



WeTrack : New Cylinder Management System

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WeTrack is a customized, modular software that provides all the functionalities and processes needed to manage the labelling, filling, tracking and distribution of cylinders and containers in the packaged gases manufacturing and distribution cycle. WeTrack solution is made by mobile applications installed on handhelds used on the field by filling station operators, drivers or agents. The solution includes also a web portal for managing assets, supervisor approvals, product catalog and all the configuration parameters.

1. Background

After the acquisition of the European business by TNSC, Nippon Gases Europe had to decommission by end of 2019 a Praxair tool named GCT (Global Container Tracking), that was used in BNF (Belgium-Netherlands-France) and Germany. The strategy to accomplish this binding agreement was to create a new cylinder tracking platform in Europe, starting from the regions that were using GCT and then rolling out to the other geographies.

A team consisting of process experts, operations staff, solution architects and developers skilled in web and mobile technologies was therefore assembled to implement the project.

2. Guidelines for design

The guidelines to develop WeTrack solution were:

- A design which allows to support various types of processes in different plants and countries.
- A modular architecture with the possibility to add new features without having big impacts on the existing functionalities.
- Use cutting edge digital technologies and development methodologies.
- Adopt a reliable and flexible way to integrate with other corporate systems.

3. Solution Details

3.1 Technical specifications and architecture

The application was developed entirely with Microsoft .NET technology. Specifically, web services, interfaces and web application use ASP.NET Core, while the mobile application has been developed with Xamarin Forms.

The choice of .NET Core gives the flexibility to run the application in Windows or Linux environment as well as allows easy installation of the application in container orchestrators such as Kubernetes.

There is a different instance of the application for each country.

WeTrack is a software solution to cover and manage barcode tracking in the processes of production and distribution of gas containers, inside and outside the fence; including batch manufacturing, testing, release and certification.

The solution is organised in modules, so to provide a set of functionalities to manage containers for the end users:

- Labelling (managing the container data and associating the container to a barcode)
- Sorting (pre-fill inspection and container sorting)
- Filling
- Analysis
- Tank replenishment (managing Bulk gases tank in filling stations, connected with racks)
- Batch release of medical products by QP (Qualified Person)
- Picking (managing sales orders and trips to be shipped by picking the needed containers)
- Delivery trip (to manage the trip of a truck driver with

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delivery of containers and picking empties at customer)

- Countersell (for over-the-counter distribution for agents)
- Retesting (for container periodic retesting operations)
- Final Amend (to manage the reconciliation of empty cylinders pickup from customers and update the related container balance)
- Procurement (to manage containers filled by suppliers).

3.2 Application layers

The solution is composed by:

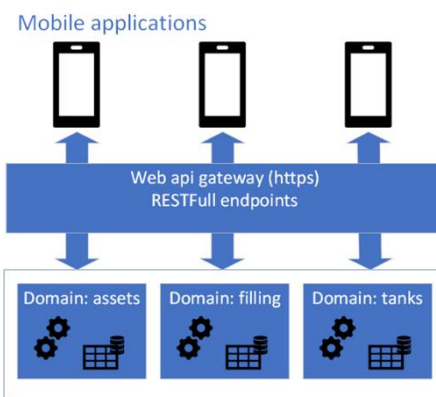
- A Data layer
- A Back End layer composed of web services, where is managed the business logic for the solution
- An Integration layer where communications with corporate systems take place
- A Presentation layer (Front End) composed by two mobile applications for operators, drivers and customers functionalities and a web application for administration, configuration, approval workflows, asset and product management.

3.3 Data layer

Each application instance has its own dedicated database. Entity Framework Core is used as the data access technology. This allows the flexibility to use any relational database for which a provider is available, in this case Microsoft SQL Server, and allows dynamic generation of database queries.

3.4 Back End layer

This layer has been implemented with APIs (Application Programming Interface), that are web services using REST (REpresentational State Transfer) technology. The APIs are organized in microservices regrouped in domains related to two main business area: Operations and Distribution.

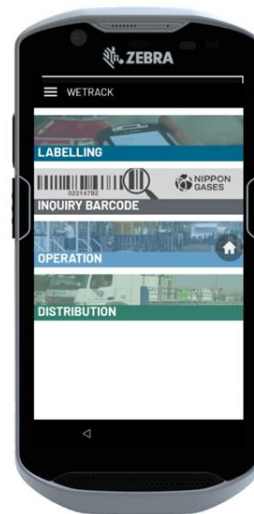


3.5 Integration layer

Communications with external systems take place in this layer. For exchanging data with the corporate applications, WeTrack exposes a set of SOAP (Simple Object Access Protocol) web services which communicate with a middleware solution, currently Microsoft Biztalk. There is an on going plan to rationalize this layer and move to Mulesoft, an innovative API-led connectivity platform that will allow the integration with ERPs (e.g. J.D.Edwards, SAP or AS400 applications) in a more reliable and standardized approach.

3.6 Presentation layer: Mobile applications

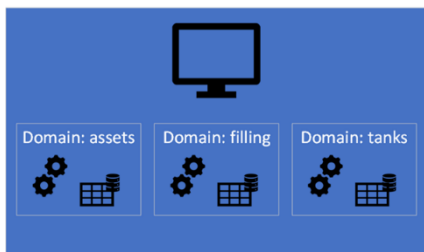
The two mobile applications, developed with Xamarin forms, rely on the underlying Back End web services layer. They work on both the intranet using wi-fi access or Internet using the handheld mobile connectivity. Mobile Applications are managed in the handhelds using SOTI, a MDM (Mobile Device Management) tool, that allows to deploy automatically new application releases to handhelds, and also to mirror the user session to provide support in case of need.



3.7 Presentation layer: Web Portal

The web portal is used for users administration, configuration, approval workflows, asset and product management.

Web application



It has been developed with ASP.NET Core MVC and rely on the same domain contexts developed for the services layer.

4. Entities in WeTrack

4.1 Locations and departments

WeTrack is managing the locations for a company (plants, depots) and departments where the production process will be done, with the possibility to be created or modified directly by the local business administrator.

4.2 Tanks and racks

WeTrack provides the possibility to setup the bulk gas tanks available inside a location or a department. The tank is related to a specific product, and connected with the racks present in the filling station, so to manage the correlation of bulk lot to the final product lot, and ensure the traceability of raw material.

The tank is managed with a status that changes during the replenishment phase and linked to the lot of the product.

4.3 Containers

The main feature of WeTrack is to manage containers (cylinders, bundles, pallets, dewar) used during the production and distribution of the product.

Every container will have a set of data that will define its properties, some of them will be mandatory to manage the production process. Every cylinder will be tracked with a unique barcode as identifier, in some countries can represent the container serial number itself.

The cylinders will have a link to a production lot that will trace the whole process of the contained product from the production to the final analysis, and during the following distribution to other depots or customers.

Each container is associated to a product family and subfamily. This product classification is used to manage the compatibility of the container with racks, tanks and determine the composition of the product, through a production recipe. The recipes are defined at country level for every subfamily with components, percentage in the composition, unit of measures and conversion factors.

The container has a status that changes during the process and linked to the lot of the product. It's possible to inquiry the history of containers and lots.

The container will have a link to a bill of material in case of association to a pallet, operation that is usually done by the operators during the sorting or during the picking.

Bundles are labelled as frames, and it is possible to manage the relationship between the frame and the cylinders inside the bundle (as different records in the same asset table).

It has been developed a product mapping setup to allow the determination of the product code used in each ERP, based on the characteristics of the containers, so to allow the integration with corporate systems. The product is classified using some attributes that identify the product and the compatibility with other products. Examples of possible attributes of a product are the following:

- Product Family
- Product Subfamily
- Container type
- Capacity
- Material
- Valve type
- Number of Cylinders In Bundle
- Working Pressure

Specifically for Nippon Gases Offshore it has been developed the possibility to manage full material codes and empty material codes, so to comply to SAP requirements.

5. Future plan

Currently the solution has been implemented in BNF (production and distribution processes), in Germany (production), in Italy (distribution module for drivers), in Offshore (production and distribution).

Next projects are:

- Finalize the implementation of the distribution module in Germany, for Nippon Gases plants and for agents.
- Initiate project in Italy for production, initiative intended to support AS400 replacement.
- Develop new module for Site Gas Management in

hospitals to replace a solution present in Germany.

- Rationalization of the Integration layer using Mulesoft platform.
- Containerize the application and migrate to Kubernetes in order to improve the reliability and high availability of the solution.
- Upgrade.NET Core libraries to the LTS (Long Term Support) version 3.1.