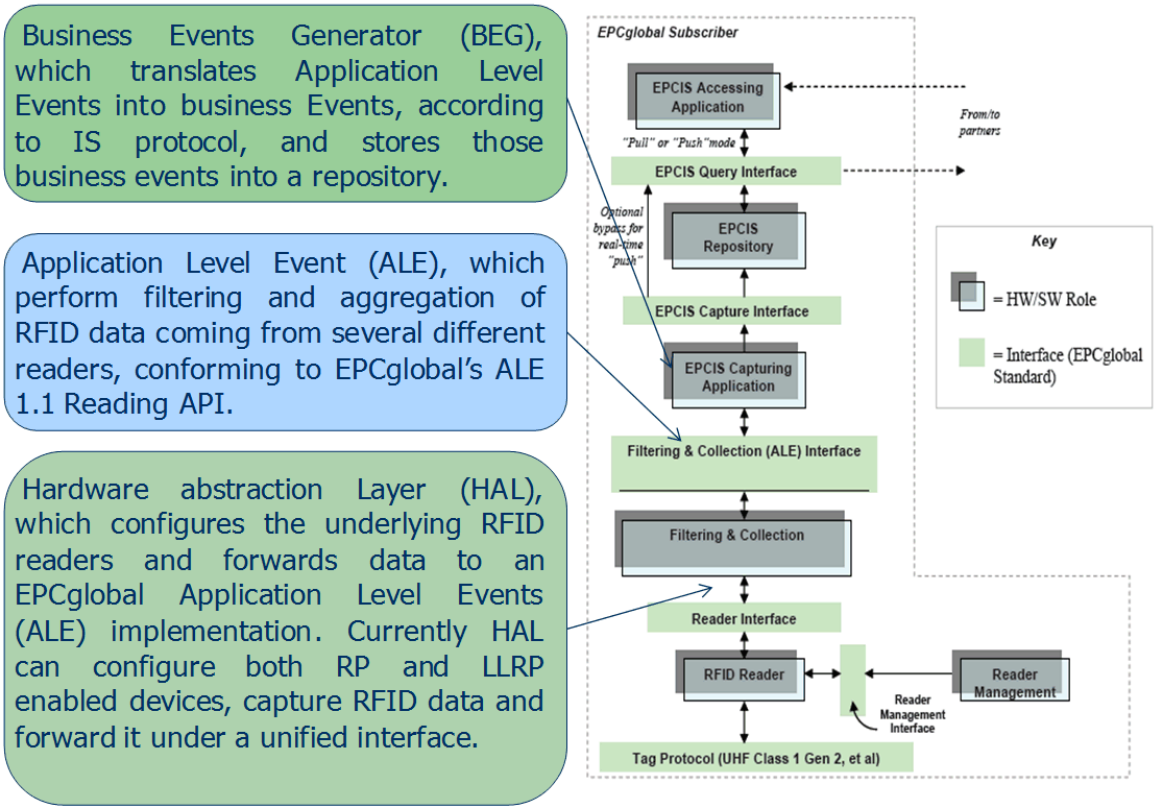



**Figure 8. The EPC protocol stack and the SENSAP software components.**

The SENSAP's software components use the following user interface in order to add functionality to the RFID infrastructures. This console can start and stop specific procedures, to recover older transactions and has also reporting and labeling encoding menus:


**Figure 9. The GUI for Receive/Ship, Report and smart Labels handling.**

The last software component is the Warehouse Viewer will be the front-end application software for the ASPIRE middleware platform. The viewer will help the employees to interface with the RFID data and to perform a variety of tasks like inventory, reporting,

searching and receiving/shipping. A beta version of this application software is presented in the following figure:

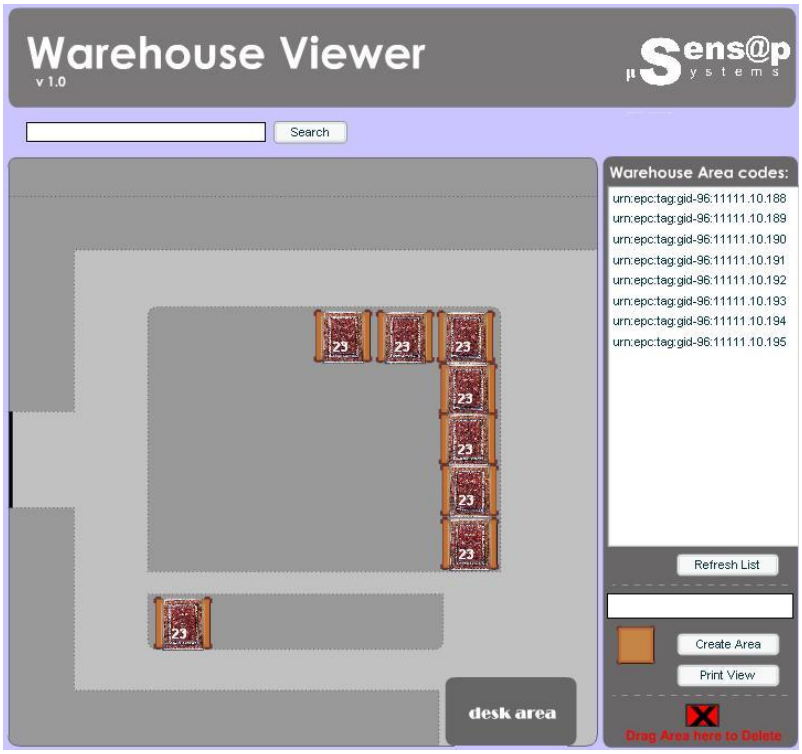



**Figure 10. A beta version of the RFID Warehouse Viewer.**

# Section 5 RFID Trial in France (PV)

## 5.1 The French Trial

### *5.1.1 Trial Scenario*

In France, it is too early, at this stage, to ensure that a company is willing to run a pilot under the ASPIRE project. Nevertheless early contacts have been made with French SMEs. Some of them have clearly manifested an interest in RFID technology and in the associated ASPIRE middleware. This document describes one of the potential pilots that could run in France.

The company, a French SME, is manufacturing textile machinery. Textile machinery's task consists in assembling and twisting several yarns (raw material) to obtain the technical desired yarn. The final yarn is conditioned on a bobbin. These textile machineries address several kind of technical yarn:

- Glass yarn that is used for electronics and reinforcement.
- Industrial yarn that are used for artificial grass, tarpaulins, ropes.
- Tire cord used for carcass and cap ply.
- Carpet yarn used for carpet or rug manufacturing.

The machine is mainly composed of metallic parts. Several "positions" are present, on both sides of the machine. Each position is able to assembly and twist raw material in order to produce different technical yarns.

**Figure 11. A bobbin and an industrial manufacturing machine (Wikipedia).**

Users of that kind of textile machine have to ensure internal traceability. They manage raw material to produce technical yarns that fit customer's specifications. They have to receive, store, and manufacture machinery according to customer's orders. The final products are stored in separate rooms and shipped to customers.

The graphics below illustrates movements (main procedures) of material inside a typical textile machinery company. The use of RFID technology could provide a reliable mean to better track and trace all materials involved in the production of technical yarn bobbins. Moreover embedding RFID technology in the manufacturing process itself could avoid operator's errors such as putting an empty bobbin on the wrong position. Finally, monitoring of physical parameters is also interesting because storage of yarn has to be done under specific conditions (temperature, humidity).

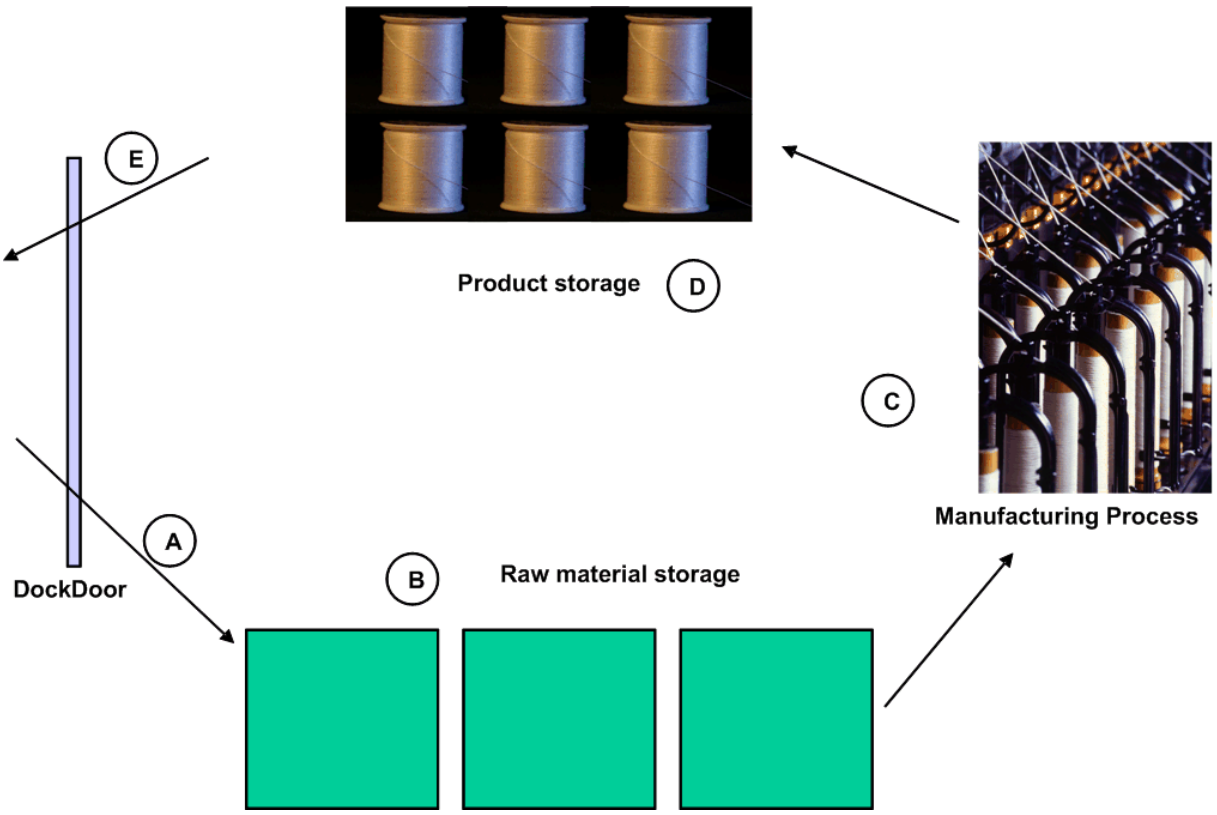



**Figure 12. Movements of material inside the company.**

The next paragraphs describe the functional specifications of this potential pilot. At each stage, data have to be captured and sent to the IT system. The following floor plan presents the stages of the trial scenario in the company and the potential RFID implementation.

**Table 2. Symbols Description (French Trial).**

| Symbol | Description |
|---|---|
|  | In/Out Warehouse Gate, the arrow declares the direction of asset |
|   | RFID Portal. |
|  | Data and Computer Center, RFID Printer station |
|  | Cartons with Smart RFID label on a pallet<br><br>Tagged cartons |
|   | Process Stage |

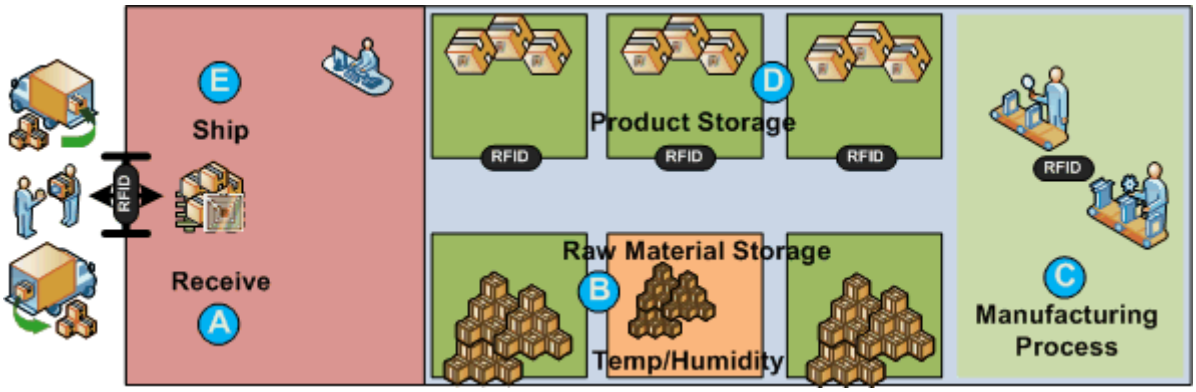



**Figure 13. The company's' floor plan.**

***Stage A: Reception of raw material***

This list is not exhaustive but raw materials are mainly composed of:

- Raw yarns conditioned on bobbins. These raw yarns can be made of synthetic fibre, natural fibre, artificial fibre and mineral fibre.
- Plastic cylinder that will be used to bobbin finished technical yarn on.
- Cardboard cylinder that will also be used to bobbin finished technical yarn on.
- Etc.

Traceability markers are completely heterogeneous. The mainly used technology is barcode technology but we can also find in some cases Datamatrix technology and rarely RFID technology.

The objective is to identify any incoming material. An operator will be equipped with a handheld multi-technology device (commercial RFID and optical reader, or a combination of existing barcode system and the ASPIRE low cost RFID reader). He will systematically identify incoming material. The information will then be sent to the IT system associated with the type of raw material of the reception date.

***Stage B: Storage of raw material***

People in charge of the storage will also be equipped with a handheld multi-technology device (RFID and optical reader). When putting raw material in the storage area, the operator will have to read RFID tag that will provide the location in the storage area. Then he will have to read the traceability marker embed in raw material. Information such as, identification number of raw material, location and date will be sent to the IT system.

Physical parameters such as humidity and temperature are critical, especially when fibre is concerned. If raw materials are too dry, the textile machinery will not be able to assemble and twist properly. Thus, temperature and humidity will have to be monitored by the system. Alerts will have to be raised when detecting a problem.

When a production order is launched, the IT system will send information to the person in charge of the storage. The handheld device will receive the information. Information about type of raw material and location in the storage area will be provided to the operator. He or She will then be able to prepare raw material and to give them to the textile machinery's operator.

***Stage C: Manufacturing process***

According to the production order, the machine will print information on a RFID label (batch number, position expected, date, time, etc, barcode) and also encode data in the RFID tag. The operator will take a cardboard or plastic cylinder and stick the label in it. Then he or she will approach a position and with a handheld reader, read the RFID tag in front of the position and the RFID label in the cardboard cylinder in order to verify that he's in front of the right position (according to the production order). If he or she succeeds in this verification, he will then start the process. When the process stops, the bobbin will be ejected on a conveyor belt. At the end of this conveyor belt, a long-range reader will identify the finished technical yarn bobbin and write quality data in the RFID tag (length of yarn, composition, date, time, etc.). This information will also be sent to the IT system.

Information will so be embedded in the bobbin itself and also in the IT system.

***Stage D: Storage of produced bobbins***

This function is similar to the storage of raw material. Nevertheless, all of the finished yarn bobbins are RFID equipped so it will be possible to do real time inventory. When a shipment order is sent, the operator will be able to locate the bobbins in the storage area.

***Stage E: Shipment of produced bobbins***

At the dock door, a long-range reader will be use to identify all the "to be shipped" bobbins before they leave the company. A sensitive screen will be used to select the delivery note before pushing the pallet through the RFID gate. All the information will be automatically sent to the IT system.

This document has provided a quick description of the French potential pilot. The choice of the RFID technology will be crucial since there is a lot a metal in the environment of textile machinery. Moreover, information concerning the expected benefits has to be collected and analysed. Finally, a lot of high-level functionalities have to be developed in order to handle all information provided by the ASPIRE platform (alert, locating, etc.). PV currently waiting for the official decision of the company concerning its involvement in an ASPIRE pilot.

### *5.1.2 Architecture*

***Physical Configuration***

The company has to generate all the smart labels for the tagging needs of the machinery products. Because of the existence of various types of materials it's important to use a labeling system, which can be functional in dry and metallic environments. The following picture shows different labeling choices.

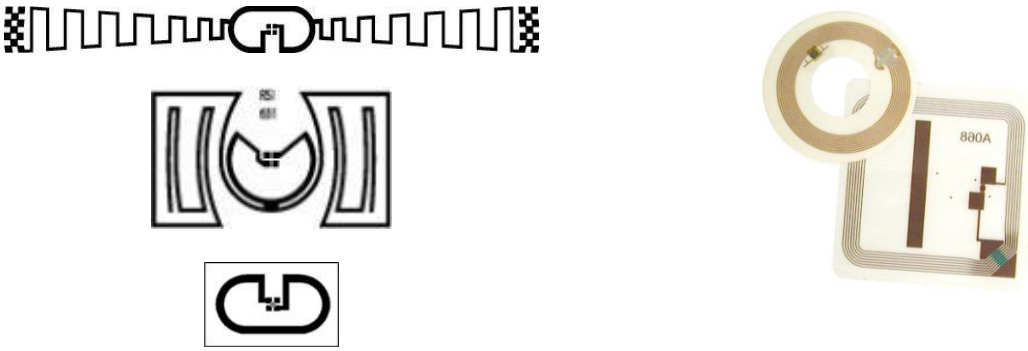
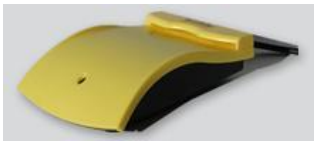


**Figure 14. UHF tags with FF and NF capabilities and HF tags (IMPINJ, Wikipedia).**

The technology solution must be decided by the company in order to achieve the best results. The UHF technology (EPCglobal) is the proprietary for logistics procedures and the capability of the tags to have NF (Near Field) characteristics make it interesting for special environments. The HF technology (ISO) is established in the process management with RFID in special environment and works suitable in special environments. The two technologies uses different infrastructure and hardware components but both of them are compatible with ASPIRE platform.

The company has an IT infrastructure and in order to implement a RFID solution will order the appropriate equipment, which in case of a HF RFID solution (The UHF RFID equipment is presented to the other 2 trials) is as show the next figure:

HF mount Reader



HF USB Reader

Multi Tech Handheld

(Barcode - HF Reader)

Mobile HF Reader

**Figure 15. Components of a HF RFID system.**

### *Logical Configuration*

The French trial will use the ASPIRE middleware in order to implement a complete RFID system.

The proposed ASPIRE's architecture (as is at the moment) and define a well-suited combination of all the famous available RFID software-middleware components available in open source projects and the new components of the ASPIRE middleware. The ASPIRE architecture is a dynamic combination of the most reliable and functional open source tools and the versioning of the architecture is referenced in Deliverable D2.3 (a) and Deliverable D2.3 (b).

The ASPIRE platform is able to incorporate also with HF hardware and data generated from a HF infrastructure. The ASPIRE architecture is able to collect data from various RFID infrastructures and to transform the collected data to business information. The ASPIRE middleware is suitable for the French trial in order to provide RFID solutions with lower implementation costs and best corporate results.

# Section 6 Liaison trial

## 6.1 Liaison with Greek Innovation Pole Trial – STAFF (SENSAP)

### *6.1.1 Trial Scenario*

The trial is based on the business needs of a company, called STAFF SA, specialized in the sector of fashion and textiles. The company has factories all around Balkan sector and the central Logistics warehouse is located in Central Greece.

Logistics and inventory in the apparel industry is a critical issue and is related with the availability of the products on the retail shelves, the ageing and the stock management. The following figure shows those important procedures.

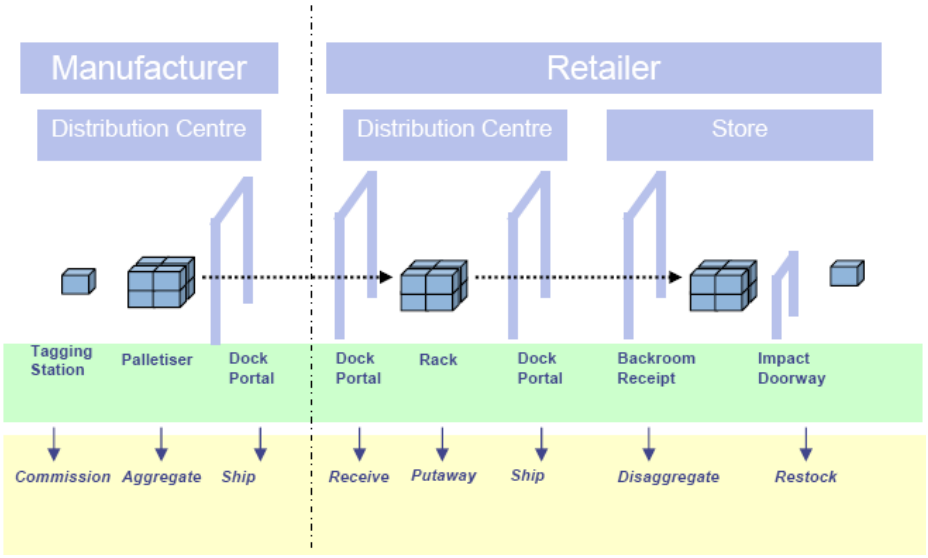



**Figure 16. The logistics chain and basics procedures steps (source EPCglobal).**

The apparel industry is in a unique case where item level RFID tagging can provide significant benefits relatively quickly without major disruptions to current operations. Apparel items are typically RFID friendly allowing a broad range of applications from automated receiving, rapid inventory, controlling on shelf out-of stock situations and shoplifting.

Our scenario for the trial has the following main objectives:

- An RFID enabled warehouse for pallet, carton and item level inventory.
- Automated handling of shipping and receiving procedures.
- Business utilization of the RFID dynamic data from two distant places.

The following figure shows the main tasks related with the procedures of the RFID warehouse of company STAFF.

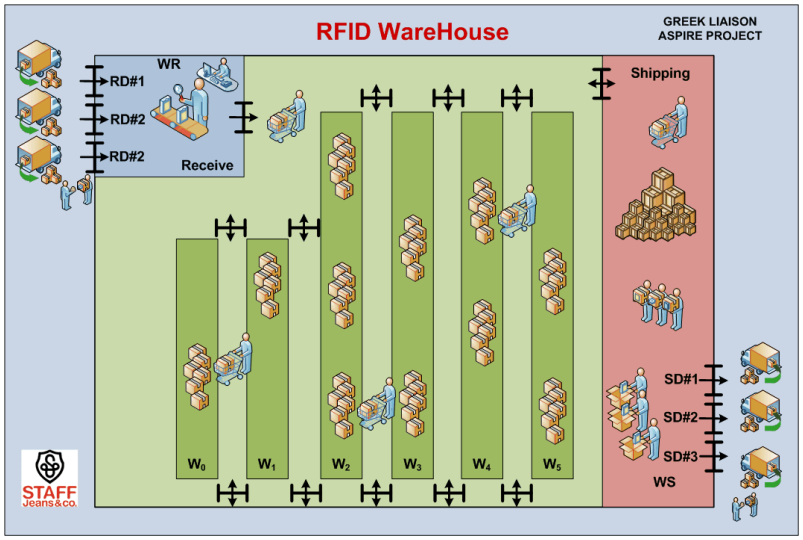



**Figure 17. Basic procedures of an apparel industry.**

The STAFF company uses RFID in order to achieve increased performance and productivity in three (3) main procedures: Receive, Ship and Inventory. The "big" picture of all the procedures of the company's logistics and the real factory plan is presented in the next figure.

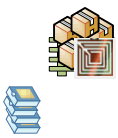
**Warehouse $W_0$ : DC Warehouse**

**Warehouse WR: Warehouse Receiving**

**Warehouse WS: Warehouse Shipping**

**Warehouse $W_n$ : Warehouse Internal storage rooms**

**Table 3. Symbols Description (Liaison Trial).**

| Symbol | Description |
|---|---|
|  | In/Out Warehouse Gate, the arrow declares the direction of asset |
|   | RFID Portal. |
|  | Data and Computer Center, RFID Printer station |
|  | Cartons with Smart RFID label on a pallet<br>Tagged Items |
|  | Picking trolley or plastic collection box |

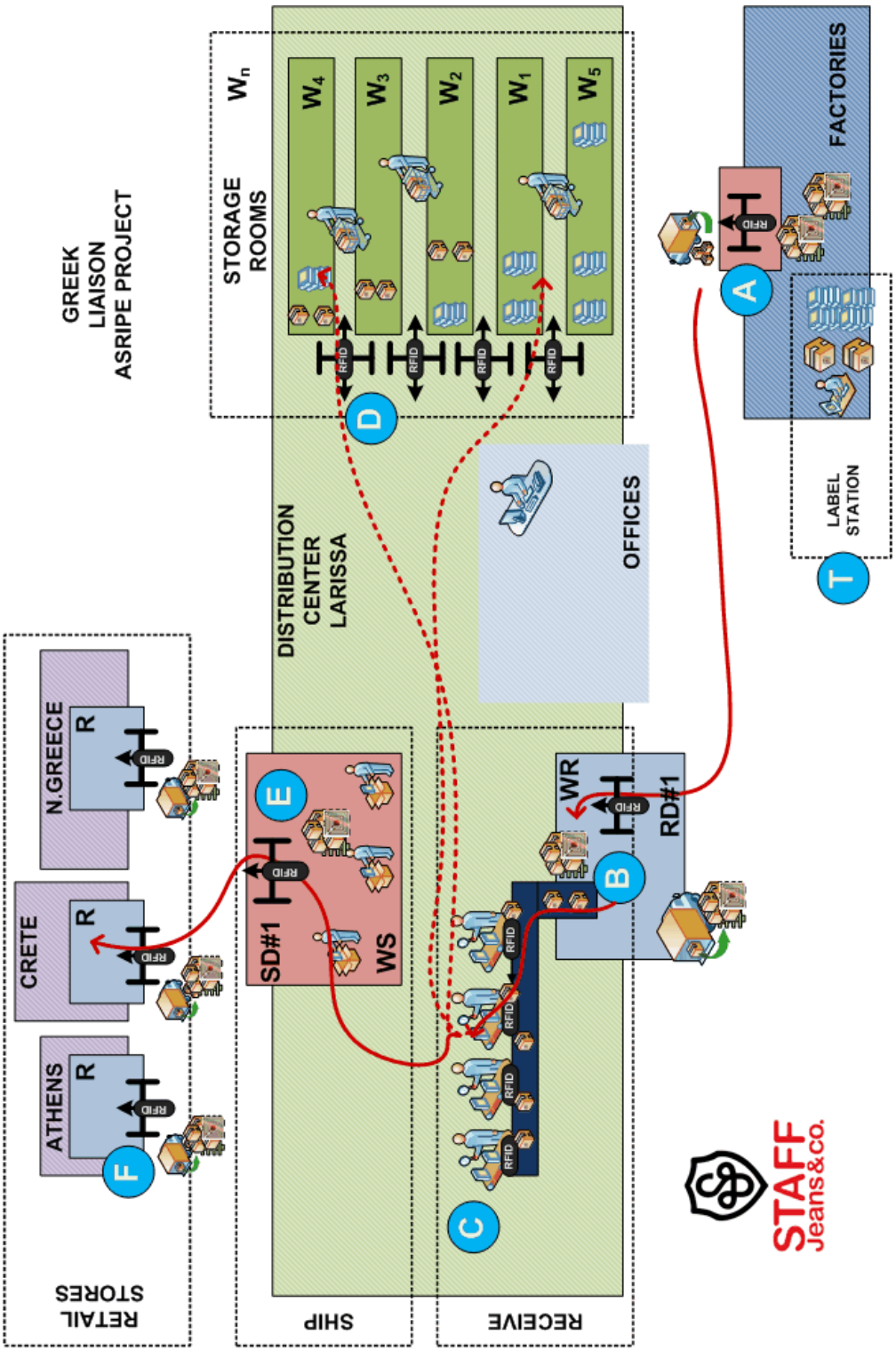



**Figure 18. STAFF SA Big Picture.**

The plan of the company shows the main procedures and places of the plant. In more details the main positions/procedures are:

**Place A:** is the aboard manufacturing factory. At this place the different product codes are manufactured, the products are labeled, the RFID portal track the goods in the cartons or pallets and on trucks the products shipped to the D.C.

**Place B:** is the incoming gate where the trucks arrive (D.C.) and the RFID portal is installed. The cartons-pallets are identified, aggregation and observation events occur and the receiving procedure executed.

**Place C:** the point where the cartons arrive and the employees select the product codes. Each carton is directed to the proper place based on the identification of the RFID class object.

**Place D:** are the internal storage rooms of the D.C. The product codes are stored in cartons or in item level on the appropriate shelves. The control and tracking of the products is achieved using RFID portals in specific positions.

**Place E:** is the preparation room for the orders, their packing in shipment cartons and the creation of the shipment pallet. At this place the pallet is tagged, identified from the RFID portal and put it on the truck.

**Place F:** Are the retail stores. Each store has a RFID portal.

**Place T:** is the smart label generation station. This room is in the D.C. and generates all the smart labels for the suppliers/factories.

### *6.1.2 Architecture*

#### *Physical Configuration*

The company has to generate all the smart labels for the tagging needs of the product codes. This procedure is based on the specific industry needs and the proposed tags are compliant with their demands. The following picture shows garment-labeling choices.

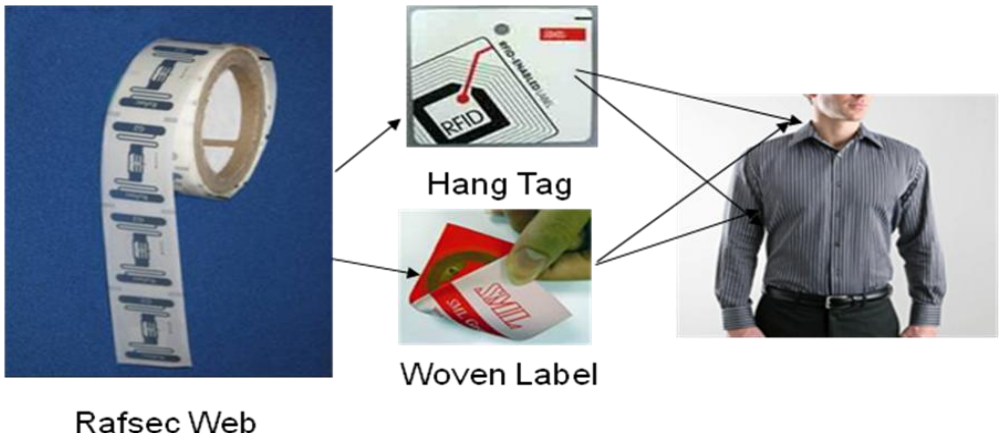



**Figure 19. A Roll of tags, types of labelling and in the field application (source. UPM Raflatac)**

The special requirement for this industry is to label the products in order to achieve Near Field (P.O.S applications) and Far Field (inventory applications) characteristics. Because of that the smart labels must be special designed and to fit with the garment industry requirements (Hang tag - small pretty size). The company will use the following labeling solutions:


Front face of a smart label for cloths

Back face of a smart label for cloths


Front face of a smart label for cartons

Back face of a smart label for cartons

Tags in Rolls for mass smart label printing and encoding

RFID smart label printer

**Figure 20. Examples of the item/carton level smart labels, RFID smart label rolls and RFID printer.**

The company receives and ships all products from central warehouse. This trial will use the following configuration:

**Table 4. The RFID infrastructure of STAFF SA.**

| | | | |
|---|---|---|---|
| **Place A** | The RFID portal is placed in the main gate in order to capture all the tracking items. | | |
| | **Reader** | **Antennas** | **Comments** |
| | 1 UHF RFID Reader | 4 UHF RFID Antennas | This portal uses the network infrastructure and is configured by the ASPIRE middleware |
| **Place B** | The receiving RFID portal. | | |
| | **Reader** | **Antennas** | **Comments** |
| | 1 UHF RFID Reader | 4 UHF RFID Antennas | ASPIRE middleware configured |
| **Place C** | Special RFID equipment for class object automated selection, use of sensors and lighting equipment | | |
| | **Reader** | **Antennas** | **Comments** |
| | 1 UHF RFID Reader | 4 UHF RFID Antennas | ASPIRE middleware configured |
| **Place D** | Internal warehouse RFID portals, for tracking and observing the product codes movement. | | |
| | **Reader** | **Antennas** | **Comments** |
| | 1 UHF RFID Reader | 4 UHF RFID Antennas | ASPIRE middleware configured |

| | | | |
|---|---|---|---|
| **Place E** | The shipping RFID portal. | | |
| | **Reader** | **Antennas** | **Comments** |
| | 1 UHF RFID Reader | 4 UHF RFID Antennas | ASPIRE middleware configured |
| **Place F** | | | |
| | **Reader** | **Antennas** | **Comments** |
| | 1 UHF RFID Reader | 4 UHF RFID Antennas | ASPIRE middleware configured |
| **Place T** | | | |
| | **RFID Printer** | **Smart Labels** | **Comments** |
| | 1 UHF RFID Printer | More than 150.000 pre Collection (4 seasons) | SENSAP's software, ASPIRE middleware configured |

***Logical Configuration***

STAFF will use SENSAP's software solutions for RFID implementations and the ASPIRE middleware in order to implement a complete RFID system. The trial at STAFF will use the SENSAP's software tools for data representation and the contribution of the ASPIRE middleware for system control and configuration.

The proposed ASPIRE's architecture (as is at the moment) and define a well-suited combination of all the famous available RFID software-middleware components available in open source projects and the new components of the ASPIRE middleware. The ASPIRE architecture is a dynamic combination of the most reliable and functional open source tools and the versioning of the architecture is referenced in Deliverable D2.3 (a) and Deliverable D2.3 (b).

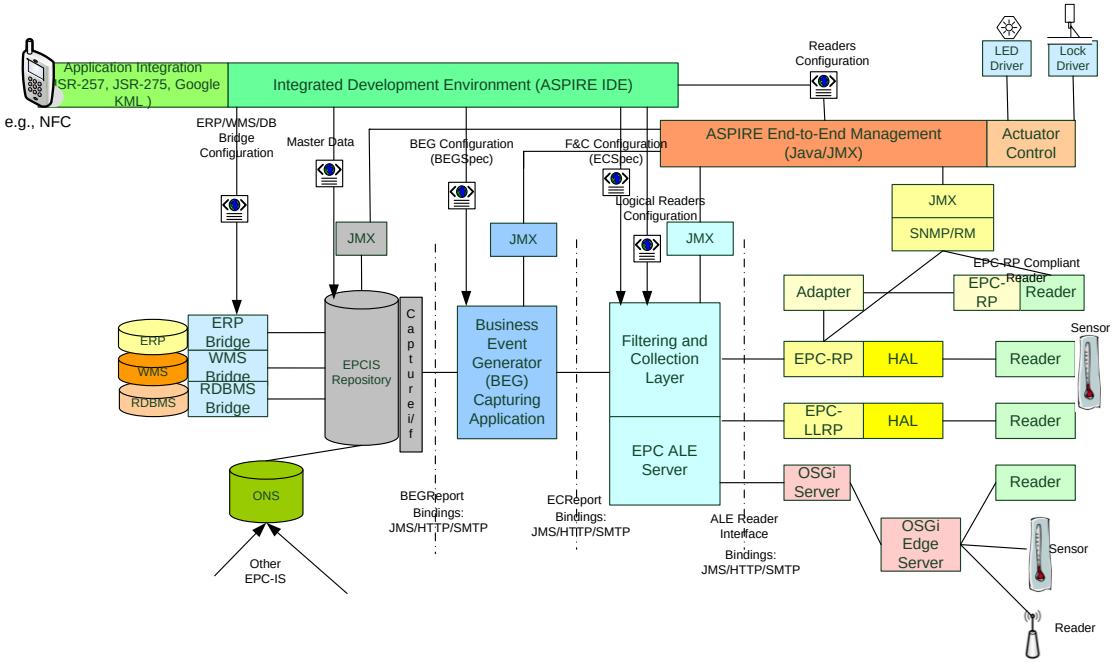



**Figure 21. The proposed ASPIRE architecture.**

The implementation of the STAFF trial uses the software - middleware infrastructure as described below:

- A Hardware abstraction Layer (HAL), which configures the underlying RFID readers and forwards data to an EPCglobal Application Level Events (ALE) implementation. Currently HAL can configure both RP and LLRP enabled devices, capture RFID data and forward it under a unified interface (ASPIRE).

- An ALE, which perform filtering and aggregation of RFID data coming from several different readers, conforming to EPCglobal ALE protocol (ASPIRE).

- A Business Events Generator (BEG), which translates Application Level Events into business Events, according to IS protocol, and stores those business events into a repository (ASPIRE).

- ASPIRE middleware for producing the necessary configuration files for the underlying software components.

- ASPIRE Middleware for accessing an EPC-IS repository.

- STAFF Warehouse Viewer, a software package for real time data representation, with searching capabilities and customized features for new business cases (SENSAP).

- STAFF's Smart Desk, a smart version of a collection desk where the employees will check, and prepare the smart logistic labels on the carton boxes for ongoing orders (SENSAP).

ASPIRE's middleware software components conforms the EPCglobal standards and implements the parts of the protocol stack as shows the following figure:

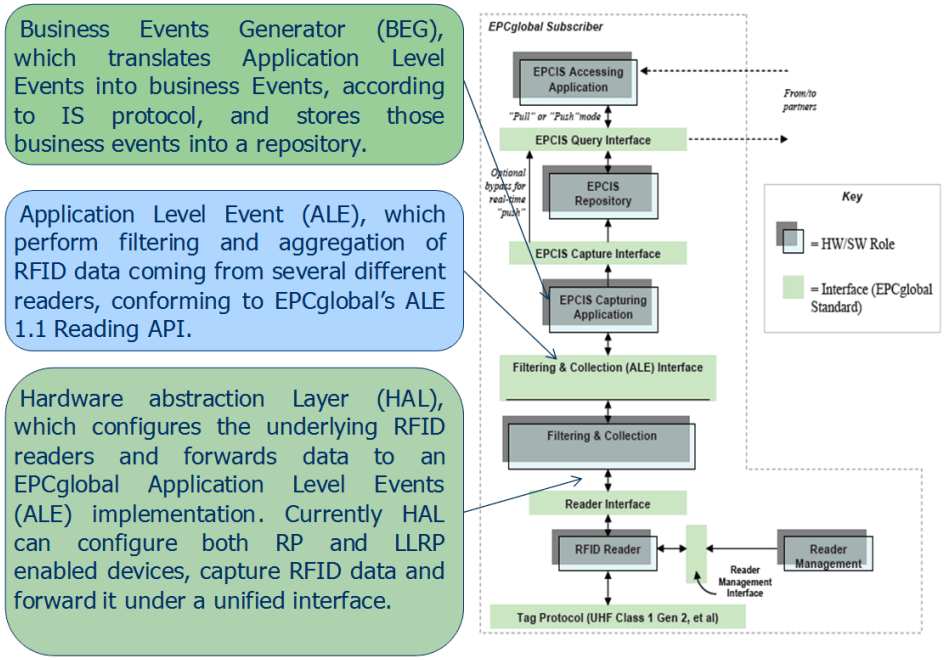



**Figure 22. The EPC protocol stack and the ASPIRE components.**

The SENSAP's software components use the following user interface in order to add functionality to the RFID infrastructures. This console can start and stop specific procedures, to recover older transactions and has also reporting and labeling encoding menus:

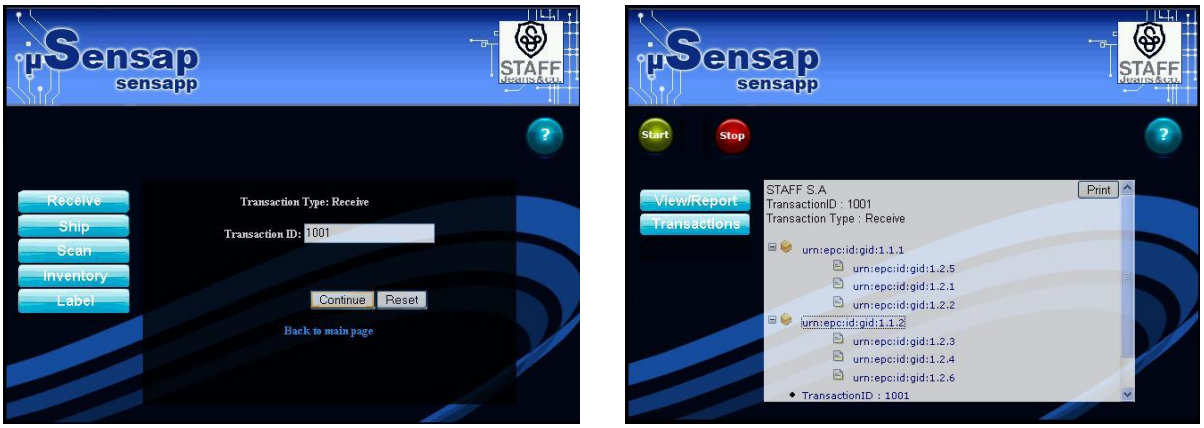



**Figure 23. SENSAP's software components GUI.**

The last software component is the Warehouse Viewer and will be the front-end application software for the ASPIRE middleware platform. The viewer will help the employees to interface with the RFID data and to perform a variety of tasks like inventory, reporting, searching and receiving/shipping. A beta version of this application software is presented in the following figure:


**Figure 24. A beta version of the RFID Warehouse Viewer.**

Finally, based on the RFID conveyor software STAFF is going to prepare software component for smart desk applications and label printing. The next figure presents the conveyor viewer user interface:

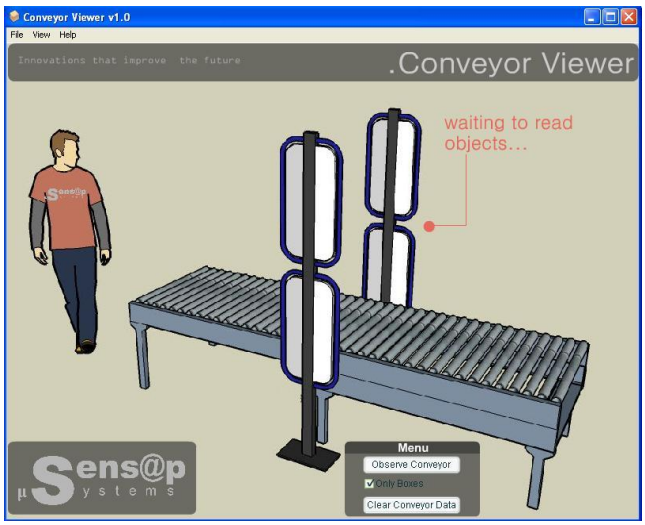



**Figure 25. A beta version of the RFID conveyor/smart desk Viewer.**

The last but one of the most important software components is the smart labeling software. This suite performs printing and encoding tasks for all the available codes of the company. This module is designed based on the garment and carton labels, generates SGTIN and SSCC smart labels and incorporates extra fine with the current procedures of the company. The figures' following shows the tabs of Print and Code View of the software module:

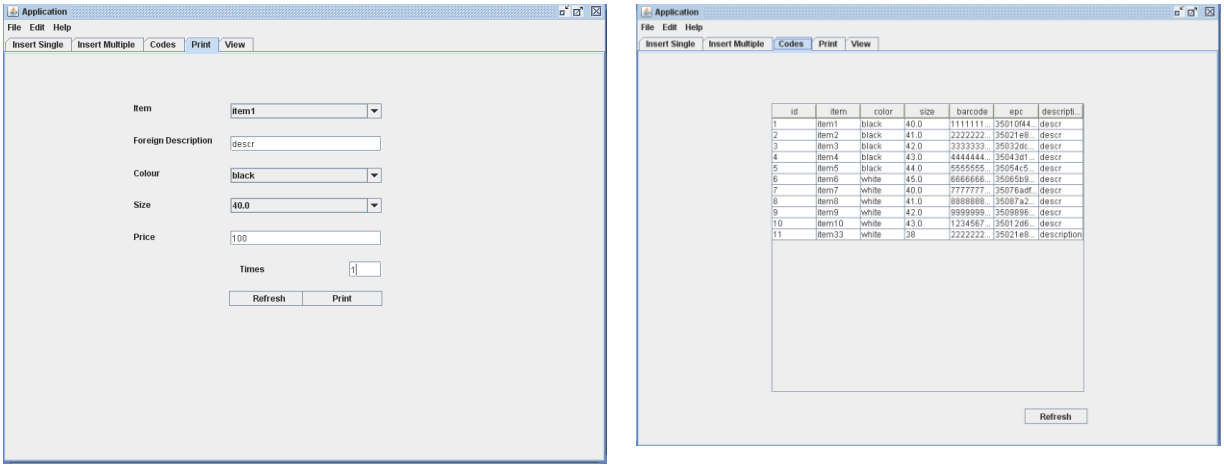



**Figure 26. The printing/encoding software GUI.**

# Section 7 Conclusions

## 7.1 New procedures, methods and their benefits

Introducing RFID technology and implementing a RFID system in a company is a difficult and demanding task. The RFID technology eliminates the human interference in many procedures and ensures more accurate results. The ASPIRE consortium is dedicated to develop a programmable and configurable open source middleware for SMEs. The availability of such kind of software platform will enforce the implementation of more RFID infrastructures with lower TCO and easier system controllability.

At the moment most companies use barcode systems in order to have automation in their procedures and their information systems are based on that logic. The ASPIRE project provide a new platform in order to use the benefits of the RFID technology and to create new procedures (more accurate and secure) and new business models.

In the trials of Textiles and Apparel industry the ASPIRE platform will be evaluated in all the industry fields (manufacturing, warehouse, retail) and will expose all the benefits of a RFID system. In order to assure the availability of authentic products in store and the consumer satisfaction, the whole supply chain has to be under control. RFID is an excellent tool to increase the security and efficiency in Supply Chain and In Store Inventory Management.

- **Source Tagging:** Combination of security & RFID source tagging capability that delivers lower cost implementation for retailers
- **Supply Chain Traceability:** Automated transfer of goods from back of store to front of store with common aesthetic data portals to enhance operational efficiency
- **In Store Inventory:** Real time in-store inventory with RFID devices to drive volume of sales and increased margin
- **POS Integration:** Integration security & RFID solution at the POS will drive sales and enhance the customer experience

Technology solution drives business benefits. The benefits achievable in each segment will be magnified as deployments are extended, and the scenarios combine into exceptions management systems operating across the supply chain.

The benefits of the RFID technology are obvious and the efficiency of the systems increases as the technology is implemented in more fields. The vision of the manufacturing process will enhance the visibility of the production line, will reduce the costs and will finally offer the best quality of the final product. Keeping electronic data in all stages manufacturing, warehouse, and logistics will help companies to increase their quality, their stock management and their reliability to existing and new customers.

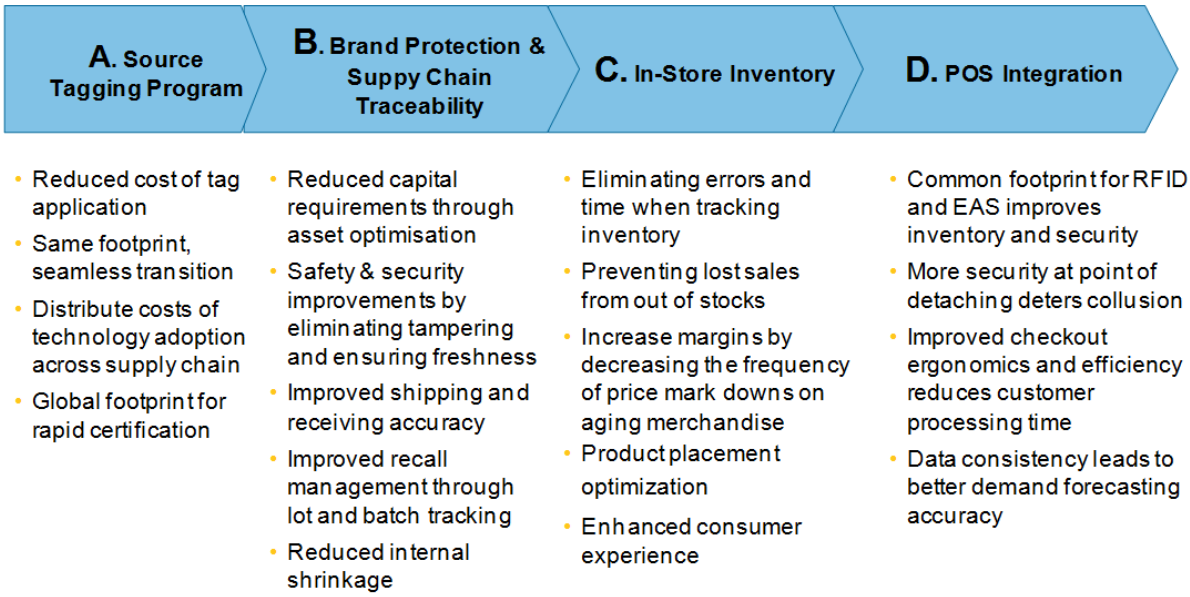



**Figure 27. The 4-stages of an RFID infrastructure application and benefits in Apparel industry (source UPM Raflatac)**

## 7.2 Implement Functionalities

The proposed trials facilitate all the modern needs of a SME. The main problems of warehouse inventory, the logistics chain vision, the tracking of sensitive products and the electronic business data handling are addressed and the APSIRE platform will be designed to elaborate all this in a common middleware.

The proposed trials implement all the functionalities bothering a common European SME:

- Improves the warehouse inventory
- New labeling for products with increased functionalities
- Implements new mass identification methods
- Tracking goods electronically and efficient business data processing
- Implements a low cost IT infrastructure
- Provides visibility in the logistics chain
- Improves the handling of sensitive products
- Introduce new methods for product authentication

Those are some of the new functionalities of a RFID system. New functionalities enables companies to implement new procedures, to re-organize their work in order to have more advance production flows, less looses and bigger margins of profit.

## 7.3 ASPIRE project contribution to European SMEs

The ASPIRE projects faces the modern needs of a European SME and provides a collaborative platform in order to introduce the RFID technology to companies, to develop an modern open source platform and low cost hardware and to evaluate those solutions in real trials.

The ASPIRE consortium proposed three (3) trials in Greece and France to evaluate the ASPIRE platform and to collect all the appropriate data. Those results will be the feed for designing a middleware solution for SME, which will decrease the implementation costs of a RFID implementation. The trials will expose those benefits and will provide a real evidence that the ASPIRE platform can be applied in large scale applications.

## List of Figures

## List of Tables

## Section 8 References and bibliography

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