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A control model for the strategic change of Incoterms in the green coffee supply chain: the case of Nestlé

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Introduction

The objective of this thesis is to analyse the complexity behind Nestlé logistics and the handling of a new supply chain management based on an incoterm transformation towards a Free On Board (FOB) system.

All the data included in this work come from a summer experience I lived in Barcelona, Spain, supporting the Nestrade division and, in particular, the Nestlé logistics team in the Barcelona HUB. Therefore, to protect Nestlé group interests and privacy, the numbers might have been adjusted accordingly.

The project I was involved in and that I describe in this thesis will touch points from a more strategic point of view with the definition of internal processes to a more operational and analytical perspective including stock levels analysis and demand forecasting accuracy.

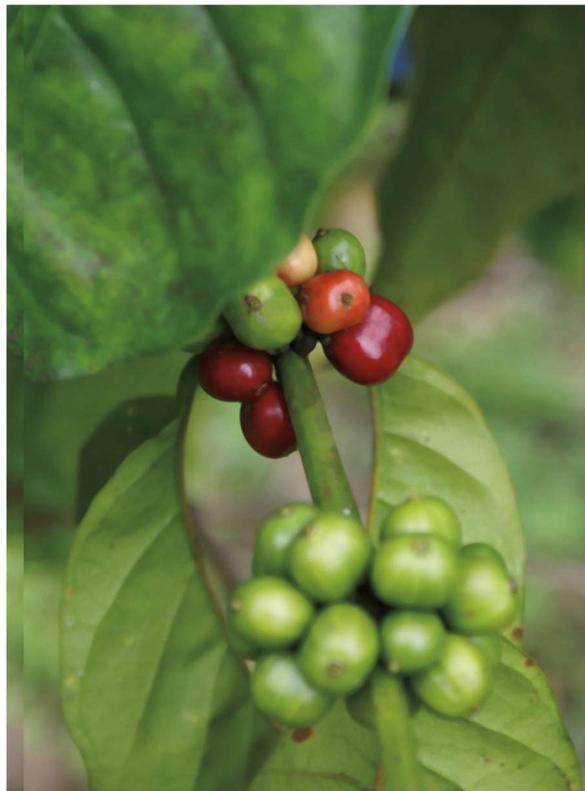
Here, it will be described how the use and combination of software and databases like Visio, SAP and PowerBI can help improving control and performance of a long supply chain with touch-points all around the globe.

The structure of the paperwork will bring the reader through the problem of managing fluctuating stock levels for eleven factories in the EMENA zone until the development and continuous improvement of potential solutions going from a well structured and automated MRP in Excel, to the Master Requirement Accuracy calculation until a completely brand-new analysis that recalls and mix demand forecasting models and quality control charts, the demand variation analysis.

Clearly, there is still room for improvement in the system that will be described in the following chapters, and this is why I wanted to include also a section of future potential improvements that could be implemented in Nestlé logistics adapting the statistical theory of logistics studied at Politecnico di Torino to the operations and needs of the multinational food and beverages company.

1 Nestlé and the coffee

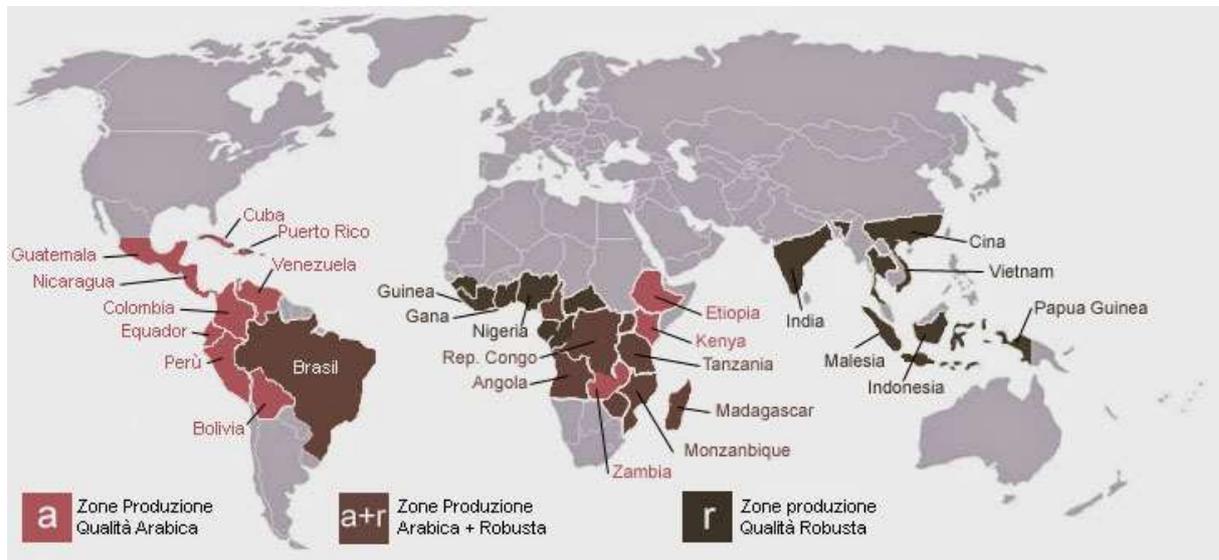
The legend about coffee probably comes from the year 1000 A.C. The first printed sources of history of coffee, dated 1671, tell that a day around VI century, in an Ethiopian region named Jimma (or Kaffa), a shepherd named Kaldi who left his sheep grazing free saw them more excited than usual. Surprised, he observed them eating red berries like cherries from a bush. Then he got closer and took some fruits to taste. The effect was extraordinary: he felt reinvigorated and jumped with his sheep with no sense of sleep or tiredness. This way he could pray all night without sleeping.



Storytelling describes how the shepherd brought the berries to the abbot of a local monastery who made the first coffee. That holy bush was the Arabica, a species of coffee plant (the *Coffea*) to which lands and climate of the Ethiopian region gave a unique taste. Its exciting effect puts this plant among one of the strongest substances that affect the nervous system. It is likely to be that its name comes from the Arabic word “*Kâvek*” that means precisely exciting.

From an industrial point of view, we find several micro-terroirs which give life to beans of various shapes and tastes but, while in the majority of the fields need an artificial implantation of an already-grown plant, the Ethiopian region represents an ideal place

with a perfect combination of climatic factors that allow a spontaneous grow of the *Coffea*.



The coffee beans are the seeds of the berries that grow on the stem and they take nine months to ripe. Then the berries are harvested manually or with small machineries, where the slope of the grounds allows to do so. After the harvest, they are kept in water for some days (washed coffee) or under the sun for some weeks to complete a drying process that ease the extraction of the seeds. The flesh of the berries is separated from the beans and generally used as animals' feed or fertiliser for other crops.

Once the beans are finished with their drying or washing processes, they can be put in bags to be exported in containers of around 21,000 kg.

To make the cultivation of the coffee sustainable, it means that it can be produced on a long period of time continuously respecting social, environmental and economic standards. Nestlé is committed to produce coffee through sustainable processes using methods aligned with laws and regimentations.

Once the coffee beans are received in a factory they are roasted. During this process, the beans increase in volume and change colour to a dark shade, passing through a yellow shade when they are initially heated and then becoming brown with a loss of around 15-20% of their water component.

At this point, the coffee beans are ready to proceed on a grinding machine to produce coffee powder or can be directly packed for distribution.

It is a common practice for Nestlé and other coffee makers to create coffee blends by mixing beans with different origin country and tastes to obtain peculiar flavours and smells.



An example of blends is the limited blends edition of Venezia Coffee, a blend dedicated to a set of historical coffees. This blend contains a mix of two origins: Ethiopia and India, two arabicas of the finest quality and richest smells, especially the Indian one. The roasting happens to be at a medium intensity which enriches the final product of a flowery and fruity aromatic profile.



The invention of the instant coffee came from a young food chemist, Max Morgenthaler, who specialised in adding vitamins to dairy products, and in 1929 moved to Vevey to work for Nestlé as a technical chemist. Across the globe that year, huge fortunes were wiped out overnight. Even the stocks of coffee hoarded for years by the Brazilian government become so worthless that the beans were burned as fuel in locomotives. The only hope for long-term protection against a coffee crisis and price collapse was an industrial process to manufacture water-soluble coffee powder. Nestlé, with its extensive experience in food preservation, seemed to be the knight in shining armour the coffee moguls needed. But in Vevey, the endeavour was viewed with scepticism. Previous attempts had failed; in all methods trialled thus far, the coffee aroma had been lost.

But the prospect of huge revenues beckoned. In 1932, the company's management instructed Max Morgenthaler to develop a method to retain the coffee aroma and flavour in a soluble coffee extract. Morgenthaler's coffee research consumed a lot of time and resources; success was nowhere in sight. In the meantime, Brazil had destroyed 52 million sacks of coffee beans and the global market price had halved. In August 1935, Nestlé's management declared the experiment terminated. But the dedicated chemist just couldn't give up. He bought a supply of coffee beans and continued his research at home. During slack times, he was allowed to work on his project in the factory laboratory. After two years of 'homework', in April 1937 Morgenthaler was convinced he had found the solution. He invited the executive board to a tasting. The reaction was enthusiastic: Nestlé planned to start industrial production of its new flagship brand 'Nescafé' on every continent.



The outbreak of the Second World War abruptly put the brakes on the high-flying aspirations of Nestlé's great new hope – except in the UK and Switzerland, where sales increased. But the war also proved to be a shot in the arm for the product. In Germany, the Wehrmacht High Command had instant coffee produced for its special forces, and in the USA demand from the army was so great that in 1942 the product was classified by the government as a 'commodity vital to the war effort'.



2 Nestrade Division

Nestlé World Trade Corporation (Nestrade) provides integrated trading solutions to Nestlé factories and companies worldwide. It offers machinery and equipment for Nestlé factories, Nestlé finished products, and raw materials, ingredients, and other semi-finished goods or accessories. The company was founded in 1977 and is based in La Tour-de-Peilz, Switzerland. Nestrade operates as a subsidiary of Nestlé S.A. with three main Global Procurement Hubs: Switzerland, Panama and Malaysia. Each HUB has the responsibility for raw material procurement and logistics respectively in EMENA, AMS, AOA regions.

Beside the Global Procurement Hubs, a centric office for Customer Service and Buyers division operated in La Tour-de-peilz and now moved to the Head Quarter of Vevey, Switzerland. While the former has a focus on the legal aspects of the relations with suppliers and carriers, the latter has the accountability for closing a “future contract” accordingly to the quantities indicated by the Procurement HUB and the best market price, in other words it buys green coffee.

Completing the structure of the HUBs, a new HUB for logistics and Operations was recently founded in Barcelona, the new main Head Quarter in Europe, to coordinate and manage all the physical movements after the activities of the Procurement. The Barcelona Logistics HUB will then manage all the scheduling of the contracts created by Procurement and manage the shipping of the green coffee beans from the origin countries accordingly to the stock level policies of Nestlé for the EMENA factories. We can affirm then that the HUB of Barcelona is actually a control room for the supply chain of green coffee, a virtual HUB, since there is no physical flow of materials through this HUB but a flow of data and information to coordinate the real flow of green coffee beans towards the Europe.

2.1 The Structure (Managing eleven factories)

The production of finished goods of coffee (products of coffee, decaffeinated coffee, Dolcegusto and Nespresso capsules) happens among eleven factories all around EMENA zone. Even though the demand planning is done with a zone global view, the MRP for each factory remains strongly linked to the demand in the country where the factory operates. In particular, the MRP is always done with a daily basis point of view and an 18-month horizon in all factories, but in Dieppe.

Germany, Schwerin

It operates with a Third-Party Logistics (3PL). It aggregates the coffee production in the German country, replacing the old factory in Mainz, closed by end of 2017.

Sweden, Helsingborg

It operates without a 3PL, using the port as temporary storage to move the green coffee to the factory, when needed. Its production has not huge volumes, but it has high seasonality in demand. Furthermore, the green coffee used here is a certified coffee from special origins, which enhances the complexity in the operations.

United Kingdom, Tutbury

It operates with a double 3PL, one in Liverpool and one in Antwerp. The factory has a great production of Nescafé Gold Label, which is highly consumed in UK, but also exported in France. A main feature of the logistic operations is that the green coffee is moved in wooden boxes to increase the durability of the raw material and the space efficiency in transportation. Although these advantages, the wooden boxes constraints the amount of coffee that can be moved towards the factory to the number of free boxes available at a certain time. Such boxes are property of the 3PL.

France, Dieppe

The French factory operates with a 3PL and, such as the factory in Tutbury, it moves green coffee with wooden boxes. However, this time the boxes are owned by Nestlé itself, which controls the number of boxes available based on the forecasts in the green coffee demand. As some issues occur in the local SAP system, the MRP is only done with a weekly basis point of view, instead of a daily basis.

Spain, Girona and Reus

Spain represents the biggest production market for soluble and powder coffee in Europe with two factories placed in the north and in the south of Barcelona, a neuralgic pole for the EMENA zone in terms of both naval and air infrastructures. The biggest factory in Europe is the one in Girona which does not only produce Nescafé products but also works for Nespresso and Dolce Gusto capsules. Moreover, this factory treats the coffee to produce decaffeinated coffee to be sold in packages or be reused as raw materials in other factories in EMENA. The two Spanish factories refer to the port of Barcelona for the unloading of the containers and are served by a unique 3PL that, sometimes, can also be used as buffer for the factory in Porto.

Switzerland, Orbe

The homeland of Nestlé S.A. hosts one of its historical factories in Orbe, a multipurpose plant designed for the production of coffee but also chocolate. Because of its wide railways net, Switzerland offers a cheap way of transportation that allows the connection between Orbe and the port of Antwerp, Belgium, where the factory can

count on one of the biggest 3PL partner for Nestlé, since the majority of the Spot purchases come from this location. Beside its large external stowing capacity at 3PL, Orbe also has a noteworthy internal warehouse with a capacity of more than 150 containers.

Greece, Inofyta

One of the smallest factories in Europe is located in Greece in the city of Inofyta where Nescafé products are manufactured for the Balkans area. Despite the factory has limited dimensions and production capacity, Nestlé covers a dominant role in the local coffee market having the majority of the market shares. This factory can count on the services of a small 3PL, but generally the material

Russia, Timashevsk

In Timashevsk there is one of the biggest Nestlé coffee factories in EMENA by volume of goods produced. It operates without the support of a 3PL and the factory carries directly the green coffee from the port of Novorossiysk to the warehouse in Timashevsk. It is the only factory, along with the factory in El Jadida, that does not operate using the MACC system to manage the schedule lines (the process will be explained more in details later).

Morocco, El Jadida

The factory in El Jadida is the smallest factory in EMENA both in terms of production capacity and finished goods demand. It operates in Morocco mainly to overcome the taxation on finished goods imposed by the government on foreign products.

2.2 Commodities (Coffee & Chocolate)

According to Nestlé quality classification, green coffee beans may be divided in three classes: 1, 4 and 7. The first two classes correspond to all the arabica coffee used in Nestlé plants, while the class 7 are all the robusta coffee. The distinction between the class 1 and class 4 is that the former is related to all the “washed” coffee beans while the latter refers to the “unwashed” green coffee beans. Moreover, it exists an internal division by quality levels among the three abovementioned categories.

Within each category, we can have a three-level division: 1, 2, and 3 where the quality of the beans decreases with the increase of the number.

Therefore, we can have a washed arabica coffee with premium quality that would be coded as “green coffee class 1.1”.

The quality level 3 of the all the classes is rarely used in any production per se and could be accepted for the production only in specific cases where a particular acidity or taste wants to be obtained, but always within a blend of other coffee beans.

The least used coffee is the 7.3, a robusta type of coffee that has big beans good for the roasting process, but with an extremely bitter taste in the finished product.

We need to know also that the three quality levels are linked to a visual quality test beside a merely tasty test in mouth with water. In fact, if the sample coming from a container of green coffee has too many foreign materials such as rocks, black beans, dust or other type of particles, it could be downgraded to a lower quality class even though the actual taste is reported to be higher and the coffee will go through a cleaning process of filters before entering the production line in the factory plant.

Two types of coffee that need a particular mention are the arabica coffee coming from Ethiopia and Kenya. These coffee beans are classified as 1.0 quality since they are the most flavoured and premium coffees that Nestlé is using for its productions. Said beans are not only the most expensive coffees but also the most difficult to be managed in the supply chain because of the poor infrastructures that slow down the transport between Africa and the rest of the world.

Furthermore, the crops that grow in Ethiopia and Kenya are the only crops that grow spontaneously in nature, without a pre-planting in a lab.

2.3 Supply Chain Services

Nestrade is offering core services linked mainly to the management and control of raw materials for EMENA's factories (coffee beans) along with the management of all the import, supply and quality control from origin countries all around the world. However, since the change in incoterms from VMI to FOB is a relatively recent transformation in the operations' responsibilities, the factories in regional markets did not want to leave the stock management of the plants to the Nestrade Commodities HUB in Barcelona, wanting to keep the data of consumption and storing levels for themselves. Unfortunately, these misunderstandings happen in big multinational companies when there is a major change like this. Therefore, in a transition phase and to accommodate the requests of the local production plants, the HUB in Barcelona was limiting its services to the management of the coffee supply chain until the 3PL, having to ensure that enough coffee beans are available to be moved from 3PL to the plant for consumption.

The activities of the HUB can be divided in tactical and strategic activities based on the criticality and the time horizon of the decisions to be taken. On a shorter-term horizon we find tactical activities while on a longer-term horizon, the actions can be considered strategic. Based on this classification, the actions and the KPIs associated to such

actions are coordinated and revised in specific meetings of operational review: DOR, WOR, MOR.

DOR

The Daily Operational Reviews (DOR) are held on a daily basis at the beginning of the working day, preferably with all participants attending by person in a meeting room, lasting from 15 to 30 minutes.

These meetings' purpose is mainly to identify criticalities and problems of the team members, as well as relevant issues that might happen around the world causing delays in shipping countries of raw materials. For example, the port of Vitoria and Santos were a constant topic during the month of July because of a huge strike involving loading operators in Brazil. This created an important crisis in the supplying of one of the most used arabica coffee in EMENA, thus generating a big demand for interfactories and spot purchases (which will be described further later). These meetings were actually established after my incorporation in the team by a new member who joined the Commodities Team in April and me. Together, we used some tools of Nestlé Operational Excellence in order to design the activities and the KPIs to be reviewed in DORs and WORs, since this new member had previously worked in Lean and Continuous Excellence for other Business Units in Nestlé.

With the purpose of making the DORs more agile and to keep track of team's issues over time, I designed an Excel file where to track macro-categories, sub-categories, time and other information of the problems occurred to later have all the data aggregated and analysed in a dynamic report in PowerBI.

This report, called "Issue Log", was useful not only to understand the seasonality of some recurring problems, but also to plan actions to solve the difficulties encountered by the team. The planification of every action was set only after a previous analysis to set a priority on the most critical problems identified (Pareto analysis). Such analysis usually started by focusing on the main macro-categories which had had the highest occurrence in the time lapse analysed. Then, I drilled the analysis on the sub-categories and finally on the specific problem identified. While some crucial actions were assigned directly in the DORs, the tool was mainly used as a report in the MOR review.

An example of the effectiveness of this tool is the fact that we managed to switch a man-knowledge into a business-knowledge over the seasonality of strikes happening in Brazil loading ports. In fact, before the introduction of the tool, a person in the team with long experience in Logistics had already experienced strikes from Brazil in the summer period but had no data to confirm or prove its seasonality. This tool, instead, showed exactly the ports involved in the strikes and the amount of time which affected the material supply. Furthermore, the analysis, also confirmed the frustration

expressed by the team on the poor quality of some of K&N's services provided to the HUB, setting the base for a point of discussion between K&N and Nestlé directors.

WOR

The Weekly Operational Reviews (WOR) had no particular structure since it had been established few months before my arrival. Furthermore, this meeting had to last maximum one hour and a half but was always lasting around two hours because of the lack of structure definition and the willing to revise all KPIs, even those which had no relevance for the weekly operations. This meeting was indeed used for more purposes than it was thought for, such as define new KPIs and verify the validity of the old ones. However, after the revision and the work spent on this meeting, along with the introduction of a person with the role of time-keeper, I managed to set the maximum length of the WORs to one hour, leaving room for external topic or an early finish of the meeting.

After my arrival, and with the wise support of the Operational Excellence member, we split the KPIs into tactical and strategical ones, keeping the tactical ones for the WOR and assigning the strategical ones to the new established MOR. Following a month of practicing in PowerBI, I managed to make leaner the Excel used in WORs, keeping only the activities revision function, and merged to the Excel a live report in PowerBI of the stock situation of all factories in EMENA. At the end of it, the report was also showing a resume of coffee in excess in the factories ready to be used for Interfactory movements.

MOR

Every first WOR of the month is considered a MOR (Monthly Operational Review). This meeting is the most important one for the whole Commodities Team since it is the time when all strategic KPIs are examined and the management evaluate the team performance. The average length of a MOR is a full hour and a half and it involves all members of the Nestrade Commodities HUB in Barcelona plus the controller, the commodities support specialist and the head of operations from Switzerland, who join the meeting through Skype. The main KPIs reviewed in the meeting are: stock cover levels in days, demurrages (paid at port), weight losses (index of supplier's quality), service level (to evaluate the relationship between the factories and the team), issue log, interfactories and spot purchases, MRA and bias and the Purchase Orders and Shopping Basket performances.

The last KPI was developed by me to keep track of the performance of both the Commodities Team in Barcelona and of the Commodities Support Specialist in Switzerland. Basically, the index was built comparing the dates of shopping basket submission from one side and the dates of contract creation from the other side.

A Shopping Basket is simply the aggregate of all materials and quantities that will be needed in the factory and will have to be bought in the times reported in the basket.

To be considered “on time”, the shopping basket has to be submitted within the first week of the month with its final version to be opened to disputes of quantities and time deliveries with both buyers and suppliers based on the contracts created in the past or based on specific needs of the suppliers. For example, if a supplier could not deliver the whole quantity requested in the first fortnight, he could ask for a split between the first and the second fortnights if the factory’s needs were not too stringent. The submission of the shopping basket was also crucial to allow the Commodities Support Specialist to be able to negotiate and close contracts with suppliers with the right quantities and with favourable contract conditions.

On the other side, the activity of the Commodities Support Specialist has to be completed for all the factories before the 21st of the same month of submission of the shopping basket, since after the closing of a contract, the information needed to be communicated to the supplier to start the process of quality check and shipment booking. Any delay the closing of a contract after the 21st could cause a direct delay on shipment arrival having a repercussion on a factory’s material supply. Frequently the most convenient action for a contract negotiation was to set a deal for bigger quantities or longer time horizons. However, this practice could generate overstock or constraints to buy the coffee in the future, even if not needed. This is indeed another topic of shopping basket disputes.

MAR

Attending the MAR (Monthly Aggregated Review) there were the major directors from Nestrade and Nestlé. In particular, there were the manager of the Commodities Team HUB, the Nestrade head of operations, the head of supply chain from Nestlé, the Global Category manager for Coffee and the finance controller reporting data.

Despite this was a director’s meeting, I had the chance to attend one of these monthly quick reviews to explain briefly the MRA and the analysis that my team and me were developing in Barcelona to inform the management but also to align the data gathered in function of their needs.

As said in the previous paragraphs, the Logistics HUB in Barcelona was basically managing the planification of the orders for raw materials for coffee. In order to do so, they had to look at the MRP coming from SAP and the stock levels for each type of raw material existing in a factory. Then, crossing the information with the transit times from origin, the PO in the system and the target for the stock cover, the team had to set appropriate volume and time scheduling crossing the information into an Excel built ad-hoc for this purpose: The Stock Cover File.

2.4 Incoterms (Moving from VMI to FOB)

The Incoterms or International Commercial Terms are a series of pre-defined commercial terms published by the International Chamber of Commerce relating to international commercial law. They are widely used in international commercial transactions or procurement processes, such as the processes of Nestrade.

The Incoterms rules are intended primarily to clearly communicate the tasks, costs, and risks associated with the global or international transportation and delivery of goods. Incoterms inform sales contracts defining respective obligations, costs, and risks involved in the delivery of goods from the seller to the buyer, but they do not themselves conclude a contract, determine the price payable, currency or credit terms, govern contract law or define where title to goods transfers.

In fact, the contracts are directly negotiated by the operational buyers of the commodities with the export managers of the suppliers where they need to agree on a differential price to be associated to each shipment agreement of the contract. Later, the contract will be confirmed and issued in the enterprise resource system by the CSS, who will also send the business confirmation to the supplier.

The fixation of the differential price in a contract is the most negotiated part between buyers and suppliers since it will depend on coffee quality, origin, availability, market trends and many more aspects. Normally, a premium differential is paid for those coffee coming from Africa like Ethiopia and Ivory Coast or for certified coffee coming from responsible sourced and organic plantations. However, the differential could also assume negative values for green coffee beans coming from low quality suppliers who put dust, stones and other foreign materials in the coffee bags to increase their weight and gain money. In any case, the differential will be added to the contract price fixed to the market value.

The market value of the coffee commodity fluctuates constantly over time and the two types of coffee, arabica and robusta, are exchanged respectively in the London and the New York trade markets. The fluctuations of the price can be observed in these markets and, when the buyer will need the coffee, the price will be fixed an agreed value within the maximum and the minimum value of the market exchange of the day.

Despite this hinged process, a supplier could by *futures*, a financial agreement where the supplier agrees with a buyer party to sell the coffee beans at a fixed price independently from the market price. The agreed price could reduce price risk linked to the fluctuations for the supplier and the buyer, but it could also represent potential loss or gains. In fact, if the price agreed is lower than the actual market price, the supplier will lose a potential gain. On the other hand, if the price goes too low, the *future* agreement will guarantee a gain for the supplier over its competitors.

Another thing that influences the differential price, and so the final total price for green coffee, is the incoterm applied to the contract.

The main incoterms managed by Nestlé are FCA, more expensive, and FOB.

The FCA (Free on Carrier), happens when the seller delivers the goods, cleared for export, at a named place (possibly including the seller's own premises). The goods can be delivered to a carrier nominated by the buyer, or to another party nominated by the buyer. In many respects this Incoterm has replaced FOB in modern usage, although the critical point at which the risk passes moves from loading aboard the vessel to the named place. It should also be noted that the chosen place of delivery affects the obligations of loading and unloading the goods at that place.

However, this is not the case for Nestlé where it has been decided that the FOB system would bring more profit to the company and also a better management of stock and demand planning.

Under FOB (Free on board) terms the seller bears all costs and risks up to the point the goods are loaded on board the vessel. Therefore, FOB contract requires a seller to deliver goods on board a vessel that is to be designated by the buyer in a manner customary at the particular port. In this case, the seller must also arrange for export clearance. On the other hand, the buyer pays cost of marine freight transportation, bill of lading fees, insurance, unloading and transportation cost from the arrival port to destination. Since Incoterms 1980 introduced the Incoterm FCA, many people think FOB should only be used for non-containerized sea-freight and inland waterway transport and should not be used incorrectly for all modes of transport. So, it is important to balance the contractual risks that the FOB terms introduce in comparison to the FCA with the actual gains in costs, planning and profit.

As said before, Nestlé has evaluated a business case comparing the two abovementioned incoterms having moved from FOB to FCA in a VMI system about ten years ago. The result of the business case developed in several workshops was that the supplier was asking for an excessive increase in cost of materials in order to guarantee an appropriate availability of raw materials at the destination country. This allowed the Nestlé factories to have flexibility in the production with changes communicated to the supplier in short advance. However, even though the increase in flexibility did not make the MRP planners to worry about the adjustments, it was increasing notably the profit for the supplier who stowed the material in the EMENA zone.

Basically, with the VMI system, every purchase of the Procurement Group could be considered as an actual SPOT purchase, which is much more expensive than the purchase from the origin country.

However, the cost of the management of the inventory by the supplier was hidden in the invoice received by Nestlé and impacted on the total cost of raw materials, which did not interest the factory managers, who were only looking at the production costs.

This is why, about two years ago, the Nestlé Group decided to move from the VMI system to the FOB incoterm creating an ad hoc team of logistics in Barcelona to manage the supply chain from the origin country to the EMENA area, as a test to be extended to AMS and AOA zones.

The VMI (Vendor Managed Inventory) is a form of outsourcing where the supplier manages everything from custom activities to reorder levels. Moreover, the raw materials stay as the property of the supplier until they are loaded on a truck (FCA incoterm) to be transferred to the production plant requiring them.

This aspect is also crucial for the books of Nestlé from a financial perspective since it means that, with the VMI system, the working capital of the company is much lower since it is not accounting for all of the stock owned by the supplier even though this material is actually there for Nestlé, but it is not in its pipeline yet.

This trick is a good move when the annual results have to be presented to the shareholders, but it is overall penalizing the company because of a higher cost paid to the supplier, thus impacting directly on the operating profit of the company.

Despite the receiver in the VMI system does not undertake the costs of servicing and maintenance of the stock, using the stock according to its needs (purchasing only as much as he requires at the moment) and this consists in an advantage, he does not even have visibility on the stock available, on the market trends and on its general performance in managing stock.

In a sort of speaking, this system hides potential inefficiencies of the company if the planning is not well structured and optimized.

On the other hand, the VMI system allows a smooth clearance system and deliveries to the receiver that otherwise will need to manage these activities on its own with additional costs and company structure. It also eases the plan of purchases that will simply have to follow sales and production activities transferring the commercial risk at the supplier.

Notwithstanding of these gains for the receiver, Nestlé in this case, the supplier will want to make profit on the managing of the stowing activities and so the potential savings of the VMI system could be only fictitious unless big scaling proportion let the costs go down.

In any case, Nestlé decided that building a logistics HUB in Barcelona would at least kept this profit made by suppliers in Nestlé's pockets. But the actual objective of the FOB implementation project was actually the one of reducing the raw material costs while maintaining a reasonable working capital in the pipeline.

2.5 The double MRP (Manage safety stock and safety time)

The MRP in Nestlé S.A. has been organized in two sets of MRPs: MRP_main and MRP.

The MRP_main is the Master Requirement Plan calculated directly on the consumption in the factory for the production line. In other words, the quantity showed as Requirement is precisely the quantity that is going to be moved from the stock in the factory and poured in the production line after passing through filters and quality inspections.

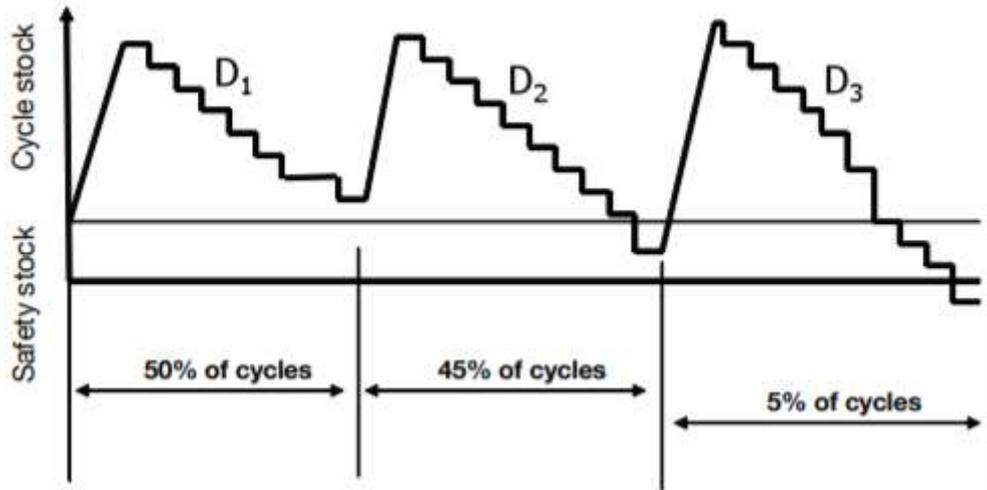
This is why we could call the Requirement figures in this MRP as the “real consumption” at the factory. These requirements of raw materials are calculated upon forecasts on sales of finished products using different Bill Of Materials with specific blending proportion of diverse coffee beans. Often, these forecasts on sales are largely volatile with variations fluctuating around $\pm 30\%$ between what is forecasted and what will be consumed. Clearly, these differences between forecasts and the actual consumption generate a “bullwhip effect” backwards in the supply chain, which will be described in the following pages.

The MRP (also called the “big” MRP) is a further calculation on the MRP_main which will take into account the requirements of the MRP_main as “demand” and will consider the stock in the 3PL as stock available to satisfy it. The “big” MRP also considers a constant delivery time which includes custom clearance and transport time from the port/3PL to the factory.

The calculation of the needs in this MRP also includes a safety stock to absorb the natural deviation related to the consumption and the lead time of the supplier. The safety stock, in fact, is an extra stock quantity that is maintained to mitigate risk of stockouts caused by uncertainties both in supply and demand.

2.5.1 What is Safety Stock

The safety stock is a function of the service level that a company wants to guarantee to its customers. For instance, a 95% of service level would mean that in the 95% of the cases, the quantity in safety stock will satisfy the demand. The remaining 5% could be determine a stock out because of the variability in the demand or, if we consider two sources of randomness, the stock out could be due to variability in the supplier's lead time. Below an image with a designed safety stock for a 95% service level.



On the other hand, we could well increase the service level we want to guarantee to the customers, but it would mean to increase the volume in the warehouse with consequently increase in holding costs, maintenance, fixed assets, etc.

Here, it really becomes a strategic management decision to set the appropriate service level accordingly to the policy of the company.

It is also true that generally the service level for luxury goods tends to be low since a high safety stock would mean critical fixed assets costs in the balance and the potential risk of unsold goods that might become obsolete or will require maintenance. For these kinds of goods, the customer is willing to wait for its delivery since the good itself carries a sense of exclusivity e social status.

On the other hand, a high service level policy adapts better to those goods with high and uniform consumption, like commodities. For these goods the initial investment is low and the customer has a wide choice of similar or substitute products to satisfy his needs. So, if the customer does not find the company's product on the shelves, he will likely go for the competition.

In this case, the risk of unsatisfied clients is more valuable than a higher volume of safety stock.

Many managers, however, will not use a mathematical approach to the determination of an efficient safety stock but will rather use feelings or experience basing the safety stocks on a proportion of the stock cycle or on the average demand and lead time, thus guaranteeing only 50% of service level.

The safety stock (SS), instead, should be calculated using the following formula in case the lead time for the supplier and the demand are independent:

$$SS = Z \cdot \sqrt{(\overline{LT} \cdot \sigma_D)^2 + (\overline{D} \cdot \sigma_{LT})^2}$$

Where:

- Z , is the variable that allow to reach the wanted service level in a Normal distribution;
- \overline{LT} , is the average lead time for the supplier;
- σ_D , is the standard deviation of the demand;
- \overline{D} , is the average demand;
- σ_{LT} , is the standard deviation of the lead time.

With the main purpose of minimizing stockouts and stops in the production, Nestlé is using a dynamic safety stock. This safety stock is calculated automatically in SAP considering a fix quantity in volume (safety volume) and a variable quantity in time (safety time).

The safety volume is used to be sure to always have a certain quantity of a raw material available in the warehouse even though the requirements present zero consumption for a continued period of time in the future. This kind of stock strategy is used for those materials with unregular demand or very little consumption during the year and will then generate small scheduled orders that are not economically efficient for the company. Therefore, it is preferred to have at least one container (21 MT) of the material available in the warehouse also for a feasibility in the transportation of the material.

The safety time, instead, is generally used for those raw materials that have a stable and regular consumption through the weeks, almost going for a continuous production. This type of stock is expressed in SAP as number of days of requirements that the stock available in the warehouse should cover with no further supply. It is indeed a variable number that changes with time but also with any changes associated with variations in requirements, thus amplifying the Bullwhip effect. The benefit of this stock strategy is the flexibility that allows the stock levels to adapt to the requirements volumes. On the other hand, if the requirements show zero consumption for a relevant number of days, such as 4-5 days, this could lead to strange variations in the stock quantity needed with drops before the period with no consumption and subsequent peaks.

Moreover, some materials could be set in SAP for a combination of safety volume and safety time based on a mankind knowledge of the difficulties in supply related to some origin countries' poor infrastructures or climate adversity.

The order scheduling is then done manually by the Commodities Team considering the transit times associated with each origin country and the quality check times for approval, thus considering an average of three months in total.

2.5.2 The Bullwhip effect

The term was coined for the first time by Jay Forrester in his work *The Industrial Dynamics* in 1961 where the evolution of variability along the Supply Chain forecasts was described as the increase in amplitude of a whip down its length.

This effect, also known as the Forrester effect, refers to increasing swings in inventory in response to shifts in customer demand as one moves further up the supply chain. Just as in the physical whip, the further from the originating signal, the greater the distortion of the wave pattern. Therefore, we can say that as we move upstream along any supply chain, the forecast accuracy decreases exponentially.

For example, we could analyse a commodity in a retail store. This good, commonly consumed every day, might have a relatively consistent consumption at retail, but the forecasts sent to the distribution centre that should supply the good to the retail might suffer distortions depending on market potential shift, marketing campaigns, noises and news in the business sector, etc.

All these factors influence the “signal” of the forecast which becomes more chaotic and unpredictable as the focus moves away from the merely consumer purchasing behaviour.

It is important to say that many times the forecasts are influenced by the service level that is decided to be guaranteed to the customer. A higher service level normally means higher volumes in the refilling forecast to guarantee a fairly high level of stock that will minimize the unserved or late-served customers. A lower service level would have the opposite effect.

The service level, in other terms, indicates the willing of a company to accept out of stock situations with a defined probability associated to the client demand. The higher the probability of out of stock the larger the possible number of potential goods not sold in the future, which means a potential loss revenue, thus an opportunity cost also called shortage cost.

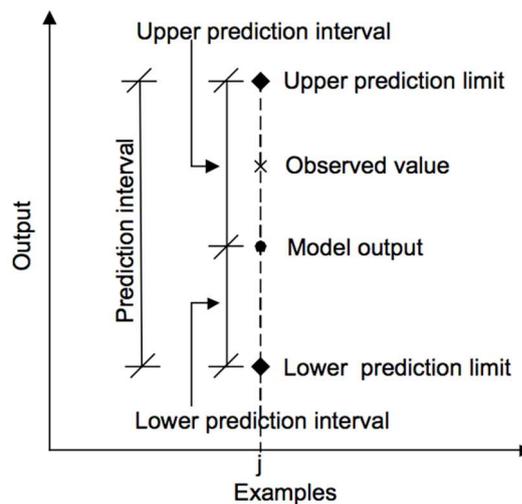
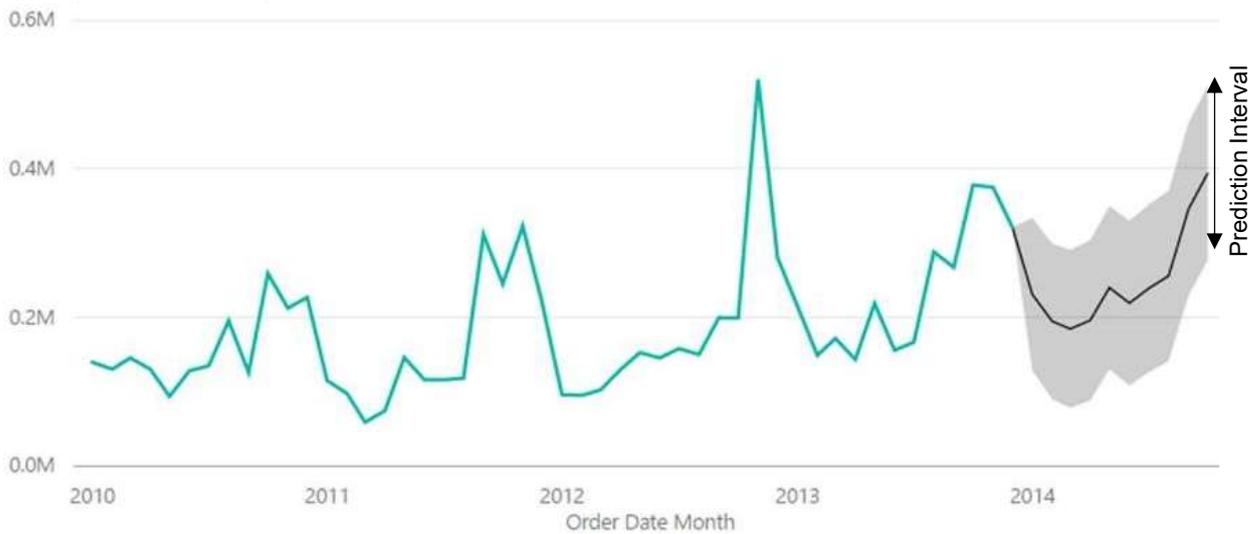
Shortage costs are those costs that are incurred when a business runs out of stock and include the time lost when raw materials are not available, the cost of obsolescence and the cost associated with idle employees. But the most impactful shortage cost is the temporary or permanent loss of sales through insufficient stock levels.

Usually in logistics, the shortage cost (C_s) is a function of the probability of shortage (p_s) depending on the safety stock, the number of orders in one year (N), the average time of shortage (T_s) and the estimated cost of shortage (c_s). The C_s is defined as follow:

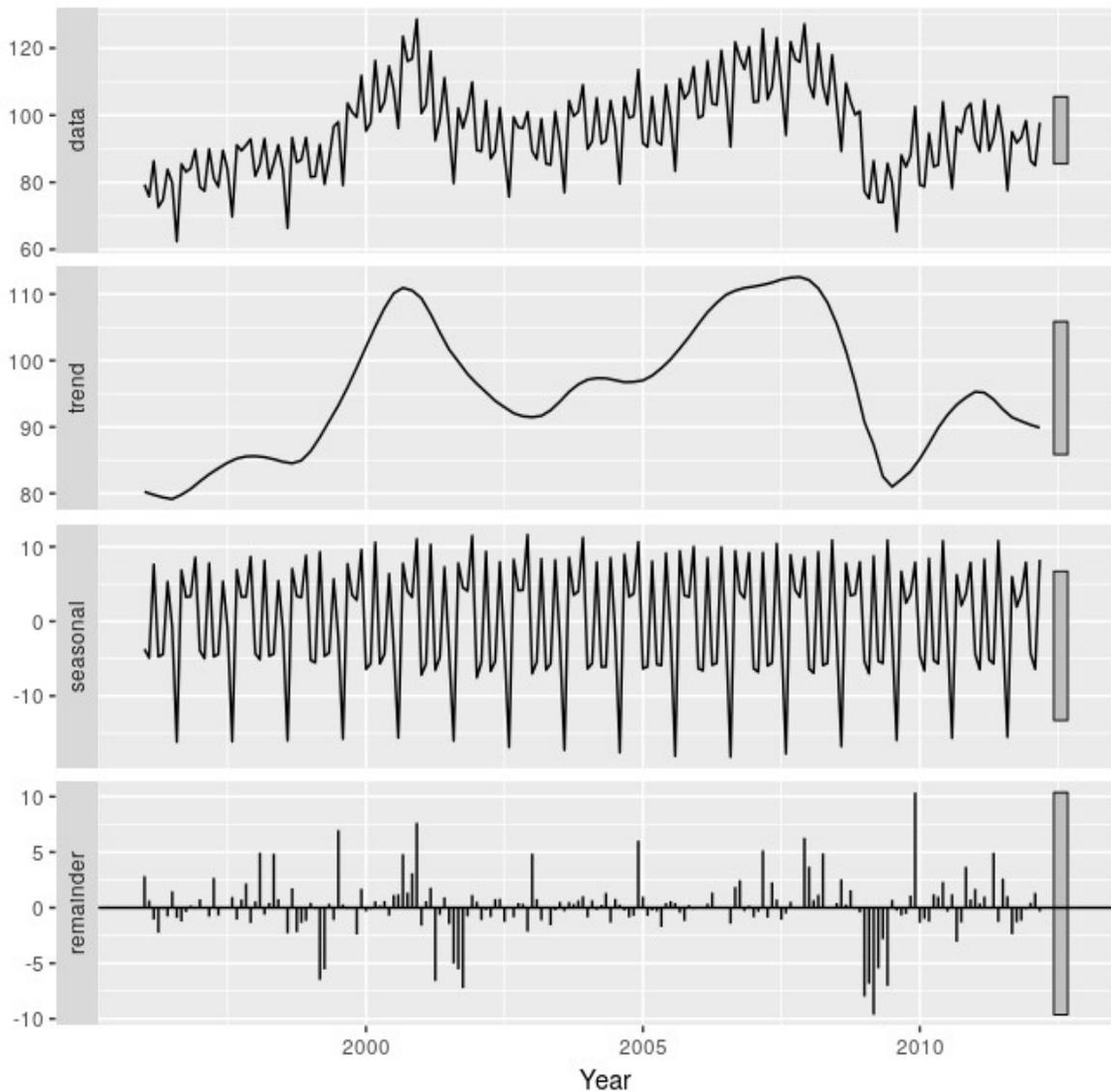
$$C_s = p_s N T_s c_s$$

Since it is difficult to precisely estimate both future demand and shortage cost, it is always a risk to calculate band of confidence for the consumption which would properly account the cost of shortage. Therefore, conservative planners might adopt a larger band of confidence in their forecasts to increase the probability that the actual demand will fall in the interval calculated. But this also means a higher variability and uncertainty upstream in the supply chain.

Sales by Year, Quarter and Month

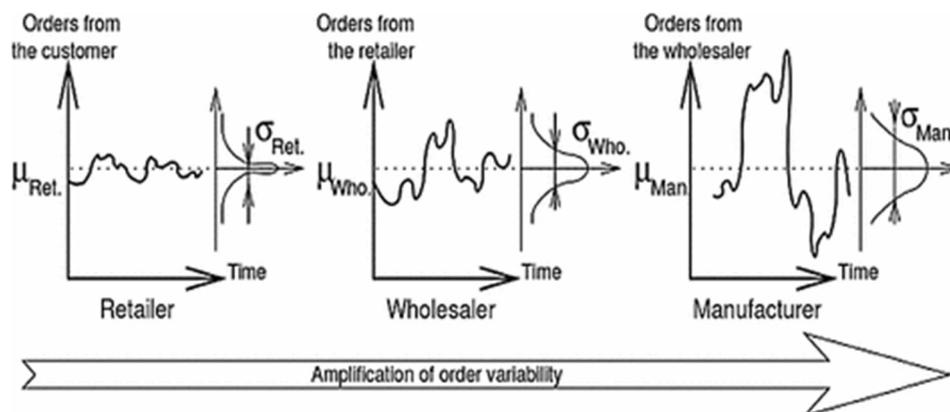
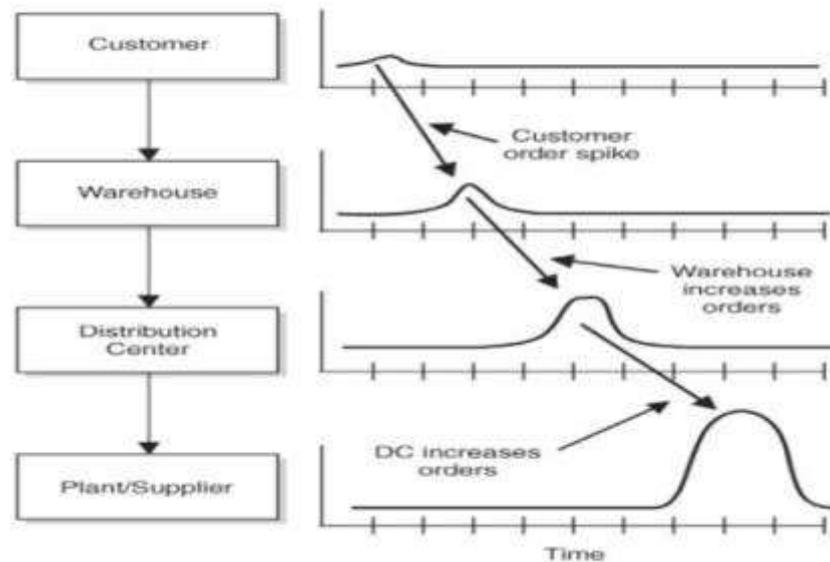


Also, complicating any forecasting model, there might be trends, seasonality and cycles beside the normal white noise of the average value of the demand over time.



As seen in the picture, the demand is not stable over time and so the demand planners need to adjust their forecasts to the actual progression of client's requests. But these adjustments will have a non-linear impact on the forecasts in warehouses and suppliers producing amplified fluctuations in the forecasts since a slight increase in the consumption of the final-user due to random variability could be read as a growth trend by the producing plant and the suppliers because of delays and amplifications in communication along the supply chain.

BULLWHIP EFFECT ILLUSTRATED



And this is just considering the average level of demand. If we sum the impact also on the confidence bands of the forecasts, a service or product provider will want to make sure that he can meet the demand, so will increase the band giving less meaningfulness to the forecast and higher uncertainty. In particular, it has been demonstrated that

Also, we need to think that the parties upstream in the supply chain will have to hold a safety stock to respond to the changes in demand of their clients. Therefore, the more the changes become larger, the larger the safety stock will be, increasing the holding cost of materials.

Considering these factors, it becomes crucial to have the most accurate possible forecast timely to be able to reduce the total cost of stock, taking into account both holding cost and shortage cost.

At the origin of this bullwhip effect, we need to remember that the objective and main cause of the fluctuation is the aim of minimizing the shortage cost for a firm.

A way to counteract the bullwhip effect is to build a supply chain based on the finished good user demand with a pure pull system. An example of a pure pull system would be a Kanban scheduling system of lean and just in time manufacturing where each client order is associated with a “card” which is pulled back in the supply chain to generate an order to refill the happened consumption.

Another potential mitigator to the bullwhip effect could be the use of a stock managing policy based on the look back methodology, where we look at the historical consumption to determine the reorder level, the optimum level of stock to maintain after the receipt of an order.

This methodology is generally used for those materials with a fairly continuous consumption and high proportion in the total consumption but have relatively low consumption value, so it is not cost-effective to implement tight inventory controls. To identify this type of materials it is required an ABC analysis.

Therefore, with the described stock management policy for this kind of materials (class C materials for the ABC analysis), we would not be much interested in the actual projection of the demand in the future, but we would rather look at the level of stock in the warehouse and the past consumption. Every predefined time frame, for example a month, an order will be placed to the supplier to restore the optimum level of stock (the reorder level).

The reorder level should minimize the hazard of out of stock situation and should guarantee availability of the material also during the supplier lead time, so until the placed order is received in the warehouse. Therefore, a proper reorder level (**RL**) in a Δt time could be calculated as:

$$RL = (\bar{x} + 3\sigma_x) \cdot (\Delta t + \bar{s} + 3\sigma_s)$$

where

- \bar{x} , average daily consumption during the time Δt ;
- σ_x , standard deviation of the consumption in the time frame Δt ;
- Δt , number of days between two orders to the supplier;
- \bar{s} , average lead time of the supplier in days to deliver the order;
- σ_s , standard deviation of the lead time.

The **RL** then takes into account the maximum consumption ($\bar{x} + 3\sigma_x$) that we will face on a daily basis with a probability of 99,73%, assuming the consumption follows a Normal distribution. This value is multiplied by the two figures of time. The first is the number of days between two orders Δt and the second is the maximum lead time for the supplier ($\bar{s} + 3\sigma_s$) with a probability of 95%, assuming the variable is Normally distributed.

In actual fact, this stock management system would still have to be compared against the forecasted projections of the demand to ensure proper reaction in case of extraordinary changes in requirements and, as a matter of fact, the planners will have to recalculate every time the volume needed (D) to reach the reorder level.

$$D = RL - S$$

where

- S stands for the stock held at the time of reordering Δt .

However, this policy of stock management would reduce the chase of the supplying scheduling against forecasts and actual consumption, allowing more margin for error in overstock, which will not be a problem in the end since the class C material is normally consumed on a daily basis.

3 The goal: Manage the stock at the right levels (KPIs)

The yearly objective set by the management team was to control the expenses related to the green coffee beans stowing and reduce the total number of days in the warehouse for the zone EMENA to 70 days maximum. It means that comparing the total stock for the zone against the aggregated demand for coffee, the warehouses should guarantee a maximum of 70 days of stock available.

The goal was set to 70 days by the end of the year to retake control of the overstocked warehouses where the passage from a VMI system to the FOB incoterm had determined a huge increase of raw materials up to more than 120 days of cover, fearing the new stock management mechanisms. Now, with the brand-new logistics team in Barcelona, it was clear that the stock levels could be controlled and reduced from the critical situation.

Nevertheless, the figure of 70 days was an end of the year aggregated target. As a matter of facts, the targets were set to 80 and 75 days for the second and the third quarters of the year, thus creating a progressive KPI to follow. Moreover, the alignment to 70 days was only meaning on average. There are, in fact, some materials that carry some criticalities in origin and availability.

For example, all certified coffees have low availability around the world since the certification is not a constant specification for the coffee plants' clients and the suppliers prefer saving some money and avoid bureaucracy having a more common coffee, unless explicitly required.

Beside these types of coffees, some origin countries struggle with plantation technologies and infrastructures to transport the crops from the field to a port for exporting. For instance, the poor level of development of Ethiopia limits significantly the amount of coffee that can be exported and the dirt country roads do not guarantee a fast transportation on trucks. Also, whenever a heavy rain or bad weather conditions happen, the communications with the coast get compromised or completely blocked.

For all these reasons, and many more, it is sometimes necessary to keep even more than 70 days of stock for those materials that carry criticalities. But, on the other side, it will be essential to reduce other stock volumes to ensure the 70 days average is achieved.

3.1 Initial situation (SAP + Excel tool)

At my arrival in Barcelona, the stock management for a factory was done mixing data coming from the SAP database and the Stock Cover file, an Excel tool for control and analysis.

Basically, a logistic planner of the Barcelona HUB had to retrieve data on demand forecasts, stock situation and Purchase Orders from a module in SAP called MACC. This module was built from the IT team in Nestlé (the GLOBE team) to manage stock and financial performances in an accounting and law compliant way.

Once the data was download from SAP for a factory, they could be used as input values in the Stock Cover file to analyse the days of stock available and the orders to be planned.

3.1.1 Stock Cover File

The Stock Cover File is a powerful tool of analysis developed in Excel to cross information coming from the SAP database and have a view on the stock cover for each factory in EMENA. There is a single stock cover file for each factory which is updated every week with the most recent information about raw materials movements.

A first version of the file had already been developed by the financial controller in Switzerland using basic Excel functions. The input data downloaded from SAP by the responsible of the factory were the “Daily Future Requirements”, the “Stock Situation”, the “Shopping Basket’s Purchase Orders created” and the “Current Shopping Basket”.

The Daily Future Requirements is a tabular version of the MRP showing some general information like plant number and material code as well as the information about the day forecasted for the consumption of the material and the quantity to be consumed. This report has generally a one-year horizon from the date it is downloaded from SAP.

Plant	Material	Material Description	MRP Controll	Prod. stor. locatid	Safety Stoc	Days	Stock Cover	BU	Requirement	Receipts	Closing Stock	Week	Month
1092	40400003	Coffee Green Class 1.0 KE MH-ARO MH-WIN	026	0001	0,000	24/05/2018	51	KG	0	0	42.648	2018.21	2018.05
1092	40400003	Coffee Green Class 1.0 KE MH-ARO MH-WIN	026	0001	0,000	25/05/2018	50	KG	0	0	42.648	2018.21	2018.05

The Stock Situation is a report showing in which storage location the material is located at the moment of the report generation. For each factory there can be three storage locations as showed in the picture below: factory storage (0001), 3PL (0005) and in-transit (0006). The factory in Tutbury (UK) had also a fourth code (0003) indicating a second 3PL for extra storage of material.

Material	Plant	Storage Locati	DF stor. loc. lev	Batch	Base Unit of Measu	Unrestricted	Stock Segme	Curren	Value Unrestricté	Transit and Trans
43200433	1092	0001		8138109201	KG	35		GBP	87,77	0
43200433	1092	0005		8140109203	KG	78		GBP	195,60	0
43200433	1092	0006		8142109206	KG	26.214		GBP	65.736,23	0

The third input data is the Shopping Basket’s Purchase Orders created. In here we can find the Purchase Orders that have already been created in SAP with the delivery date and the quantity to be delivered. This information will be compared with the one of the Shopping Basket submitted by the Commodities Team to show if all the material has been purchased.

Material	Material Description	Purchasing Docume	Bill of lading	Delivery de	Header Incoterms	Created on
43733047	Coff Grn Class 4.2 Pf BR Scr 17 Sust 4C	9500005745	SPOT NOVEMBER 17 MERCON	09/01/2018	FOB	25/10/2017
43396004	Coffee Green Class 4.1 BR LM-S/S Sust 4C	9500004035	OLAM DELIVERY JAN18	17/01/2018	FOB	25/09/2017

The last input data, the Current Shopping Basket tab, is a report that shows the quantities to be purchased for each material code in each month. It is important to underline that the meaningfulness of this report is to be considered from 4-5 months onwards. It is indeed very difficult to estimate exactly the quantities to be purchased with a longer time horizon because of the volatility of some markets.

Reporting Year	Reportin g Month	CM: Forecast Year	CM: Market CoCd	Plant	Material	Day	Delivery Period	Forecast Vol Jan	Forecast Vol Feb	Forecast Vol Mar
2018	4	2018	GB11	1092	40607771	1	From 01 To 31	304.320	314.640	160.000
2018	4	2018	GB11	1092	43733047	1	From 01 To 31	64.800	1-	1-

Finally, the “Stock Cover Calculation” crossing all the information has this look:

Storage Locati	Transport time (week)	Min Stock Cover	Max Stock Cover	Material	Material description	Measure	2018.21	2018.22	2018.23	2018.24
				43200433	Coffee Green Class 1.2 Sust 4C	Requirements	156.000	26.000	-	233.600
				43200433	Coffee Green Class 1.2 Sust 4C	Receipts in 3PL (shipments)	-	84.000	-	402.600
				43200433	Coffee Green Class 1.2 Sust 4C	Receipts in 3PL (Shopping Basket)	-	-	-	-
				43200433	Coffee Green Class 1.2 Sust 4C	Manual Adjustment (in 3PL)	76.890	-	-	-
				43200433	Coffee Green Class 1.2 Sust 4C	Receipts in 3PL (total)	76.890	84.000	-	402.600
				43200433	Coffee Green Class 1.2 Sust 4C	Receipt In Transit	80.490	-	-	-
0001	5			43200433	Coffee Green Class 1.2 Sust 4C	Stock end week (factory)	65.132	65.132	65.132	65.132
0005	0003			43200433	Coffee Green Class 1.2 Sust 4C	Stock end week (3PL)	128.978	186.978	186.978	355.978
0006				43200433	Coffee Green Class 1.2 Sust 4C	Stock end week (In-Transit)	675.840	591.840	591.840	189.240
				43200433	Coffee Green Class 1.2 Sust 4C	Total Stock end week	869.950	843.950	843.950	610.350
				43200433	Coffee Green Class 1.2 Sust 4C	Stock cover (weeks)	12	11	10	9
				43200433	Coffee Green Class 1.2 Sust 4C	Stock Cover days (Total)	82	75	68	61
				43200433	Coffee Green Class 1.2 Sust 4C	Stock Cover days (3PL)	12	17	15	36
				43200433	Coffee Green Class 1.2 Sust 4C	Stock Cover days (In-Transit)	64	53	48	19

In the picture above is showed an example for one material reference. It is clear here the scheme of the MRP table where we have the “Requirements” row representing the consumption at 3PL, the “Receipts” rows indicating the scheduled orders, the “Stock end week” rows showing the stock situation at the end of the week as a result of:

$$\text{Total_Stock_end_week}_t = \text{Total_Stock_end_week}_{t-1} + \text{Receipts_in_3PL_total}_t + \text{Receipts_in-transit}_t - \text{Requirements}_t$$

The split in the Stock end week rows allows to maintain a visibility on the different storage locations where the raw material is stowed. The “Stock Cover day” rows, instead, calculate how many days the current stock situation can supply the requirements ahead without considering future receipts.

A limit of this version of the report is the assumption that the stock end week (factory) is considered constant along the time. It was a constraint due to two facts: there was no visibility on the real consumption in factory (the requirements show only consumption at 3PL) and the stock at the factory is intended to be untouched so to have the assurance to always have material available in the factory and guarantee a high service level to the production. It is clear that this is a relevant limit in the stock

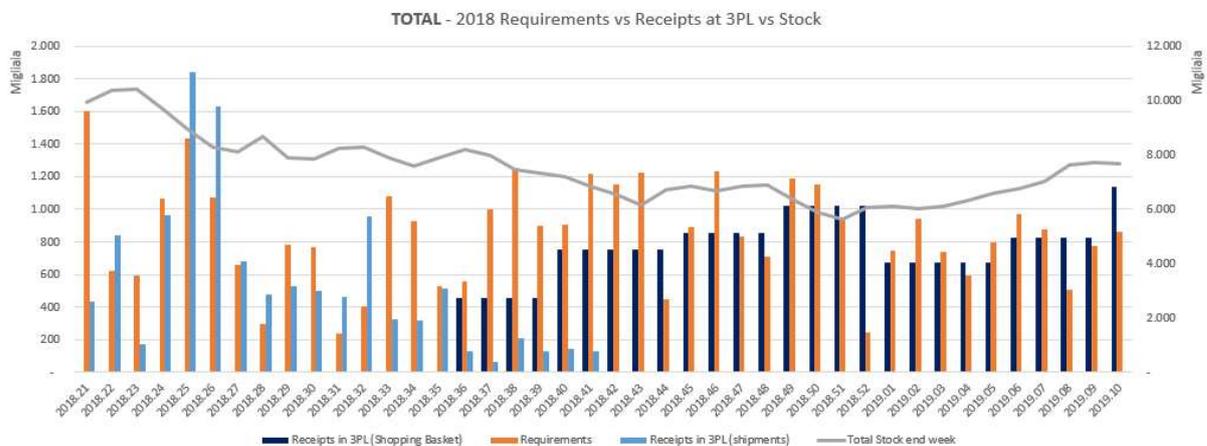
analysis in particular in the calculation of the Total Stock end week both in quantity and days because if the factory is overstocked at the moment of the report generation, it will remain overstocked for all the report horizon without following the real fluctuation of the stock.

Another tab in the Stock Cover file is the “Stock Cover calculation no Shopping Basket”. This tab has the same layout as the Stock Cover calculation tab. However, the former has the “Receipts in 3PL (Shopping Basket)” row empty since it does not consider any quantity that has no Purchase Order already created in SAP. This distinction allows to take out of the equation the potential quantities to be still purchased that might have problems in contracts or shipments and so have delays in arrival. We could say this shows a situation closer to the real one.

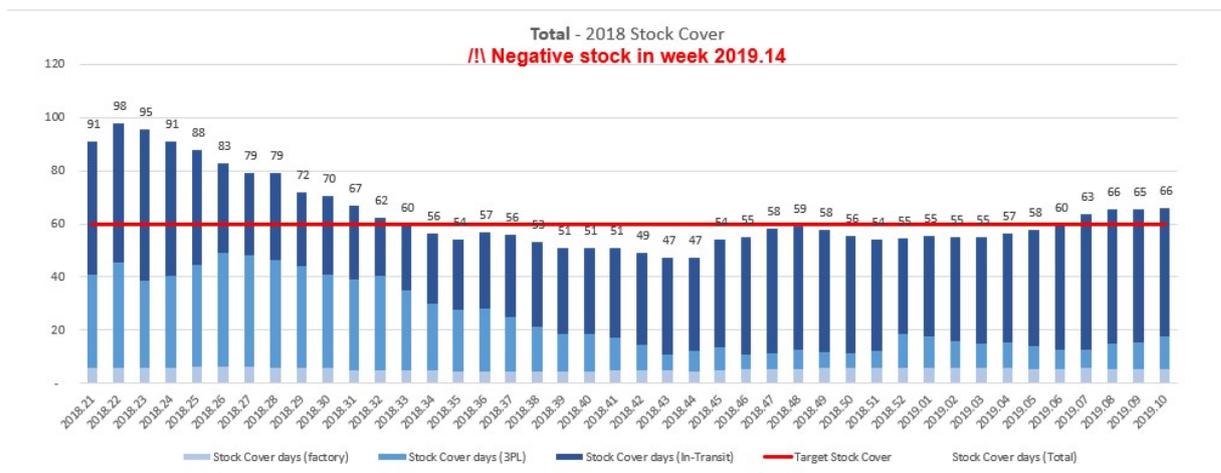
Material	Material description	Measure	2018.23	2018.24	2018.25	2018.26	2018.27	2018.28	2018.29
43200433	Coffee Green Class 1.2 Sust 4C	Requirements	-	233.600	130.000	78.000	26.000	26.000	52.000
43200433	Coffee Green Class 1.2 Sust 4C	Receipts in 3PL (shipments)	-	402.600	-	189.240	-	-	-
43200433	Coffee Green Class 1.2 Sust 4C	Receipts in 3PL (Shopping Basket)	-	-	-	-	-	-	-
43200433	Coffee Green Class 1.2 Sust 4C	Manual Adjustment (in 3PL)	-	-	-	-	-	-	-
43200433	Coffee Green Class 1.2 Sust 4C	Receipts in 3PL (total)	-	402.600	-	189.240	-	-	-
43200433	Coffee Green Class 1.2 Sust 4C	Receipt In Transit	-	-	-	357.000	210.000	-	-
43200433	Coffee Green Class 1.2 Sust 4C	Stock end week (factory)	65.132	65.132	65.132	65.132	65.132	65.132	65.132
43200433	Coffee Green Class 1.2 Sust 4C	Stock end week (3PL)	186.978	355.978	225.978	337.218	311.218	285.218	233.218
43200433	Coffee Green Class 1.2 Sust 4C	Stock end week (In-Transit)	591.840	189.240	189.240	357.000	567.000	567.000	567.000
43200433	Coffee Green Class 1.2 Sust 4C	Total Stock end week	843.950	610.350	480.350	759.350	943.350	917.350	865.350
43200433	Coffee Green Class 1.2 Sust 4C	Stock cover (weeks)	10	9	8	11	12	11	10
43200433	Coffee Green Class 1.2 Sust 4C	Stock Cover days (Total)	68	61	54	80	82	75	68
43200433	Coffee Green Class 1.2 Sust 4C	Stock Cover days (3PL)	6	38	31	45	38	31	24
43200433	Coffee Green Class 1.2 Sust 4C	Stock Cover days (In-Transit)	45	12	28	46	55	55	53

The graphical part of the Stock Cover file is contained in the “Graphs” tab where there is a resume of Requirements, Receipts and Total stock end week both in quantities (MT) and in days. Moreover, the report shows a focus of the same data but only for the 3PL side, excluding transit and factory stocks, since the actual service provided by the Commodities Team is intended to keep material available at 3PL to be moved to the factory for consumption.

Graphs showing the aggregated situation:

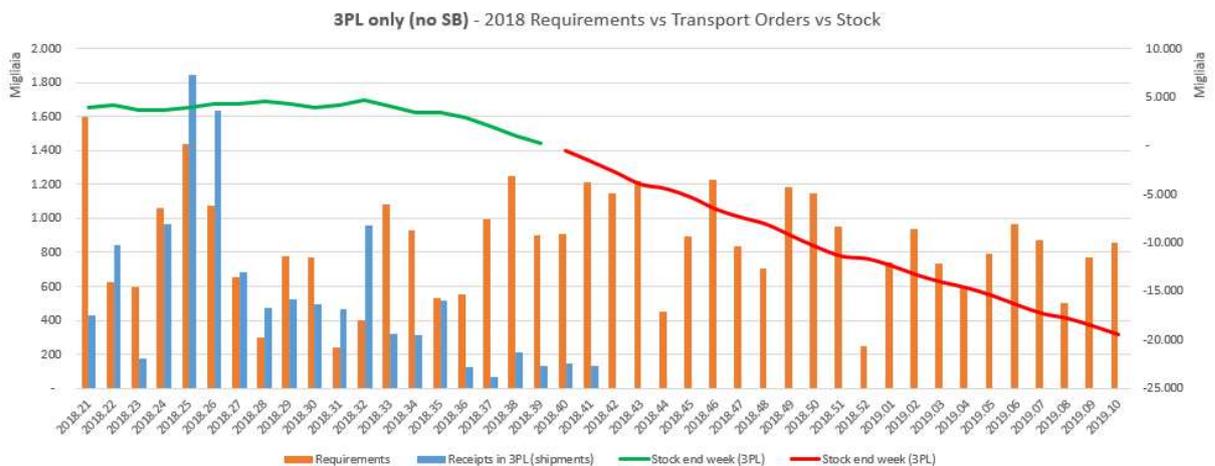


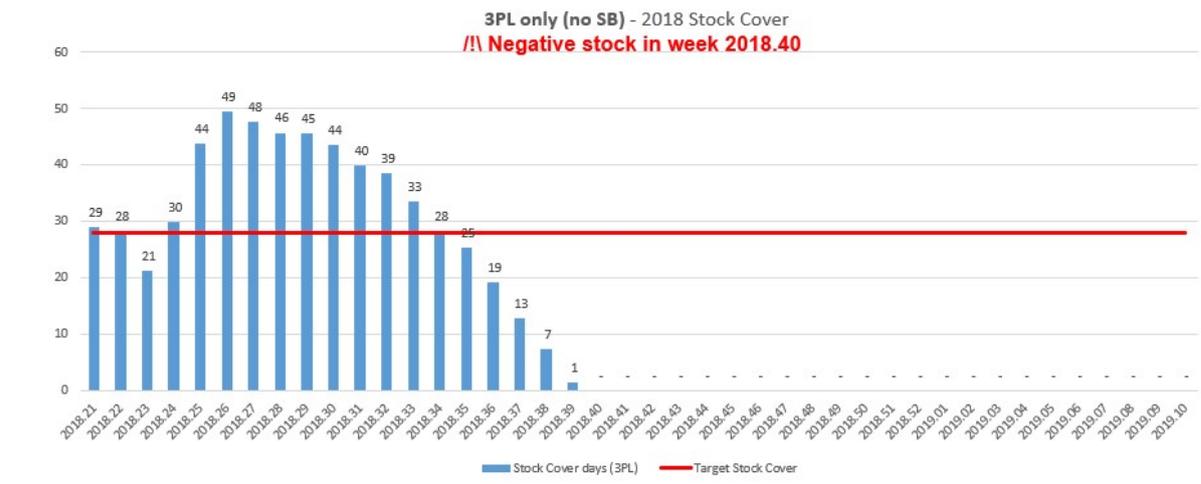
This graph immediately gives an overview on the proportion between requirements (orange bars) and receipts (blue bars). With a qualitative analysis, it is possible to have quickly see if the receipts are going to be enough to satisfy the demand planned in the weeks. For example, if we see many blue bars much higher than the orange ones, we could already affirm that the ordered scheduled for the supply are going to generate an overstock in the factory, thus we will have to potentially reduce future purchases to rebalance the equilibrium in stock cover. However, it is always required a further quantitative analysis to clearly understand which are the critical materials and how it is possible to reschedule/modify quantities throughout time.



The red line is showing the target in days that should not be overtaken by the total stock cover of all materials by the end of the year 2018, in this case 60 days. The columns, instead, are divided in days of coverage by storage location (in-transit, 3PL and plant).

Graphs showing the stock situation in 3PL only:





3.1.2 PIPELINE

The Pipeline is an excel file manually filled which had a previous application to the introduction of the Stock cover file and the use of the SAP module MACC for the managing of procurement processes.

Each factory could have a personalized version of the file where, with a 8-10 weeks horizon the factory was providing the information of weekly consumption of raw materials while the logistics planner was asking the 3PL the updated information about the current stock situation and then enclosing the information about containers shipped in the file, adding a line for those quantities in transit for each material code.

Apart from this considerably large manual work, the logistics planner had then to tint manually the cells corresponding to the weeks of production covered by the stock available and the shipments in inbound. Also, every shipment had to be updated with the estimated time of arrival retrieved either from the shipping line or Kuehne Nagel and write a note in the cell with the date of arrival and the Purchase Order number.

The Pipeline tool was used mainly to check if the material on hand and the one already shipped could be enough to meet the demand of the factory, excluding any projections of Purchase Orders still not shipped but planned.

It represents a useful tool for controlling purposes at an operational level, but it was highly subject to human errors since all data was put manually in the file and not coming from a centralized database system as SAP and the process of building and updating the file was extremely time consuming. But still, some planners where adopting this solution beside the Stock Cover file in the communication with the factory for a double check of the stock level scenarios.

3.2 Targets vs Variability

Nestlé S.A. management was aware of the increase in stock levels determined by the passage from VMI to FOB incoterms. To properly respond to this increase and in order to limit the Work in Progress and the Working Capital along the supply chain, the board of directors in Vevey established a target stock cover of 70 days maximum at the end of the year 2018, to be further lowered in 2019 with the final objective of transforming the Nestlé supply chain for coffee in a Just in Time flow.

3.2.1 Just in Time

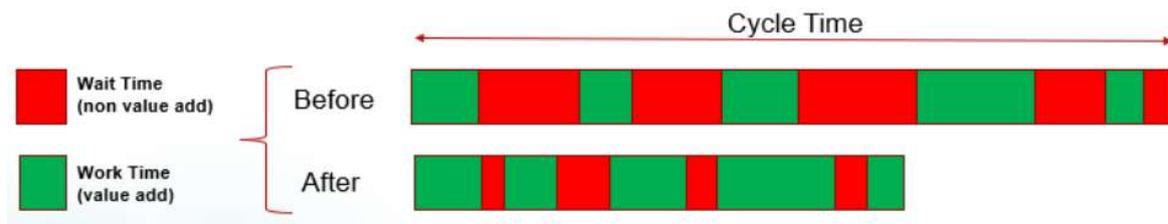
Just in Time is a stock management policy that aims to improve operations and manufacturing processes. Its principles can be summarized with the sentence “do more with less”. In fact, JIT aims to produce only what is required when it is required, thus implementing a “pull” system philosophy.

The process that better suits the JIT policy is indeed the Make to Order (MTO) process where goods are processed and assembled only when an order takes place, so we know there will be a client taking this order and emptying our warehouse. In contrast with this process, we can identify the Make to Stock (MTS), where the production’s aim is to fill the warehouse independently from the client’s demand, since the client of the process is the warehouse itself. The MTS process does not fit the JIT policy and tends easily to produce overstocks and inefficiencies along the production.

JIT, instead, has the objective to reduce inefficiencies by lightening the stock of raw and semi-finished goods. The main advantage for a company that applies JIT is a substantial reduction in stowing, handling and stock management costs.

Another benefit of this strategy, apart from reducing stock volumes in the warehouse, is to optimize the efficiency ratio (*Eff*) of value-added activities (*VA*) time and total processing time (*TP*).

$$Eff = \frac{VA}{TP}$$



So, it is clear that the goal of Nestlé’s management with JIT was to build a pull system with a balanced and continuous flow of materials coming from the origin countries.

Nevertheless, JIT requires a strong trust and stability relationship with the suppliers because deliveries and lead time cannot suffer delays since every good in JIT becomes critical in quality, volume and time.

3.2.2 Variability

However, against the objectives set by the management there is another force playing in an opposite game which is the variability, the worse enemy of supply chain and logistics.

In the Commodities Logistics HUB in particular, I was registering and monitoring two main sources of variability: the variability associated with the MRP and the one associated with the shipments.

The former is generally linked to the volatility of the final markets who were asking changes in the quantity to be delivered on a monthly basis. Beside this, the DSP (Demand Supply Planner) of the factory was trying to balance the requests of the Production Manager pushing for an increase in the OEE (Overall Equipment Effectiveness) by keeping the productivity high. Therefore, every cut in the production of the material 'A' determined by a decrease in sales forecasts was often compensated by an increase in the production of material 'B', for example advancing its production. This could be easily managed by the supply chain management if the materials used in the factory are few, but it becomes a nightmare when a factory manipulates over 35 raw materials in different blend combinations. Yet, the major problem was represented by the lack of communication between the factory and the point of contact in the Barcelona HUB. In fact, the DSP was not informing HUB about any changes in the MRP and this was causing emergencies in overstock/understock every week the Stock Cover file was being updated with the new MRP forecasts. The fluctuations were not clear in the graphs associated with the analysis of stock cover since such graphs only showed the current situation of the MRP vs stock without any comparison with the previous week. This missed visibility will be solved with the Excel analysis I developed for MRA and demand variation analysis, described later in this document.

The variability associated with the shipments, instead, was less detectable since there was no way to track the actual shipment time of each shipping line neither the data associated with delays in shipment bookings.

The stowing of the information associated with the shipments was split between Nestlé and K&N. From the Nestlé side, the team had to create the schedule lines concatenating the PO number from the Supplier to Nestrade, the SO (Sale Order) number from Nestlé to Nestrade, the PO number from Nestlé to the Supplier and the incremental number for the shipment associated to the PO (for example if there was a split in the shipment of the PO throughout the month of shipment). These schedule lines were used to define and communicate to the supplier the fortnight of shipment for the PO. So, the supplier had to book a shipment with K&N for the corresponding period

since K&N was managing the allocation of containers and spaces with the shipping line by taking the information contracted by the Nestlé Logistics Team in Vevey with the shipping lines themselves. In order to properly negotiate this space allocation, the Nestlé Logistics Team used some forecasts coming from the MRP which has now been substituted by the report I built of Shipment Allocation that gives an exact visibility on the number of containers for each route with a weekly time frame and one-year horizon.

While the booking normally lasts from 3 to 4 days, the shipment may happen at any time within the shipment fortnight indicated in the schedule line.

The process of definition the schedule line started from the calculation of the needs coming from the Stock Cover Calculation file where it is showed when the material is needed. From this information, the Planners in the Commodities Team in Barcelona had to rest the theoretical transit time from the origin country to obtain the shipment fortnight in the schedule lines. Once created the schedule lines in SAP, it was automatically created the Estimated Time of Arrival (ETA) and the Estimated Time of Shipment (ETS). This information, sent to K&N, allowed to calculate also the Estimated Time of Booking (ETB) in order to keep a control on the suppliers' booking activity.

Once the supplier had received the schedule line and had started the quality approval process, K&N had the responsibility to keep up to date all the ETB, ETS and ETA to allow a complete check on the shipper performance. However, each update of these data in the SAP system for Nestlé also meant an update in the K&N database where the same information was stored. At the end of the process, there was a loss of the initial information thus missing the chance of having a proper statistic on shipment performance (delays vs on time). The only information that could be extracted from the data available was a rough statistic on the transit times for the shippers.

Due to this flaw in the system, it was required to organize a GSTD (Go See Think Do) on the whole problem. Therefore, the two most experienced members in the team and I started the analysis of Nestlé SAP and process flow. After a couple of sessions, we convened to use a text field called "Reference" in SAP associated with each schedule line that was being used to record the Bill of Lading when the PO was shipped. In this field we defined a standard way to save the first ETS followed by the Bill of Lading information. Then, we started testing this solution with two markets (France and Switzerland). After the first week of testing, I started a phase of "testing" to check the data was properly entered in the system so to extend the system to all the factories. Unfortunately, I detected that the field "Reference" was impacting on the ETA which apparently assumed the same value written in the field Reference. A first conclusion was that the field reference could not be used when filled with a time type data but could have still be used to save the Bill of Lading. This forced us to look for a solution in the K&N system, since there were no other fields usable for our scope and there was no possibility to add a field for the schedule line by the IT team, involved fully in another transformation project.

The first step was to organize the first of a long series of meetings with the K&N IT and Business Intelligence teams to explain our issues and potentially solve the problem with some coding in the K&N platform to automatically store the data. Regrettably, the processes from the K&N side were not that easy and, despite my proposal of using a specific query in SQL when updating the database, the K&N team wanted to work for another solution and tried to take more time to study and develop it.

In the meantime, we tried to still build the report and still use the “Reference” field, but inserting some text characters before the date, so that the field wouldn’t be recognised as data-type. In order to properly build the report, I had to use a formula in Excel to extract solely the information needed and format it as date. The report was so built in the final period of my internship and there was no time to gather a good amount of data to shape a deep analysis on shipments’ variability with the calculation of variance and mean for each shipment route.

3.3 Limits of the current system

In the system used by Nestlé for the coffee supply chain we can identify a series of limits linked both to the process flow and the tools used to schedule. Moreover, other limits were represented by variability and uncertainty of the demand forecasts provided from the local markets.

3.3.1 *The Frozen Period*

To compensate the overstock or the understock generated by the sources of variability mentioned in the previous paragraph, Nestrade had planned two solutions to move raw material, one internal and one external. Moreover, we need to bear in mind that Nestlé is adopting a three-months of “frozen period” policy to be able to implement the FOB incoterm. In fact, the time needed for the supplier to pass the sample approval, book a vessel and move the coffee into EMENA takes approximately a lapse of time of three months, considering also the creation of contracts and POs. During this frozen period, it should not be possible to change the requirements in the factory since there would not be enough time to react to the demand.

Furthermore, the procurement of raw material was done on a monthly basis for all materials types. It means that the reordering of materials could take place only once per month. The rest of the time, the Logistics HUB could only, theoretically, monitor the stock situation without asking for new contract creation and coffee deliveries. This policy overall is indeed reducing the flexibility for the factories; therefore, Nestlé is using Spot Purchases and Interfactory movements to enhance the elasticity in the system.

3.3.2 Spot purchases

The Spot purchases are purchases of raw material that are made with FCA incoterms, instead of FOB. Normally, the purchase happens on the European Union soil from another trading company based in Switzerland or Denmark who either had already the coffee physically in a warehouse or had bought some coffee titles on the trading market of London or New York and, therefore, could sold the position to Nestrade. This kind of purchase is always more expensive than the normal process of buying in FOB since a premium must be paid to the seller for the urgency of the coffee need and for the management of the transportation.

3.3.3 Interfactory movements

These movements are considered internal movements within the company of Nestlé since both vendor and buyer are represented by Nestlé local markets. These movements are, again, managed by the Nestrade Logistic HUB in Barcelona who has the visibility over the total stock cover and the requirements of the factories. Normally, an Interfactory movement take place either because a factory has an imminent need in materials for production or because a factory is extensively overstocked and needs to lower its storage to achieve the target set by the EMENA zone. In both cases, the best practice is that the receiving factory pays for the transportation to the sending factory. In fact, the overstocked factory had paid the FOB condition to the supplier while the receiving factory is going to pay FCA incoterms for carrier transportation on roadways.

3.3.4 Limits of the Stock Cover file

Apart from the limits dictated by the long frozen period needed to implement the FOB system, there were many limits in the Excel tool built on the data coming from SAP. In fact, the Excel tool showing the MRP structure used to calculate the stock cover was relying on many assumptions and basic formulas and graphs that could be easily misinterpreted by the logistics planner and the factory representatives. For example, an assumption used to build the file was that the stock hold in the factory was considered constant for the whole horizon of the report. Hence, the volume of the stock would be fixed at a certain value when downloading the data from SAP and would so influence positively or not the total cover in the supply chain pipeline (factory + 3PL + in-transit). Moreover, the report would not show visibility on actual changes in the stock. So, the team would never know if the factory is actually having stock problems or not in the future.

Other limits of the system linked to the MRP in Excel were that there were continuous changes in the MRP forecasts on a weekly basis because of production changes, blend changes, etc.

All these changes could not be detected in the Excel tool because the data used for building the report were a constant set of data coming from SAP on Thursday. So, all the adjustments done after Thursday on the MRP were visible in the report only the week later, reducing consistently the reactivity of the Logistics team to the changes.

Not only the data would be fixed to a constant value, but also there was no mean to control variations in the MRP and compare two sets of data to observe gaps since once the MRP was updated in SAP, the previous version was erased leaving no historical archive for further studies and analysis.

Thus, we could affirm that the Logistics team was missing two key factors to build a well-structured control on stock: visibility on the real stock situation and a live update and easy view on the report.

4 The potential solution: MRA

4.1 Gathering data

In order to monitor the accuracy of the forecasting methods of the local markets, I performed an action of collecting data from SAP. The aims of building the Master Requirement Accuracy were mainly two: to build knowledge on demand planning variations causing shortages/overstocks and to be aware of potential changes that might affect future requirements.

The problem was that the factories around the EMENA zone were claiming a bad stock planning from the HUB because of the high occurrence of shortages and overstocks.

An overstock was generated when the total stock cover in days exceeded the target set for the factory by the zone. The target itself, measured in days, was a function of the total future demand in volume (MT) against the total stock cover in volume (MT) for a specific factory. Therefore, it measures how many days the factory could run without any further supply. However, the total stock cover in volume was the result of the sum of stock available in the factory, stock available at 3PL and stock in transit.

It's clear then that there is a distortion in the concept of total stock "cover" since this measure just shows a potential autonomy of the factory, in terms of raw materials. Indeed, the stock in transit was not immediately available for the consumption in the factory. It rather had a transit time required for the transportation from the origin country to the destination port in Europe. During this whole period of time, the coffee counted in the days of cover of the factory but was actually on the sea. Beside this misinterpretation of the numbers, the calculations were not taking into consideration the potential delays in shipment and travel of the vessel, which we will see had a critical impact in the lead time.

On the other side, the factories were aware of the actual stock available in land, so they calculated and presented in the Weekly Operational Reviews (WOR) a different scenario for the stock situation. Every week on Friday the responsible for the factory on site had a telephone conference with the responsible of the factory in the HUB. In such conference, the "Pipeline" file was discussed to highlight the shortages and potential stop in the factory's production. This was then compared with the "Stock Cover File" to add the information of the incoming shipments with new coffee. Despite this information provided to the factory, there was a constant feeling of distrust and tension for the potential break in the production flow.

A break in the production schedules would mean a fail in delivery to the end customers, and it had to be avoided whatsoever.

An instrument to control the variations in the demand and the accuracy of the requirements is the MRA, an analysis built on Excel that was used to compare the MRP against the actual consumption after three months for the same reference period, also called MRA -3 Months analysis.

The concept behind this analysis was that at the beginning of one month, January 7th for instance, the HUB in Barcelona was getting the Requirement information from the 7th onwards for all the raw materials of each factory. This forecast had to have an 18 months horizon but the tolerance on accuracy for the forecast varies depending on the time frame. For the first 4 weeks horizon, there were no changes acceptable in the Requirements, for the first 2 months horizon there was a 10% tolerance and finally on the 3 months horizon it was agreed a 20% tolerance. Wider horizons had not operational purposes and were just taken as reference for strategic decisions.

The first 3 months horizon from the Requirement forecast is called “Frozen Period” since it is the minimum lapse of time required to properly manage the FOB system along the Supply Chain for coffee.

Therefore, the forecasts done on the 7th of January referring to the Requirement for April would then be compared against the real consumption in April checking differences and increases. Now it should be clearer why the name MRA -3 Months.

The sources of the Requirement forecasted came directly from the transaction in SAP called Daily_FU, a transaction showing a picture of the future requirements at that specific moment on a daily basis.

The horizon of the forecasts included in the report were set to 18 months in order to have a rough picture on future scenarios in the production plant and also to allow the coffee buyers in the other Nestrade HUBs to lie down some contracts with suppliers in the long term, thus obtaining some discounts and a better planning for the suppliers. Furthermore, this information was a critical basis for the edging team in Vevey.

The edge team has the task of fixing long terms positions in the financial market to secure coffee contracts for physical transfer. This team had the role to buy financial options such as “futures” to fix a range with upper and lower bands where the coffee price could fluctuate but would not exceed these limits.

This is a good financial instrument to protect the company against the variability of the coffee financial market, since the bands could be contracted having the average at a weighted average of the total budget for the year, thus limiting the discrepancies between the budget forecasted and the actual spent. Moreover, this instrument let the price to be fixed at a maximum level at which the coffee would be paid independently by how much the price would increase in the financial market, so determining gains and a competitive advantage over competitors.

However, we need to consider that if the price goes down lower the bottom limit, the price paid by Nestlé to buy the coffee would still be the minimum price related to the band, which will so be higher than if Nestlé was to buy coffee at the market price.

This could represent an advantage or a disadvantage depending on the financial market changes. In any case, the company would protect itself from the uncertainty associated to the market. It is a risky task and it could mean millions of savings as millions of losses. Therefore, the edging team requires accurate and long-term information to properly analyse the situation and act a wise decision making.

Going back to the Daily_FU report, it could be done for all the factories at once, but it would rather be downloaded separately for each market since the MRA analysis was a specific report for each plant. This was mainly due to the large amount of data coming from the report and the high complexity of the Excel file.

The problem with Daily_FU transaction is that the values of the demand depend on the day when they are downloaded, and this is why everybody in the HUB in Barcelona had to be aligned to download it at the same moment to allow a proper comparison among factories. In this case it is clear the importance of historical data and how difficult it is to get and maintain this data so that they can be meaningful for the business.

To ease the download of the data, my team and I set up an automatic job routine in SAP that would download the MRP Requirements on a scheduled time for all the factories aligning so the reports for the EMENA area. Unfortunately, this action was considered as “uncompliant” from the IT department because it would have generated too many reports in the SAP system allocating memory storage and slowing down the system. Consequently, we had to go back to the manual download.

Anyhow, all the MRP reports had to be saved as historical archive. So, I developed the MRA analysis Excel spreadsheet with a logic to keep the forecasted Requirements and the week of download information in the same sheet. This database of subsequent MRPs forms the basis for the demand forecast.

Then, the demand forecast will be included in a pivot table selecting only the total monthly consumption for each reference coming from a specific forecast month. For example, the MRP downloaded during week 05 of 2018 was used to calculate the total forecasted consumption for May. While the week 09 of 2018 would be used to evaluate how much it will be consumed in the month of June.

Later, these values will be compared against the actual consumption of May and June.

Input data view:

Volume forecasted Week of consumption

Plant	Material	Material Description	Week	Day	Requirements	INPUT DATA WEEK	Demand week	Demand Month	MRA data	Input Week ordered	MRA Referen
0814	43189960	Coffee Green Class 1.1 Sust 4C	23.2018		27.000	09.2018	23.2018	2018.06	2018.06	2018.09	2018.06
0814	43189960	Coffee Green Class 1.1 Sust 4C	24.2018		286.500	09.2018	24.2018	2018.06	2018.06	2018.09	2018.06
0814	43189960	Coffee Green Class 1.1 Sust 4C	25.2018		27.000	09.2018	25.2018	2018.06	2018.06	2018.09	2018.06
0814	43189960	Coffee Green Class 1.1 Sust 4C	26.2018		199.500	09.2018	26.2018	2018.06	2018.06	2018.09	2018.06
0814	43200418	Coffee Green Class 1.1 CAmer St	23.2018		204.000	09.2018	23.2018	2018.06	2018.06	2018.09	2018.06

Forecasted on week 09 June consumption

Pivot table view:

Sum of Requirements			MRA data	INPUT DATA WEEK		
Plant	Material	Material Description	2018.01	2018.02	2018.03	2018.04
			40.2017	44.2017	49.2017	01.2018
0814	24316100	Coffee Green Class 7.2 VN				
0814	40607711	Coffee Green Class 1.1 N1				
0814	40607712	Coffee Green Class 1.2 N1				
0814	40607741	Coffee Green Class 4.1 N1				
0814	40607742	Coffee Green Class 4.2 N1				
0814	40607771	Coffee Green Class 7.1				
0814	40607772	Coffee Green Class 7.2				
0814	41162014	Coffee Green Robusta Class 7.2 BR 60kg	39.000	34.500	72.000	54.000
0814	43025569	Coffee Green Class 1.1 CAmer				
0814	43186890	Coffee Green Class 1.1 CO Sust4C	114.000	142.500	-	-
0814	43189960	Coffee Green Class 1.1 Sust 4C	400.500	199.500	565.500	268.500
0814	43200418	Coffee Green Class 1.1 CAmer Sust 4C	294.000	292.500	205.500	204.000
0814	43200433	Coffee Green Class 1.2 Sust 4C	264.000	171.000	192.000	105.000
0814	43200435	Coffee Green Class 4.1 Sust 4C	141.000	96.000	123.000	79.500
0814	43369695	Coffee Green Class 7.2 Sust 4C	1.152.000	1.255.500	1.978.500	1.329.000
0814	43418323	Coffee Green Class 7.2 VN Sustainable4C	282.000	253.500	535.500	396.000
0814	43418324	Coffee Green Class 7.1 Sustainable 4C	136.500	136.500	136.500	69.000
0814	43457959	Coffee Green Class 4.2 Sust 4C	202.500	303.000	613.500	313.500
0814	43647528	Coffee Green Class 7.2 Sust RA	-	-	180.000	-
0814	43006170	Coffee Green Class 1.1 CO				
Totale complessivo			3.025.500	2.884.500	4.602.000	2.818.500

On the other side, the consumption was a bit more complex to estimate. We tried in the first moment to take the consumption in the factory, which was all the volumes consumed in the production plan during a month.

This was not difficult to estimate since we could not use the MRP_main which was a production plan forecasted but we could rather use all the negative movements in SAP that were subtracting material volumes from the factory storage location. Though, I would have had to exclude all those movements linked to quality inspections.

But we should not be misguided by the term “consumption”.

We are actually not interested in the consumption in the factory plant since we are not interested in how much the factory is accurate in forecasting its production plans. Even though this is strictly linked to what we are seeking for, we are interested in measuring the service level at 3PL, thus the consumption and the forecast accuracy at 3PL.

In fact, the demand we are using as forecast is the one coming from the MRP, which cannot be compared against the consumption at the factory otherwise we should use the MRP_main.

This is the reason why, after the first test of building the MRA with the consumption at the factory, the numbers were showing big gaps between forecasts and consumption. This, apart from a conceptual error, was due to the fact that the factory could actually move materials from 3PL to the factory's internal warehouse, but still not consume that coffee.

This would generate requirements in 3PL but not in the factory.

Or, viceversa, the factory could consume more coffee than the volumes moved from 3PL to reduce the stock on hand.

This would generate requirements in factory but not in 3PL.

It was then clear that, to properly calculate the MRA analysis, it was required to look at the consumption happening at the third-party logistics.

5 Building the Excel against the consumption (at third party logistics)

On the other side, the consumption was a bit more complex to estimate since we had to measure the consumption at 3PL, meaning all the MT of coffee that were actually required and moved from the 3PL to the Factory, not necessarily for production.

We had to look at this kind of consumption rather than the consumption in the factory linked to the production line because the service provided by Nestrade is to have coffee available at 3PL for Factory needs, independently whether the Factory is going to use the coffee straight away in the production or the coffee is being moved just to increase the stock available at the factory for future productions.

Identifying a transaction to show this consumption in SAP was not easy. This is why I had to use the BW (Business Warehouse) section in SAP to study all the movements for each factory that might approximate better the information we wanted to see.

For this reason, I decided to pick all the movements considered as GR (Goods Receipt) at the factory since they indicate that the coffee has been actually received in the plant and so it had been surely been requested to 3PL.

This was a good approximation of the 3PL coffee demand but had to take in account all the quality movements and also some movements that moved directly the coffee from the storage location in-transit to the plant, bypassing the 3PL, and all the movements between the plants themselves (Interfactory movements) that generally did not pass through 3PL.

Furthermore, I had to exclude those quantities that were blocked and rejected at the plant for quality issues. To make this exercise I had not only to consult an SAP manual were all movements with movements explanations and purposes but I also to check with the “factories point of communication” representatives if the number resulting from my analysis were plausible. This was mainly done by summing all the quantities values in the transactions I detected as GR in the factory and comparing that sum was the estimated sum of raw material consumption that took place in the same time frame of reference (normally one week).

At the end of my analysis, I built a “mapping table” in an Excel file with the information of the factory plant code, the raw material code and description, the month of when the movement took place and the quantities moved for the transaction. With a long list of plant-movement codes combination, I was then able to put an advanced filter on the plant field to sort the movements that were useful to subsequently filter another report of all the movements of all the factories in a certain month.

The final look of the filter set for the mapping table was the one below, with the basic information that could be applied to all material codes and all months (for September in the example):

Plant code	Posting Month/Year	Movement Type
0814	09.2018	ZA1
0814	09.2018	ZA2
0814	09.2018	101
0814	09.2018	102
0289	09.2018	ZA1
0289	09.2018	ZA2
0289	09.2018	101
0289	09.2018	102
0289	09.2018	301
0289	09.2018	302
0289	09.2018	323
0289	09.2018	324
0698	09.2018	101
0698	09.2018	102
0698	09.2018	311
0698	09.2018	323
0444	09.2018	101
0444	09.2018	102
0444	09.2018	323
0012	09.2018	101
0012	09.2018	102
0012	09.2018	311
0012	09.2018	323
0012	09.2018	325
0303	09.2018	101
0303	09.2018	102
0303	09.2018	323
0298	09.2018	101

Plant code	Posting Month/Year	Movement Type
0298	09.2018	343
0298	09.2018	102
0298	09.2018	323
0298	09.2018	ZA1
7016	09.2018	101
7016	09.2018	102
7016	09.2018	301
0895	09.2018	101
0895	09.2018	102
0895	09.2018	ZA1
0895	09.2018	323
0895	09.2018	325
1092	09.2018	101
1092	09.2018	102
1092	09.2018	311
1092	09.2018	325
1092	09.2018	ZA1

After the advanced filter application, the mapping table would have this aspect:

Material code	Material	Plant code	Plant	Posting Month/Year	Storage Location code	Storage Location	Movement Type	Movement Type	Qty in BUoM	UoM
24316100	Coffee Green Class 7.2 VN	0814	FR PL DIEPPE	09.2018	0004	DIEPPE FOB Trans	101	GR goods receipt	647.950	KG
40607711	Coffee Green Class 1.1 N1	0814	FR PL DIEPPE	09.2018	0001	Mag. principal	ZA1	GR Nestle ASN	196.925	KG

In this way, I could come up with a final table for each factory reporting the raw material that was actually received in the plant within a certain month.

This information could now be compared against the forecasts done three months in advance to build the MRA. The MRA analysis is made up of “Difference”, “Absolute difference”, “BIAS %” and “MRA %” for each material code in each month for all the factories. Then, the aggregated number of the analysis elements was showed on the top line of the Excel file to give an overview on the accuracy performance in general. Also note that the cumulative value of the MRA analysis elements was calculated to control the overall trend of the factory over time.

Here it is a look of the pivot table for the consumption:

Suma de Qty in BUoM				Posting Month/Year			
Plant code	Material code	Material	UoM	01.2018	02.2018	03.2018	04.2018
0814	40607771	Coffee G KG					
0814	40607772	Coffee G KG					
0814	40607773	Coffee G KG			5419		
0814	41162014	Coffee G KG		25056	24380	34941	12803
0814	43186890	Coffee G KG			146061	55139	61699
0814	43189960	Coffee G KG		471925	494424	386774	438868
0814	43200418	Coffee G KG		221165	292279	210827	209924
0814	43200433	Coffee G KG		214870	124977	213739	220814
0814	43200435	Coffee G KG		115611	103698	130858	116516
0814	43369695	Coffee G KG		1559239	1429336	1388157	2069866
0814	43418323	Coffee G KG		438817	425516	453332	261782
0814	43418324	Coffee G KG		176889	136076	64296	126624
0814	43457959	Coffee G KG		666892	438313	443834	326406
0814	43647528	Coffee G KG				192387	
0814	40607711	Coffee G KG					
0814	40607712	Coffee G KG					
0814	40607741	Coffee G KG					
0814	40607742	Coffee G KG					
Total general				3890464	3620479	3574284	3845302

The “Difference” was a simple subtraction of:

$$Forecasts_{(M-3)} - Consumption_M = Difference_M$$

This element was useful to see whether the factory was forecasting too much or too few three months before the consumption to happen and exactly by how much (in kg) the forecasts deviated from the real needs of the factory.

On the other hand, “Absolute difference” was the absolute value of the difference calculated. This number had the purpose to show the total deviation of the forecasts from the real consumption without considering the sign of the deviation itself. In this way, positive and negative deviation were not to compensate each other in the aggregated value for the month hiding, for example, an excess in forecasts for one material code with an equal amount of value in defect for another material.

			Jan					
Plant	Material	Material Description	Demand WK 40	Consumption Jan	MRA %	Bias %	ABS Diff	Diff
0814	All SKUs	All SKUs	3.025.500	3.890.464	53%	-29%	#####	- 864.964

			Jan					
Plan	Mater	Material Description	Demand WK 40	Consumption Jan	MRA	Bias %	ABS Diff	Diff
0814	4318996C	Coffee Green Class 1.1 Sust 4C	400.500	471.925	82%	-18%	71.425	- 71.425
0814	4345795E	Coffee Green Class 4.2 Sust 4C	202.500	666.892	-129%	-229%	464.392	- 464.392
0814	43200433	Coffee Green Class 1.2 Sust 4C	264.000	214.870	81%	19%	49.130	49.130
0814	4336969E	Coffee Green Class 7.2 Sust 4C	1.152.000	1.559.239	65%	-35%	407.239	- 407.239
0814	43418323	Coffee Green Class 7.2 VN Sustainable4C	282.000	438.817	44%	-56%	156.817	- 156.817
0814	4320041E	Coffee Green Class 1.1 CAmer Sust 4C	294.000	221.165	75%	25%	72.835	72.835
0814	43418324	Coffee Green Class 7.1 Sustainable 4C	136.500	176.889	70%	-30%	40.389	- 40.389
0814	4320043E	Coffee Green Class 4.1 Sust 4C	141.000	115.611	82%	18%	25.389	25.389
0814	41162014	Coffee Green Robusta Class 7.2 BR 60kg	39.000	25.056	64%	36%	13.944	13.944

The “BIAS %” was calculated as:

$$\frac{\text{Difference}}{\text{Forecast}} = \text{Bias\%}$$

This division shows the portion of difference between consumption and volume forecasted three months before consumption as a proportion over the volume forecasted. With this figure it is possible to evaluate the deviation of the consumption in relative terms, thus allowing a first-look understanding of what is happening independently from the variations in net quantities among different months.

However, the weak point of this figure is that it just allows a flat comparison between materials that have different net requirements in the same month. For instance, let’s analyse the example below.

Material	Forecast	Consumption	Bias %
X	100	200	-50%
Y	50	100	-50%

In the above table, the material X has double the forecasts and the consumption than the material Y, thus having double the impact over the total stock situation of the plant and the supply chain. However, the Bias shows the same value in percentage relatively to the forecast. But we all understand that a Bias of 100 units for material X is going to have a different influence than a Bias of only 50 units that we had for material Y, considering the same conditions for all the other parameters (cost, time, etc).

Considering this, the Bias was used mainly to communicate to the Zone EMENA directors the trend of the factories to over-plan in production in long term. A clear case that was escalated to the Zone was the case of Orbe factory, in Switzerland, where the factory was highly influenced in the fluctuations of the finished goods demand coming from Turkish market, a big and highly volatile market where variances of small percentages could mean thousand finished products and hundreds of tons of raw materials differences.

Finally, the MRA % figure is showing the accuracy of the forecasts M-3 against the consumption at 3PL. It is calculated as the complementary value of the Bias %:

$$1 - \frac{|Difference|}{Forecast} = MRA\%$$

Which may also be seen as:

$$1 - Bias\% = MRA\%$$

We need to consider that the MRA % calculated on one single material is exactly equal to the complementary of the Bias %, however, when we consider the aggregated value of all raw materials for the factory, there might be discrepancies in this definition. In fact, the formula for the total MRA % changes in this way:

$$1 - \frac{\sum_1^n |Difference|}{\sum_1^n Forecasts} = MRA\%$$

Where 'n' is the total number of raw materials used in the factory. Consequently, we notice that the sum of the absolute value of the difference could have positive and negative elements that do not compensate each other. This makes the MRA % a stricter value than the Bias % since it measures purely by how much the forecast deviates from the consumption and not if the overall forecasts, without regarding on the specific codes, they more or less balance the consumption, as the Bias % does.

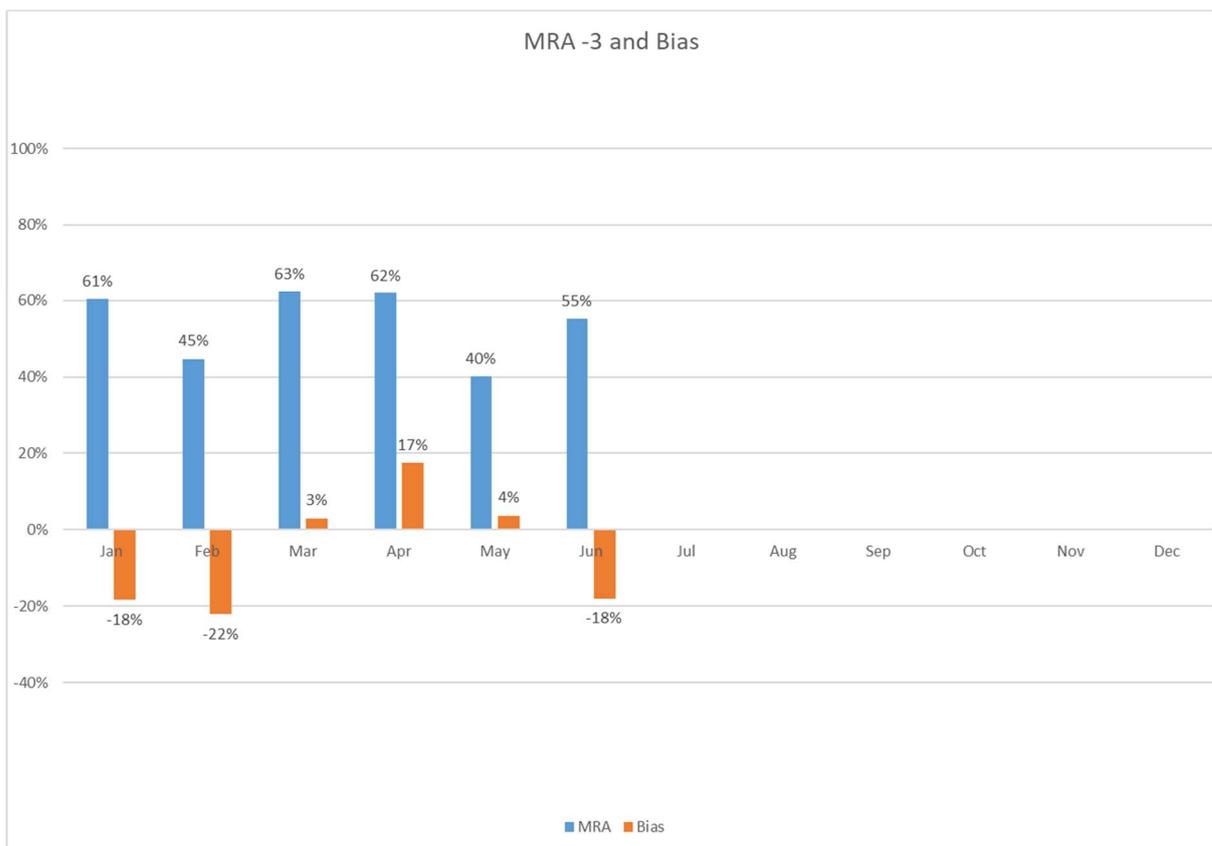
It is indeed more precise to see the deviation of each single code rather than looking at the aggregated value of the forecasts versus the total monthly consumption. In fact, the total forecasts and the total consumption could even have similar values, but it is not possible to use a different raw material code for the production of a specific material code. This means that for the overconsumed materials we are going to screen a stock out situation or a need in SPOT purchase. On the other hand, for the material under consumed we are going to face an over stock and extra cost in 3PL and in working capital blocked along the supply chain.

The values most analysed in the EMENA reports where the Bias % and the MRA %, which are the most significant figures for this analysis. While the former KPI had no specific target to reach because of its relativity and compensation of positive and negative values, the latter had the target set to 80% in total for the factory along the three months horizon between the forecasts and the consumption. This KPI means, in practical words, that the consumption should not deviate more than a $\pm 20\%$ from the original forecasted value. This target was set to let the production department able to adapt its activities to the variations on the end-user demand. On the other side, the restriction of 20% was coming from the clause in the contracts with the supplier of decreasing at maximum by 20% the volumes contracted during the frozen period without incurring in any extra cost.

In this way, also Procurement could have a certain flexibility over buying and supplying of raw materials to follow the end-user demand.

Below an example of the MRA graphs analysed by me.

Plant	Plant Name	Material	Material Description
0303	0303 PT PL Porto	All SKUs	All SKUs





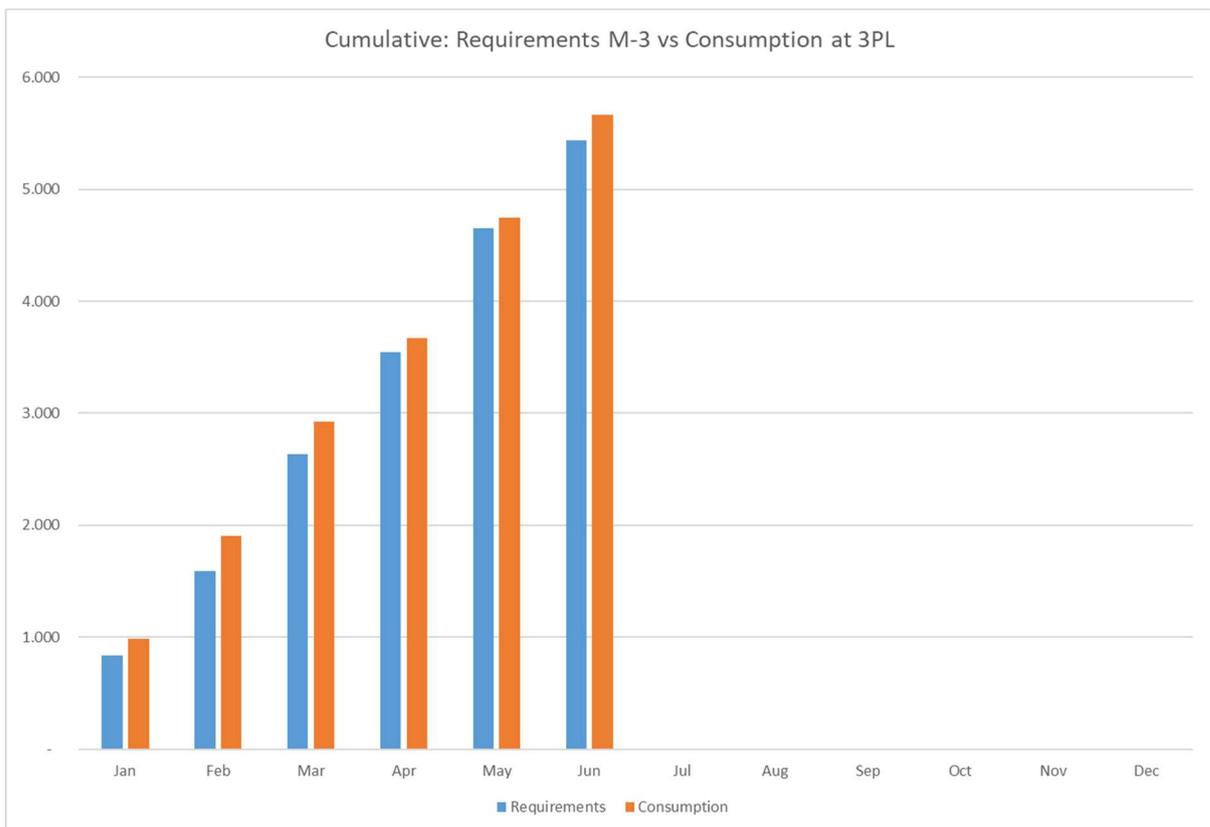
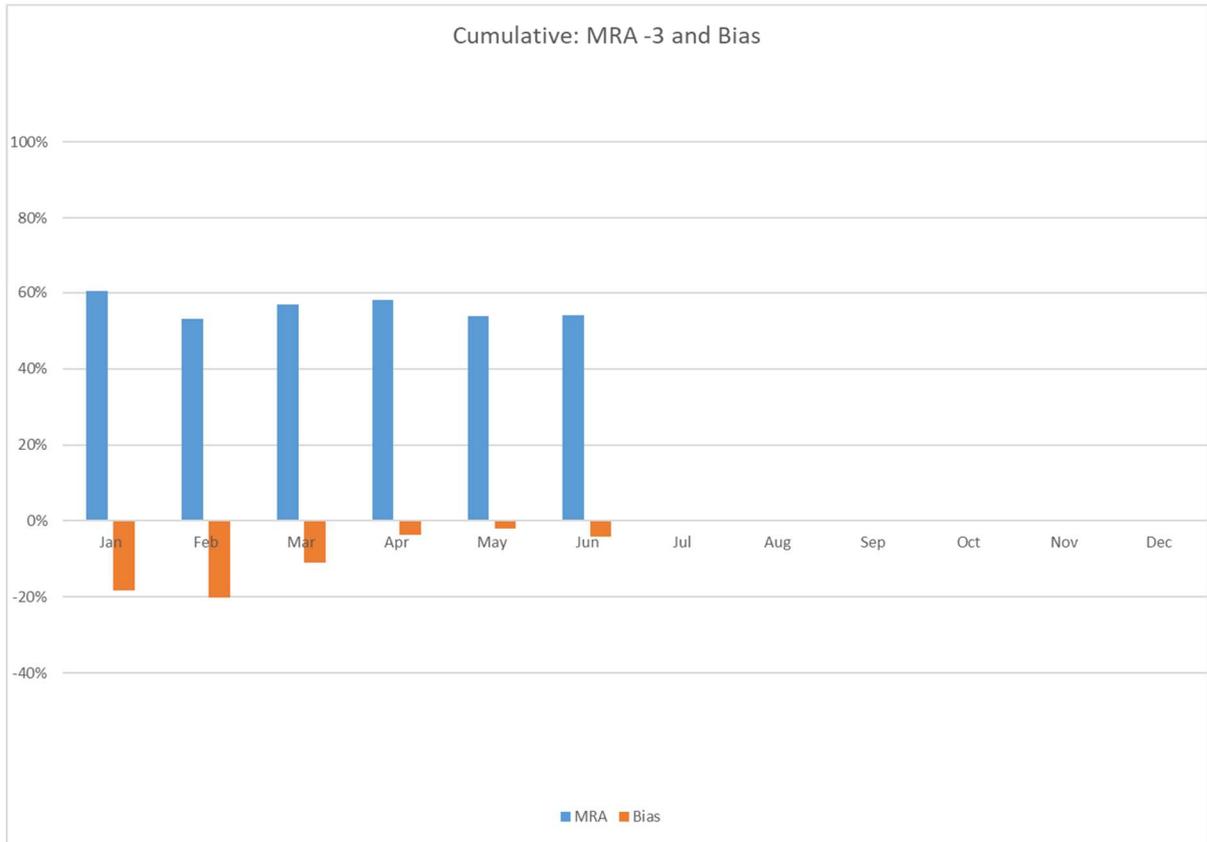
For instance, the graphs above show a 40% MRA and a 4% Bias for May. It means that the total consumption against the total forecast has almost come to a balance, in fact the Bias at 4% indicates there is just a small difference between consumption and requirements, as showed in the second graph. However, if were to analyse each material individually, we would notice that discrepancies between what was forecasted and what was actually consumed are significantly larger than what presented in the aggregated value. This consideration can be deducted from the MRA value. Such a low value (40%) should make us think that the accuracy at an individual level as been poor and the absolute difference between consumption and requirements has increased, hence increasing the numerator of the fraction in the formula and decreasing the final value of the MRA:

$$1 - \frac{|Difference|}{Forecast} = MRA\%$$

The whole analysis, in other words, was designed to guarantee a solidity within the three months frozen period on the production plans to allow the supplying of materials from origin countries while maintaining enough flexibility upstream in the coffee supply chain.

To complete the MRA analysis, we also need to talk about the MRA “cumulative” value that was introduced after the MRA analysis had begun for all the factories.

The graphs below show the cumulative MRA, BIAS, Requirements and Consumption values for Porto's factory as an aggregated view for all the materials.



Reading the two graphs above we notice a subsequent reduction in the Bias value over time, meaning that the aggregated values of requirements and consumption tend to equal each other despite the discrepancies in each single month.

Despite this trend should, in the end, bring a balance in the stock levels since the materials that are not consumed in one period are likely to be consumed in the following ones, it is not necessarily true that the stock will decrease overall and reach healthy levels. In fact, if a lack of stock is generated in the frozen period from an increase in the requirements, the logistics planner will have to compensate the gap ordering more material on extraordinary processes such as Interfactory movements. However, the following month, we could be likely to register a decrease in consumption versus the forecasted quantities to close the gap in the Bias. This would generate then an overstock situation in this period.

These fluctuations do not ease the work of the logistics planner who constantly have to chase factory needs with operations that bring extra costs compared to the standard FOB process.

This figure was mainly introduced after a particular situation detected in the Portugal coffee plant in Porto where it looked like the factory was fluctuating between a month of understock and a subsequent month of overstock in a cyclical path.

This behaviour captured the attention of my line manager and Porto's raw material planner after I reported the values and it made us all think that the factory was overall planning correctly against consumption during the year but was actually shifting the production plan from one month to another. Thus, we could say that the MRP planner in the factory had a good accuracy but only looking at a two-months horizon since the forecasts and the consumption of the two months together matched pretty closely.

This way of working was also reflecting the willing of the factory to stay within the budgeted production plan and costs forecasted at the beginning of the year. So, the factory manager had to compensate for those months which had gone under or over the budget estimations in terms of production volumes or costs.

The introduction of the cumulative value, then, allowed our team in Barcelona to report this situation to the EMENA zone and to organize a two-days mission travel to the Portugal market with the purpose of explaining the control activities implemented in Barcelona and clarifying the findings of the MRA analysis.

Attending the meeting there were my line manager, the Porto factory planner and all the factory representatives and MRP planners. This event helped a lot understanding the MRP cruciality and impacts on the supply planning for the factory side. Apart from the positive and constructive feedback received by the Portugal market, we from the Barcelona HUB registered an increase in the Master Requirement Accuracy (MRA) of about 10% during the following months.

Furthermore, the meeting was useful also to establish some strategic changes in the stock management policy for the Porto's factory.

In fact, during those days, the attendants tried to find a solution on the demand variability on the upstream value chain and decided to set the parameters for the MRP calculation so that the MRP_main of the factory would actually ask for more material to be moved from the 3PL as safety stock. This action had the purpose of increasing the use of the warehouse next to the factory plant, which had plenty of space to store raw materials for the production.

This change, indeed, would have not only increased the OEE of the Portugal market, but would also secure more raw materials available immediately for the production, since stored next to it, despite changes in the production itself. It would have generated, in a sort of sense, a "pillow" to soften the hit of rapid changes in the production.

It is important to say that the MRA analysis could be built only for those factories that had a reliable MRP in SAP with correct Master Data parameters setting safety stock and times.

Unfortunately, this was not the case for all the factories. For example, the factory of Dieppe in France had some issues in the parameters for the calculation from the MRP_main to the MRP submitted to the Barcelona HUB for the logistic planning and they could only show the production plan as an aggregated value at the beginning of the week.

For instance, 100 MT of raw material consumption reported on Monday, could indicate an actual consumption of 20 MT regular consumption every day.

For this reason, the majority of the reports were built on a weekly timeframe horizon, that would attenuate this issue by consolidating, in any case, the total demand of the week for a factory in one unique value for the week consumption.

5.1.1 The Morocco case

Other cases, however, had much more critical problems between MRP_main and MRP. In particular, the factory of Morocco had an MRP that was absolutely not reliable since it was showing random values for the consumption at 3PL with respect to the actual consumption for the production plan at the factory. Such discrepancies, coming from a negligence in updating the system and the forecasts, represented a total variance of more than 20% between MRP and MRP_main volumes. For this reason, the MRP were not recorded for Morocco and the MRA analysis was not set up for this factory.

We also need to consider that in Morocco there was a strong cultural component playing under the appearance since in Morocco there is a strong hierarchical structure that force any decision or change to be approved by several subsequent levels before

any action can be taken. Beside this, the logistic planner for the African factory in Barcelona was a lady, which struggled a lot in receiving news from the factory and in the communication in general with the factory representatives because of the social and sexual differences dictated mainly by the Muslim religion and the local culture. Still, the factory plant in Morocco was using only two material codes for the production and had an impact on the total EMENA volume that could be considered negligible.

5.1.2 The Timashevsk case

A volume that could not be considered negligible, instead, was represented by the Russian factory of Timashevsk which was processing around five thousand MT of raw materials per month, representing the second largest coffee factory in Europe after Girona, with a consumption of roughly seven thousand MT of green beans.

In Timashevsk, again, there were discrepancies between MRP_main and MRP which were reported to be around 10%. This did not allow to build a reliable MRA analysis and did not even allow to use the standard way of working used for all the other factories in EMENA for the logistic planning in FOB. In fact, this plant was using a different Excel file called “pipeline” to monitor the situation of the stock and the stock in transit with the shipment information with the PO numbers and the arrival date. However, this was a completely manual updated worksheet, open to human errors, uncontrolled and extremely time consuming to maintain. So, apart from being uncompliant from a best practices point of view, this way of working was also bringing issues in terms of accounting and due diligence reliability.

Considering the volumes of green coffee beans consumed on a monthly basis, this was not a plant that could remain uncontrolled like it was. So, the EMENA directors decided to establish an IT task force completely dedicated to the Russian market in order to make the way of working compliant with the international requirements and to integrate fully the factory in the SAP system.

5.1.3 The Inofyta case

Aside from the cases described previously, also Greece reported issues in calculating a correct MRP coming from the MRP_main. Apparently, the parameters in SAP were set correctly, but there was a constant difference between the two sets of values.

The MRP, in fact, was not transferring all the volumes showed in the MRP_main and this was not a simple issue of time and quantity transfer from the week of production to the appropriate week back in the past to guarantee timings for supply and moving the material to the factory.

The issue in Greece was rather that, comparing a weekly or even a monthly time horizon, the values of the MRP forecasts were constantly lower than the MRP_main for the same period frame.

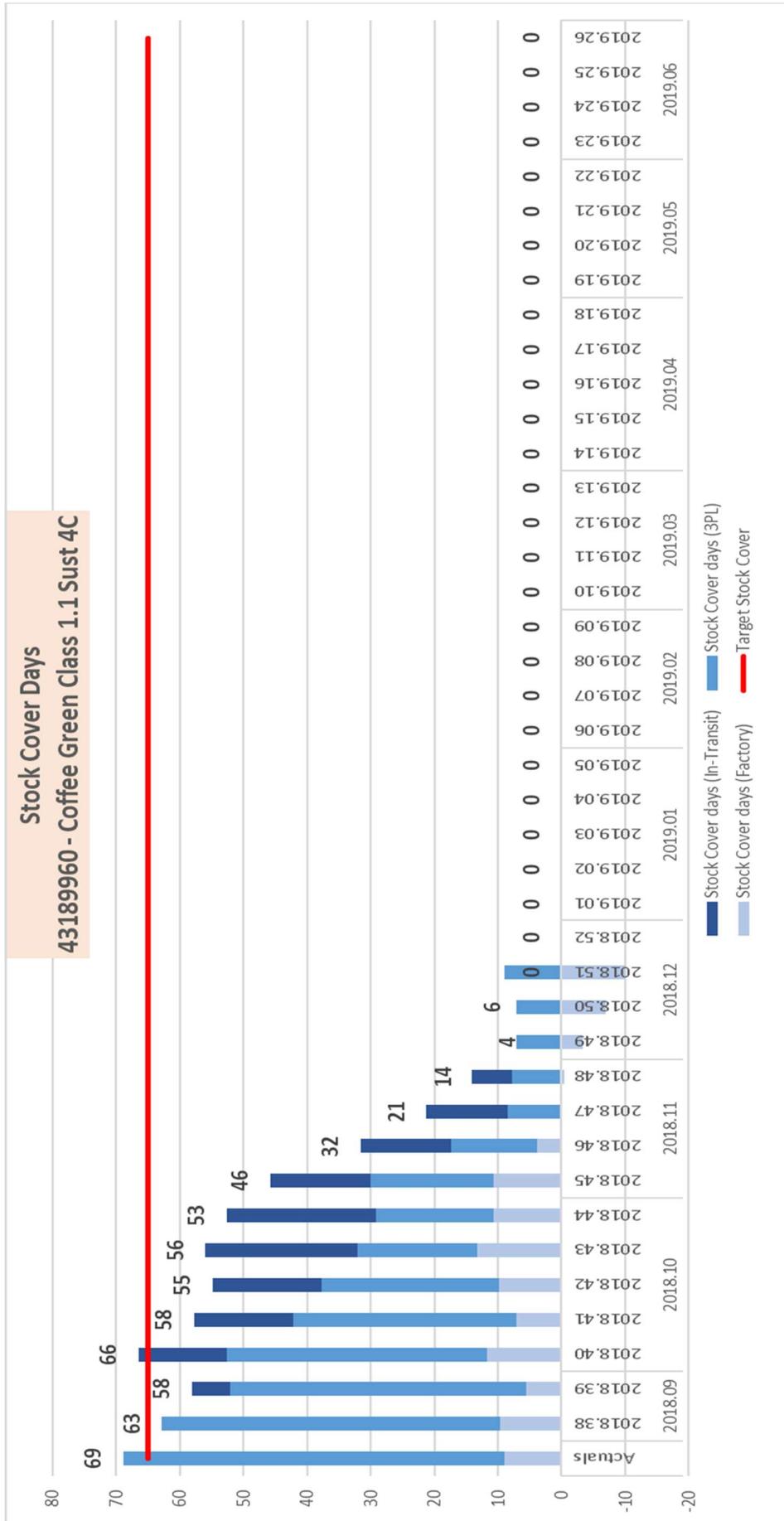
This means that, if the logistic planner in Barcelona was to rely purely on the information coming from the MRP, he would never plan enough material arrivals to the factory for the production plan, thus generating stockouts at the factory and stop in the plant production.

This peculiar situation was discovered by my analysis on the Stock cover calculation file after the high number of SPOT purchases that took place in the past months in the Greek market.

My analysis focused mainly on a particular graph in the Stock cover calculation file where the bar for the factory stock cover was reporting negative values even though the stock in the 3PL was still reporting positive values.

Material	Material description	Measure	2018.46	2018.47	2018.48
43189960	Coffee Green Class 1.1 Sust 4C	Requirements (Factory)	152.602	107.699	67.679
43189960	Coffee Green Class 1.1 Sust 4C	Requirements (3PL)	84.000	73.000	62.000
43189960	Coffee Green Class 1.1 Sust 4C	Receipts in 3PL (shipments)	20.700	20.700	-
43189960	Coffee Green Class 1.1 Sust 4C	Receipts in 3PL (Shopping Basket)			57.225
43189960	Coffee Green Class 1.1 Sust 4C	Manual Adjustment (in 3PL)	-	-	-
43189960	Coffee Green Class 1.1 Sust 4C	Receipts in 3PL (total)	20.700	20.700	57.225
43189960	Coffee Green Class 1.1 Sust 4C	Receipt In Transit	-	-	-
43189960	Coffee Green Class 1.1 Sust 4C	Stock end week (factory)	36.723	2.02	-3.655
43189960	Coffee Green Class 1.1 Sust 4C	Stock end week (3PL)	126.703	74.403	69.628
43189960	Coffee Green Class 1.1 Sust 4C	Stock end week (In-Transit)	135.150	114.450	57.225
43189960	Coffee Green Class 1.1 Sust 4C	Total Stock end week	298.576	190.877	123.198
43189960	Coffee Green Class 1.1 Sust 4C	Stock Cover days (Total)	27	20	13
43189960	Coffee Green Class 1.1 Sust 4C	Stock Cover days (Factory)	3	0	0
43189960	Coffee Green Class 1.1 Sust 4C	Stock Cover days (3PL)	11	8	7
43189960	Coffee Green Class 1.1 Sust 4C	Stock Cover days (In-Transit)	12	12	6

The table above shows clearly a negative stock at the factory of -3,655 kg for the material code 43189960 in week 48. This is due to the unbalance between the requirements of the factory in weeks 46, 47 and 48 (327,980 kg in total) and the requirements of 3PL (219,000 kg). This difference will not allow the stock in the factory to be refilled sufficiently to face the production of week 48.



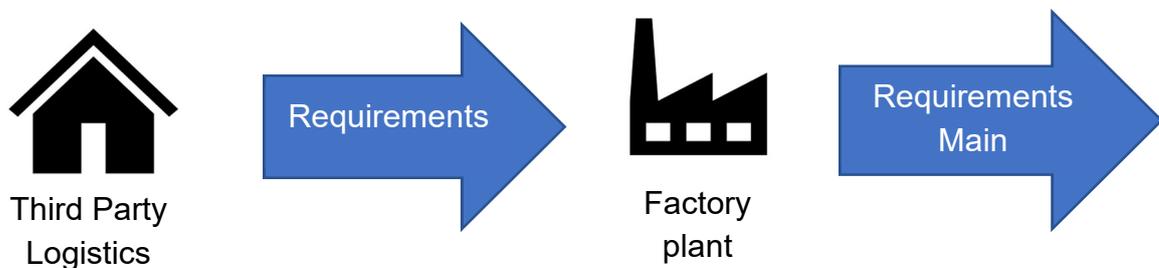
The reason behind this was that, as per the information coming the SAP database, the factory plant was having production plan volumes larger than the quantity the plant itself was showing as Requirements.

Curiously, the phenomenon was happening also in the opposite sense. It means that, for some large periods, the MRP was significantly higher than the MRP_main generating, this time, out of stock at 3PL.

Material	Material description	Measure	2018.32	2018.33	2018.34	2018.35
43189960	Coffee Green Class 1.1 Sust 4C	Requirements	84.000	105.000	105.000	147.000
43189960	Coffee Green Class 1.1 Sust 4C	Receipts in 3PL (shipments)	62.100	-	-	62.100
43189960	Coffee Green Class 1.1 Sust 4C	Receipts in 3PL (Shopping Basket)	-	-	-	-
43189960	Coffee Green Class 1.1 Sust 4C	Manual Adjustment (in 3PL)	-	-	-	-
43189960	Coffee Green Class 1.1 Sust 4C	Receipts in 3PL (total)	62.100	-	-	62.100
43189960	Coffee Green Class 1.1 Sust 4C	Receipt In Transit	103.500	124.200	-	-
43189960	Coffee Green Class 1.1 Sust 4C	Stock end week (factory)	203.519	203.519	203.519	203.519
43189960	Coffee Green Class 1.1 Sust 4C	Stock end week (3PL)	125.240	20.240	84.760	169.660
43189960	Coffee Green Class 1.1 Sust 4C	Stock end week (In-Transit)	227.700	351.900	351.900	289.800
43189960	Coffee Green Class 1.1 Sust 4C	Total Stock end week	556.459	575.659	470.659	323.659
43189960	Coffee Green Class 1.1 Sust 4C	Stock cover (weeks)	6	6	5	4
43189960	Coffee Green Class 1.1 Sust 4C	Stock Cover days (Total)	41	44	37	30
43189960	Coffee Green Class 1.1 Sust 4C	Stock Cover days (3PL)	9	2	7	16
43189960	Coffee Green Class 1.1 Sust 4C	Stock Cover days (In-Transit)	17	27	28	27

However, this was an issue more recurrent in a previous version of the Stock Cover file, as showed in the picture above.

As showed in the diagram below, it is clear that the incoming flow of materials from 3PL was not enough to balance the outflow, determining an inexorable erosion of all the stock of the warehouse.



Another problem linked to this issue was that the factory in the plant was being considered as constant since, theoretically, the Requirements_main had to be at least balanced by the Requirements at 3PL. This assumption, done at the beginning of the creation of the Stock cover calculation Excel to simplify the development of the file, was done considering that the Barcelona HUB of Nestrade had to provide a service to the factory where the stock in the 3PL had to be kept positive to allow the factory to manage the stock in the plant autonomously.

So, if there is always availability of raw materials at 3PL, the factory could ideally move the quantities that will be consumed in the production plan to the plant immediately

before the consumption, thus maintaining a stock situation that could be considered, approximately, unchanged.

Despite this assumption works accordingly with the service level contracted by Nestrade with the factories, it was impacting the total stock cover calculation in days since it was strongly dependant on the initial stock situation of the factory at the moment of the download of the data from the SAP database.

For instance, if the factory was facing a high volume of stock at the moment of the downloading of the data relative to the stock situation, this would have had an impact on the total stock cover of the factory for the whole horizon of the Stock cover calculation report, thus for the 18 months in the future.

It needs to be specified that the download of all the data necessary for the building of the report was aligned for all the factories in EMENA on every Thursday on a weekly basis for mainly two reasons:

- 1 Be able to look at the stock cover of raw materials of the market without discrepancies linked to time;
- 2 Use the most accurate MRP plan available in SAP. In effect, the MRP planner in the factory had to update all the new production requirements forecasts for an 18 months horizon at maximum on Wednesday end of the day, since at the midnight between Wednesday and Thursday it was set up a batch job that uploaded the MRP forecasts submitted by the factory MRP planner and recalculated all the future needs for the factory considering safety stocks, safety times and transit times from the 3PL to the factory plant, which normally accounted for a working week considering the transport times with a truck and the custom clearance activities.

Another relevant issue linked to the assumption of considering the stock in the factory constant was that this stock was always assuming positive values in the control reports of the Logistics HUB in Barcelona even though the factory was not receiving enough materials from the 3PL to maintain the reported level of stock. Therefore, the situation reported was not reflecting the real situation where a factory could actually be running out of stock both in the 3PL and in the factory's warehouse.

Although this situation was not clear with the numbers, the factories, especially in Girona, were reporting "run out of stock" situations and bad management of the Barcelona HUB for the supplying of the materials.

This is why I got involved in some Weekly Operational Reviews with the Greek stakeholders to understand and analyse the situation ongoing.

Gathering data and observations from the market, I was able to understand the real situation of stock reported by the factory and compare it with the data coming from SAP real-time and the data used as input in the Stock cover calculation file.

None of the figures matched.

But the reason why there was no match among these values was because the SAP values were reflecting the real situation in volume (MT) of how much stock was available in the warehouse, the report from the factory was a conversion of a close-to-real situation of stock converted in value by multiplying the volumes by the relative cost of the materials, while the Stock cover calculation was showing a fix stock situation frozen at the moment of the download of the data.

A real comparison of the three numbers was not possible if not done on Thursday morning.

However, the analysis I carried on this case brought me to focus on the flow of inbound and outbound at 3PL and I could work along with the Finance controller for the Barcelona HUB on a solution to increase visibility on the stock situation.

So, I made my proposal to the controller and, later, to my line manager in Barcelona respectively on the new formulas and on the change of scope of the report. The report, in fact, was no longer used only to monitor the stock situation at 3PL but was rather used to have full visibility on the total stock along the supply chain (in transit + 3PL + factory), despite the mission of the Nestrade HUB was still to guarantee the stock available at 3PL.

After two weeks of tests and adjustments, the new version of the Excel file was delivered to the Barcelona team for their weekly control and planning activities.

5.2 The need of a live update of the data: Power BI tool

In a fast pace environment such as the coffee commodities one, it is required to have a live data update to make the most accurate decisions and react to the sudden changes happening in a vast environment.

It is important, in fact, to consider that every event happening around the world might affect the financial market for this commodity. For instance, any depreciation in the Brazilian currency could mean a fall in prices for arabica coffee and a need for more stock cover at convenient prices.

Another example could be any strike happening in a coffee origin country port, which would delay any shipment of containers and jeopardize the supply in Europe.

This is exactly what happened in the port of Santos, in Brazil, during the summer period. A huge strike involving the logistics operators in the port took place blocking every container that was scheduled to departure in that period.

The information on daily issues and other troubles faced by the team was recorder in an Excel sheet called Issue Log with categories and sub-categories for issues, a description of the problem and the information about origin country, destination country and the date when the issue happened.

This Excel, along with other Exceles containing KPIs, was imported in PowerBI where the data was shown in charts and tables with a dynamic refresh option on the raw data.

PowerBI is a business analytics service by Microsoft. It aims to provide interactive visualizations and business intelligence capabilities with an interface simple enough for end users to create their own reports and dashboards.

The Business Intelligence tool offers both an offline desktop interface, called "PowerBI Desktop" to build dashboards and reports on your PC and a cloud-based service to share the built dashboards with hundreds of users online, "Power BI Services".

Since one of the tasks I was carrying out in the team was being a Business Analyst, I also had to learn using this innovative tool to serve with fresh data the HUB.

However, I had to be a self-starter since the Business Analytics team was not expert on this new tool and training courses were only held in Vevey, Switzerland. Fortunately, Microsoft is offering a full training online to learn the basics on how to manipulate data in PowerBI and I had plenty of time to experiment all the functionalities of the tool.

In order to make the operational reviews of the Barcelona HUB quicker and more dynamic, I developed a WOR dashboard and a MOR dashboard in PowerBI where all the relevant KPIs were presented, tactical KPIs for the former and strategic KPIs for the latter.

Both dashboards were taking data directly from the Nestlé Sharepoint where the Excel containing the information were uploaded and updated by the team.

Yet, we need to mention that in order to create a live update from different sources in PowerBI, we will need to code in the tool pointing at the right address of the file in the Sharepoint with the right name.

I have to say that it was not easy to keep the reports working at the first try every week because of the many changes taking place in the Excel file names and the reorganization of the Sharepoint with new folders and paths.

This is why, every day before the meeting, I had to double check that the refresh button brought no errors in the system.

In order to reduce my maintenance on the automatic reports that I built, I agreed with my line manager to state some "One-point lessons" or some "Standard way of working" to standardize the way of operating and the way of saving the files in the Sharepoint.

These documents were mainly some work or power point documents where I was explaining, with text and pictures, how, where, when and how to name the files when uploading useful information online.

These instructions were then included in the flow chart in Visio with direct links to create a dynamic learning section online which will be described in more details in the paragraphs ahead.

5.3 A new problem: Lack on forecasting weekly changes in the MRP

As discussed in the previous sections, the variability linked to the MRP forecasts was strongly impacting the operations of the Logistics team. These variations could have a wide range of causes behind, from a change in the blend production, to an increase in finished goods demand.

What could easily happen was that there would be a variation, either an increase or a decrease, in the requirements in the future altering the calculation on the stock cover. So, the stock planned and available for a specific week could be insufficient to satisfy the variation in the demand. In this context, the issue came when the variance happened within the frozen period, when there was not enough time to properly adapt to the demand. This is where Spot purchases and Interfactory movements kick in.

However, the main problem with the variations in the demand was that there was a lack of visibility for these changes in the MRP from one week to another since the data was overwritten every time a new MRP was launched in SAP.

So, since no historical database nor a proper analysis were implemented for this crucial aspect of planning, I decided to enhance the Excel for the MRA calculation with a new type of analysis where to monitor these changes: the demand variation analysis.

5.3.1 *The demand variation analysis*

The demand variation analysis is a solution that merges quality control procedures with the complexity of Nestlé logistics.

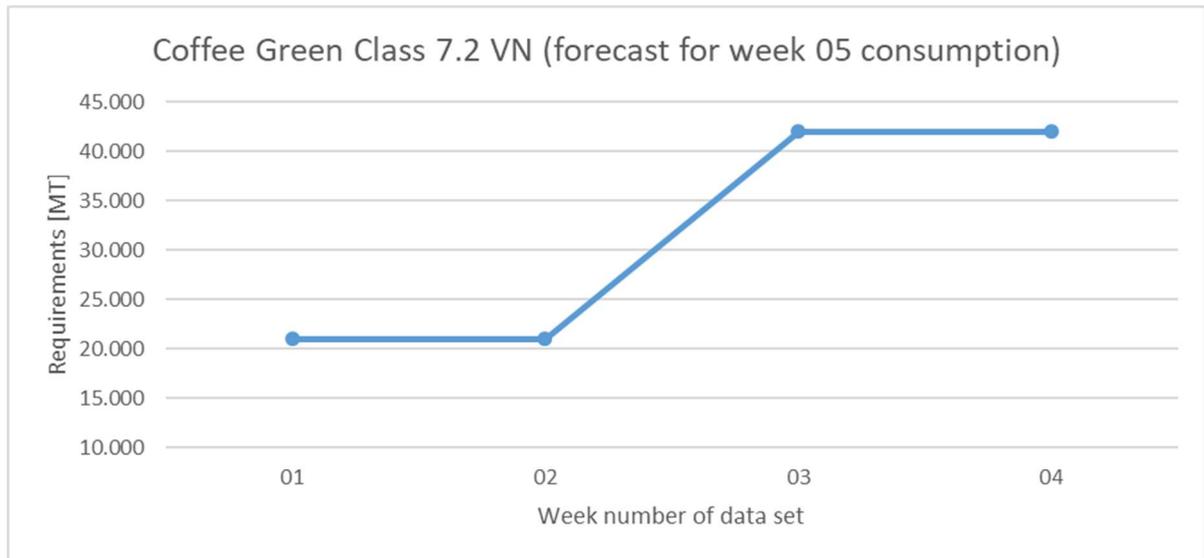
It is built in the same file of the MRA analysis since the input data come from the MRP, of which there is an “historical database” in such Excel already. The analysis, in fact, aims to compare the subsequent versions of the MRP ordered in a chronological way to follow the evolution of the level of the demand over time.

To do this, it is necessary to have two references of time: the first must be the forecasted week of consumption, which is when the coffee will be consumed, while the second reference will be when the MRP has been downloaded, which will be the same for the whole set of data but will let us compare different MRP versions within the same time horizon.

It is important to underline that this analysis was done to monitor the variations on the forecasts and so it is not intended to be a forecasting model itself for the future requirements. In fact, to be able to produce a forecasting model, it would be required an historical database of actual consumption rather than an historical database of

forecasts. However, the analysis was still useful to control the activities of the MRP planners and to increase visibility and reactivity of the logistics team to changes.

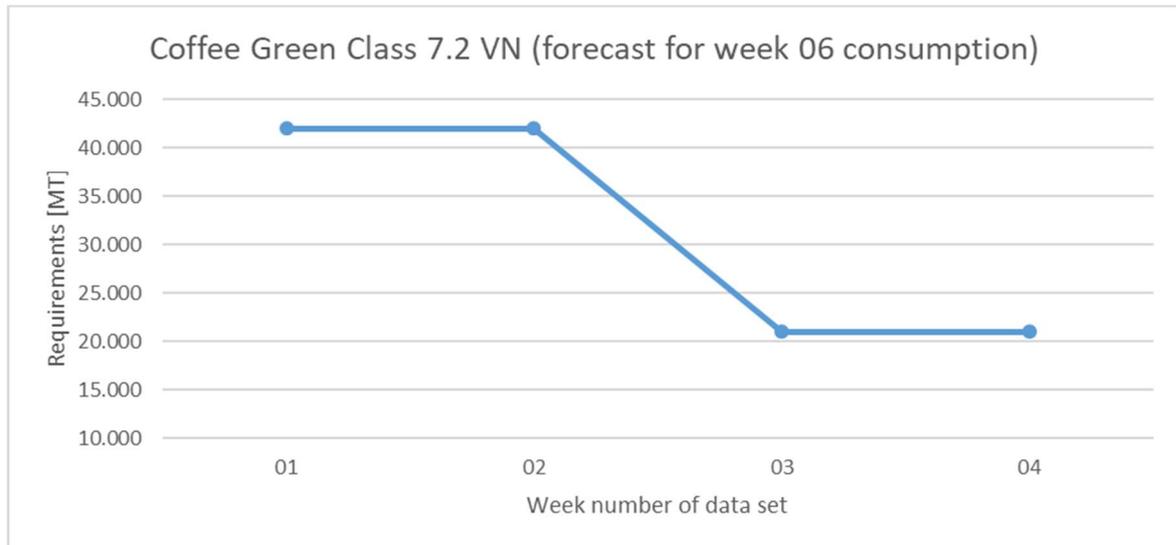
Initially, I built the demand variation analysis using a weekly comparison against the week of consumption, the first of the two time references described above. This would allow to see if any change happened in a specific week. For instance, if we had four MRP of four different weeks all having forecasts referred to the week number five, we could observe the evolution of the forecasts for the fifth week from week one to four.



As showed in the chart above, the forecasts for the class 7.2 green coffee for consumption on week five have increased from week two to three by 21 MT. For a logistics planner this would mean scheduling an additional container to be moved for week number five.

This is just a simple example of demand variation, but the fluctuations registered in real cases might be much more impactful than a single container, especially when we speak of big volumes of materials. Sometimes, though, even one container of difference could generate problems if the cover for the specific material is usually low and it is difficult to retrieve that material.

However, let us analyse another case.



This time we register a decrease of 21 MT within the same planning horizon of the previous case, but this time it is for consumption in week number six.

This is a typical case of switch in production where the peak of production has been advanced from week six to week five, potentially to face some delays in the production.

If we look at the two cases together, the variation may be negligible since the additional container was actually planned for a fairly close number of week with respect to the actual week of consumption. This should not be considered as a critical case then.

But beside the movements of production from one week to another (even a variation of few days could generate a variation in the week), the variations on a weekly basis could be difficult to identify and surely time consuming if analysed material by material for the twelve weeks in the three months frozen period.

These are the reasons why, after some experiments with the factory of Orbe following changes in demand in the Weekly Operational Reviews, I tried to implement the analysis observing a monthly aggregated view for consumption, thus assuming that the demand could tolerate advancement and delays within a four weeks horizon.

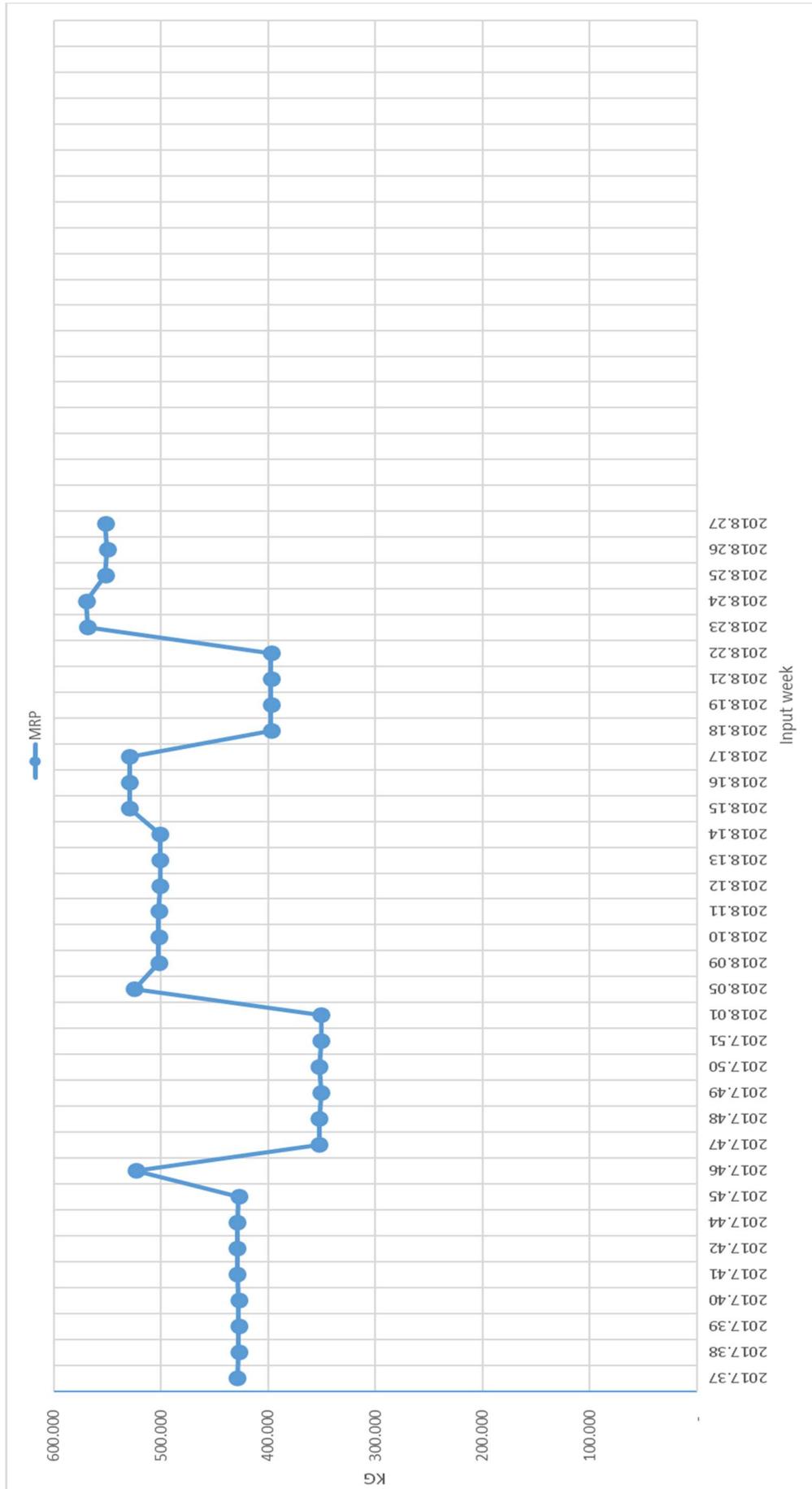
To do so, I had to consolidate the information coming from the MRP tables into pivot tables in Excel aggregating the weekly information for each month into one single column.

Sum of Requirements						Demand Month	Demand week
Plant	Material	Material Description	Input Week ordered	MRA Reference		2018.11	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.37			429.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.38			427.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.39			427.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.40			427.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.41			429.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.42			429.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.44			429.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.45			427.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.46			523.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.47			352.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.48			352.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.49			351.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.50			352.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2017.51			351.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.01			351.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.05			525.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.09			502.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.10			502.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.11			502.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.12			501.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.13			501.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.14			501.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.15			529.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.16			529.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.17			529.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.18			397.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.19			397.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.21			397.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.22			397.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.23			568.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.24			570.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.25			552.000	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.26			550.500	
0814	43189960	Coffee Green Class 1.1 Sust 4C	2018.27			552.000	

The example presented above is referring to the plant of Dieppe (0814) where we can observe subsequent demand forecasts for the month of November (Demand Month column) starting from the week number thirty-seven of 2017 (Input Week column).

In the table it is clear that there are fluctuations in the requirements from one week to another. However, we can also see that the requirements become more stable the more we approach the month of November. For example, we can see that from week one of 2018 it was forecasted a consumption of 351,000 kg while in week five of 2018 the same consumption had increased to 525,000 kg. From week eighteen to week twenty-two, instead, we see a constant value of 397,500 kg.

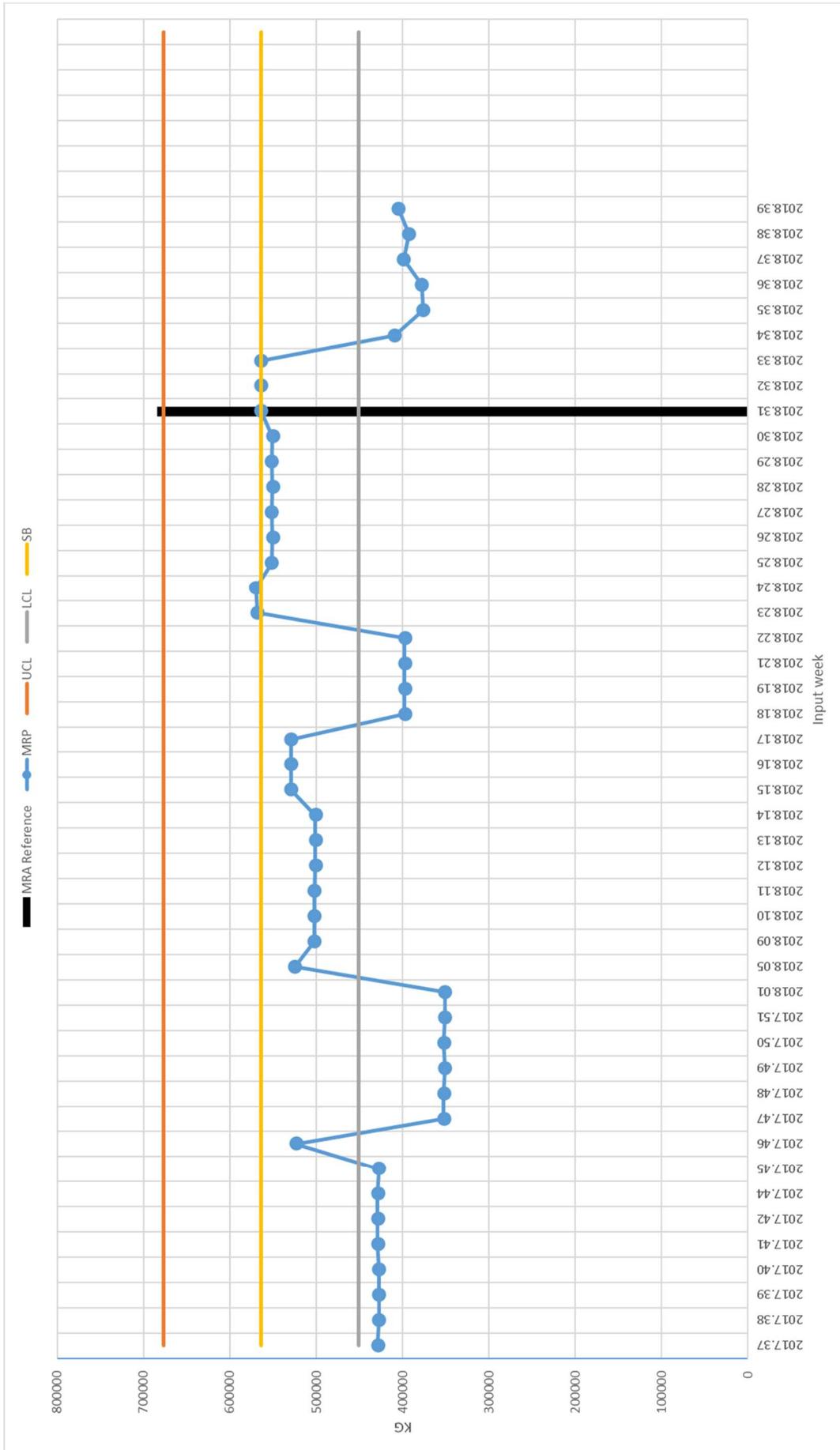
Surely this is not the easiest view to read the data and we cannot even identify any path in the forecasts we received as input data. This is why I designed also a graph to accompany the reading of the report.



This view is much more user-friendly. It allows a faster interpretation of the data set the we have been recording since September 2017.

Despite here we can see some increasing trends in the forecasts and recognize a curious recurring fluctuation of stable drops and subsequent significant increases (between week eighteen and twenty-three for example), we still do not have any reference point to establish if the fluctuation is acceptable or will require an action.

Therefore, with the purpose of setting a reference value and linking the analysis to the objective of the EMENA zone of 80% MRA accuracy, I completed the graph with some more helpful information.



Adding some more input weeks until week thirty-nine, we can extend our vision on the forecast evolution and introduce some information.

For instance, we can take week thirty-one as reference for the following forecasts since during that week the quantities for November consumption will be purchased to respect the three months frozen period and the shopping basket will be submitted in the SAP system. The black bar is highlighting the specific week of reference. We could then set a value, let us say a Central Limit (in the graph called SB) around which the following MRP could fluctuate but should not differ too much. So, we can set a yellow line to indicate this level of volume.

But how can we define whether the fluctuation is too much or it is still acceptable? It is important to understand this distinction because the actions to be taken are different for the two cases.

In case the fluctuation is still acceptable, the factory should only be warned about the registered variation and informed about the maximum variation they could still play with before crossing the limits. At this point, the logistics planner should check if the stock available and the orders planned during the shopping basket submission are sufficient to face the variation and, if not, should begin one of the two safety procedures of Spot purchases or Interfactory movements.

On the other hand, if the fluctuation is not tolerable, the logistics planner should talk to the factory to understand the root causes behind this change and should try, if possible, to rebalance the volumes within the limits forcing a production plan adjustment with the factory responsible.

Taking back the concept of the MRA target of 80% and that the contracts signed by the buyers could have a 20% flexibility in the volumes already contracted in the frozen period, we could align an upper control limit and a lower control limit to $\pm 20\%$ with respect of the central limit. This would guarantee that if the factory sets its consumption within the limits defined, the contracts could be adjusted with the suppliers without incurring in any extra cost and the factory will achieve its target in forecast accuracy.

This explains the red line that indicates the upper control limit (*UCL*) and the blue line that indicates the lower control limit (*LCL*) respectively calculated as:

$$UCL = (1 + 20\%) \cdot SB$$

$$LCL = (1 - 20\%) \cdot SB$$

For the specific case presented, it is clear that the drop to 409,500 kg registered in week thirty-four and maintained in the following weeks is not tolerable and will generate an overstock in the warehouse with respect to the quantity purchased in week thirty-

one of 564,000 kg. Also, the MRA of the factory will be lower than 80% if the consumption will remain at 409,500 kg, precisely it will be of 72.60%.

Once again, the tool presented is intended to improve the communication between the Logistics team and the factory plant and also to increase visibility on MRP changes.

It would be interesting to analyse a business case linked to the Girona factory that brought to a serious emergency in the stock levels, an emergency situation that could have been prevented with a proper follow up of the demand variation analysis.

I would take in exam four materials to perform a simple analysis on what happened during my absence from the Logistics team.

Plant	Material
0289	40607712
0289	24316100
0289	43054372
0289	27200019

Looking at an aggregated view of all materials for the months of February and March, we observe an encouraging MRA value with an increasing tendency and well aligned with the target set by the EMENA zone (80%).

Feb					
Demand WK 44	Consumption Feb	MRA %	Bias %	ABS Diff	Diff
7.919.400	8.058.421	70%	-2%	2.364.317	-139.021

Mar					
Demand WK 49	Consumption Mar	MRA %	Bias %	ABS Diff	Diff
9.025.800	9.131.498	80%	-1%	1.760.434	-105.698

The MRA was registered to 70% in February, a satisfactory value for the MRP accuracy with only a 30% discrepancy of absolute difference between forecasts and actual consumption at 3PL. Moreover, we notice that the Bias is actually quite low (-2%) meaning some overconsumptions have been balanced by lower consumptions for other materials, thus resulting in only -139,021 kg of difference between the total forecasts and the consumption. So, we can affirm it has been consumed only 2% less than expected in the total demand.

For the month of March, despite the considerable quantities, the indicators are even more positive with higher accuracy (80% MRA) and lower net difference (-1% Bias).

On an individual level, the figures are more or less on the same tendency.

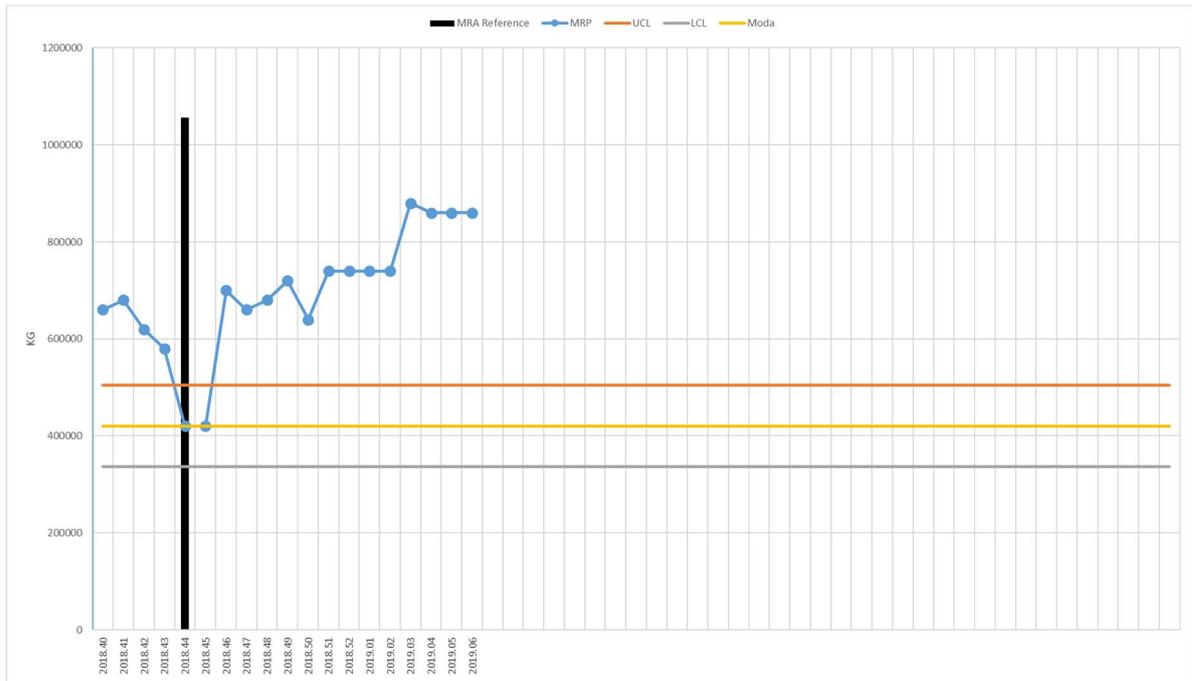
Feb						
Material	Demand WK 44	Consumption Feb	MRA %	Bias %	ABS Diff	Diff
40607712	280.800	415.901	52%	-48%	135.101	-135.101
24316100	4.116.000	4.230.135	97%	-3%	114.135	-114.135
43054372	420.000	684.209	37%	-63%	264.209	-264.209
27200019	60.000	157.612	-63%	-163%	97.612	-97.612

Mar						
Material	Demand WK 49	Consumption Mar	MRA %	Bias %	ABS Diff	Diff
40607712	302.400	345.268	86%	-14%	42.868	-42.868
24316100	4.536.000	4.325.642	95%	5%	210.358	210.358
43054372	480.000	651.435	64%	-36%	171.435	-171.435
27200019	80.000	119.368	51%	-49%	39.368	-39.368

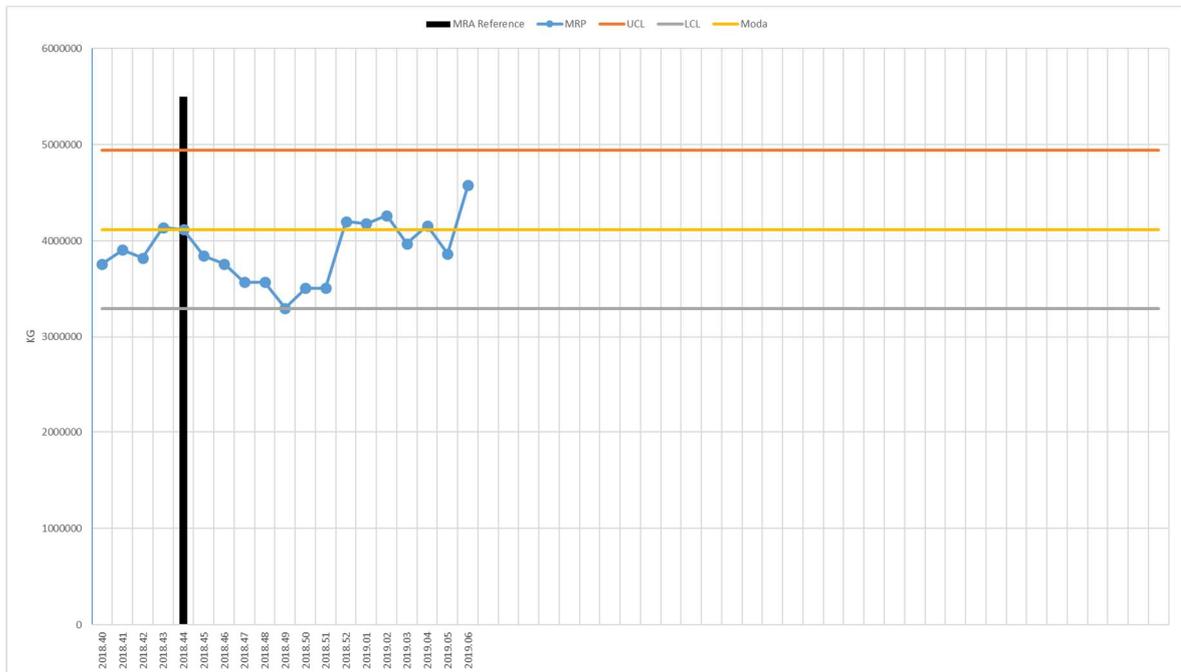
Keeping in mind the aggregated values of the MRA and the Bias, we see actually materials 43054372 and material 27200019 did not have a very precise forecast for both months since the MRA values are always below 60% and the Bias for 27200019 is even -163% in February.

However, we should look at the material 24316100 which has high values of forecast accuracy. This material has the biggest impact on the aggregated MRA since the quantity for this single material accounts already almost 50% of the total demand. So, even though the difference for 24316100 is larger in absolute value in comparison with the other materials, it is much lower in relative terms to the forecast.

Let us now see the graphs of the demand variation for February consumption to observe the evolution of the MRP through time until consumption. It is relevant just the qualitative trend of the graph that reports a significant increase in the demand right after the coffee was contracted in week 44 of 2018. After that increase, the demand has been fluctuating constantly over the UCL (red line) represented by the quantity contracted plus 20%. It means that it was clear since November the consumption in February would have been larger than expected.



On the other hand, below there is the demand variation for the material 24316100. Here we see the demand is much more accurate and constant although there is a drop in the very first month after the material was bought. However, the forecasts stay within the control limits.



Unfortunately, the positive evolution of February and March was followed by a complete disaster in April, month where the 3PL saw its stock erased by an unexpected high demand.

This is what the aggregated view looks like for the month of April.

Apr					
Demand WK 1	Consumption Apr	MRA %	Bias %	ABS Diff	Diff
3.857.200	7.174.961	-1%	-86%	3.908.199	-3.317.761

At first glance, it is critical the MRA value of 1%. Meaning only 1% of the initial forecast has been actually respected. The Bias also shows a huge discrepancy between forecast and consumption dictated, most likely, from an underestimation of the consumption in the first week of January (week 01).

In fact, it looks strange the total forecasted demand of only 3,857,200 kg when we registered more than double the demand in the previous two months. However, it could be that the factory was planning to stop its production for some weeks in April, hence dropping the normal monthly consumption.

In any case, there there was a misjudged forecast planning by the factory's demand planner, either because of a production stop or a variation in the final client's demand. And the impact of this on the warehouse was the erosion of ordinary and safety stock levels, leaving the factory exposed and unable to react to any demand change in May.

Apr						
Material	Demand WK 49	Consumption Mar	MRA %	Bias %	ABS Diff	Diff
40607712	108.000	108.493	100%	0%	493	-493
24316100	1.764.000	3.602.890	-4%	-104%	1.838.890	-1.838.890
43054372	480.000	774.223	39%	-61%	294.223	-294.223
27200019	60.000	194.253	-124%	-224%	134.253	-134.253

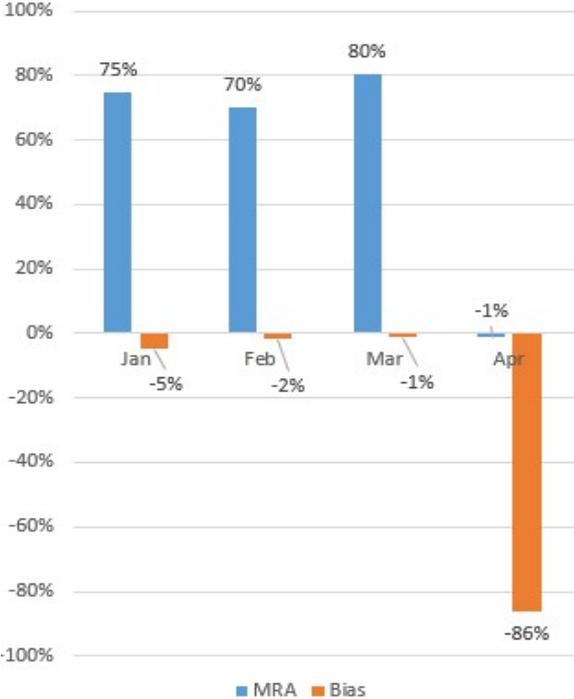
At an individual level, we still see the accuracy for materials 43054372 and 27200019 struggling to increase but this time also the material 24316100 has seen a poor accuracy of 4%. For this material it was expected a reduction in the demand that did happened, but not as drastically as forecasted. As showed in the graph below, it is to exclude any error in the information system since the same demand level had been forecasted for a consistent period of three months before rising. Hence, we can suppose the cause of this fluctuation is to be looked for either in production scheduling or workload planning. Beside the numbers, it is important the context. In fact, Easter fell right in the end of April this year, so it is not to exclude an increase in the demand coming from the retail stores who saw a flow of clients asking for Nescafé products over their expectations.



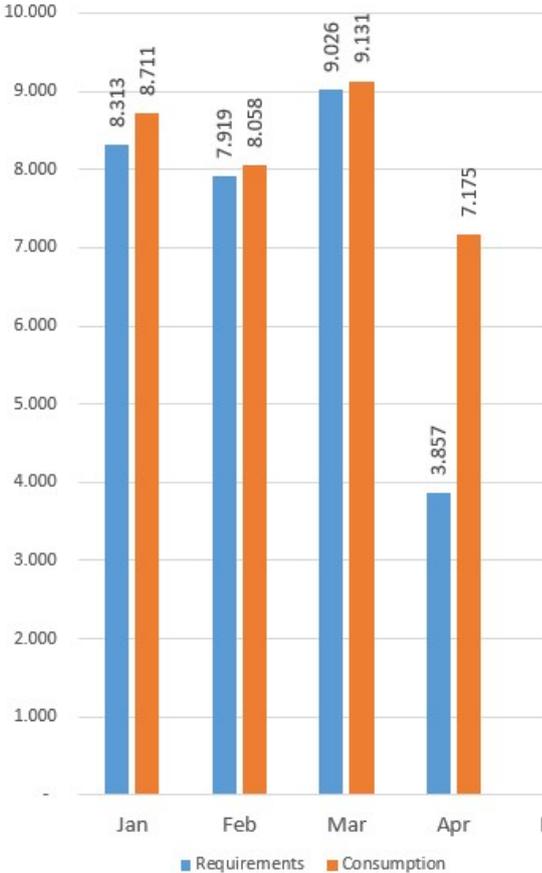
Whatever the root cause, that will be eventually investigated, and actions will be taken to prevent future similar situations, the phenomenon was anticipated far in advance. The first week of February indeed shows a critical peak that generates an outlier in the chart. This should have been the first alarm bell for the logistics planner since, at this point in the timeline, it was still possible to react with the emergency processes presented in the previous chapters.

Once again, this case shows that while the MRA is an indicator of the accuracy for the past since it requires the consumption to happen to be calculated, the demand variation analysis is a tool to foresee and forestall inconvenient events.

MRA -3 and Bias



Requirements M-3 vs Consumption at 3PL



5.4 A new version of the stock management file (Excel tool)

As described in the previous paragraphs, there was a strong need of changes in the Stock cover calculation Excel due to the business case related to the Greek market.

In addition to this, a stout crisis happening in Brazil during the summer called for a speed up in the changes to have visibility over the real situation of stock on hand (3PL plus factory) to face a shortage in supply of arabica coffee class 1 and 4.

The emergency urged a change in the way the logistics team was watching at the stock levels. It was no more acceptable to assume the stock in factory as a constant value since it would have compromised the entire projection of stock levels. Moreover, it was required to have visibility only on those quantities that had already been booked and shipped on a vessel, excluding the containers that were still to be loaded.

This last adjustments on shipments was needed to reduce the uncertainty on stock level projections of 4-8 weeks. In fact, those containers which had already been shipped could carry maximum 3-4 days variability in the estimated date of arrival. On the other hand, materials not shipped could see their estimated date of shipment and arrival delayed of over 4 weeks because of the strikes in Brazil, thus reflecting an unreal refilling of stock in the warehouse that would actually happen sometime in the future.

To implement this view change in the Stock Cover file, I decided, with the supervision of the HUB controller and my manager, to include in the file a view with only those Purchase Orders that had been transformed in Stock Transfer Orders (STO).

An STO was a fictitious movement of stock created in SAP done every time a shipment with its associated Goods Receipt (GR) was entered in the system. Since the GR would show the material in the system as immediately available for consumption, the STO movement was needed to simulate the transfer of this material in a temporary storage location (in-transit) so that the quantity would be showed as floating and incoming on a specified date of delivery. Then, once the material had been received at 3PL, the delivery date would be confirmed, and the material made available for further utilizations.

The introduction of a dynamic stock calculation for the factory warehouse was not a simple modification to the file, both in terms of calculation and data input.

The factory stock view, in fact, needed to be calculated looking at the MRP_main which gives information about the forecasted consumption in the factory plant and comparing the stock already available in the factory and the one moved from 3PL, so the MRP of the 3PL.

Henceforth, the Excel tool had to be redesigned to include a new set of data, the MRP_main, that would be downloaded by the logistics team every Thursday morning together with the normal download of the MRP. Now the file would present two lines

for each material, one for the requirements of the factory and one for the requirements of the 3PL corresponding respectively to the consumption in the production line and the stock moved from 3PL to the factory.

Therefore, we can affirm that everything what is moved from 3PL to the factory (Requirements) can be summed up in the stock value of the factory itself.

Unfortunately, it is not necessarily true. In fact, if these requirements are higher than the actual quantity available at 3PL in that week, then we cannot unconditionally add the value presented in the requirements to the stock in factory. We would rather need to consider only the stock that was available for the movements and this could be solved with a logic structure in the Excel formula.

So, as it has been designed, the file would show the stock going to zero first at 3PL and then in the factory, following a real course of events and overcoming the assumption of fixed and always positive stock in the factory.

For example, we can observe a practical case for the factory of Orbe:

Material	Material description	Measure	Actuals	2018.38	2018.39	2018.40
43369695	Coffee Green Class 7.2 Sust 4C	Requirements (Factory)		30.049	44.632	174.942
43369695	Coffee Green Class 7.2 Sust 4C	Requirements (3PL)		129.600	21.000	189.000
43369695	Coffee Green Class 7.2 Sust 4C	Receipts in 3PL (shipments)		-	-	259.200
43369695	Coffee Green Class 7.2 Sust 4C	Receipts in 3PL (Shopping Basket)				
43369695	Coffee Green Class 7.2 Sust 4C	Manual Adjustment (in 3PL)				
43369695	Coffee Green Class 7.2 Sust 4C	Receipts in 3PL (total)		-	-	259.200
43369695	Coffee Green Class 7.2 Sust 4C	Receipt In Transit				
43369695	Coffee Green Class 7.2 Sust 4C	Stock end week (factory)	165.189	264.740	241.108	255.166
43369695	Coffee Green Class 7.2 Sust 4C	Stock end week (3PL)	437.000	307.400	286.400	356.600
43369695	Coffee Green Class 7.2 Sust 4C	Stock end week (In-Transit)	259.200	259.200	259.200	-
43369695	Coffee Green Class 7.2 Sust 4C	Total Stock end week	861.389	831.340	786.708	611.766
43369695	Coffee Green Class 7.2 Sust 4C	Stock Cover days (Total)	57	50	43	36
43369695	Coffee Green Class 7.2 Sust 4C	Stock Cover days (Factory)	18	16	9	18
43369695	Coffee Green Class 7.2 Sust 4C	Stock Cover days (3PL)	35	17	11	23
43369695	Coffee Green Class 7.2 Sust 4C	Stock Cover days (In-Transit)	21	15	10	-

The picture shows the first three weeks of production, from thirty-eight to forty for the material 43369695. The first two lines show the quantity to be used in the production, in the line called “Requirements (Factory)”, and the materials to be transferred to the factory from 3PL, in the line “Requirements (3PL)”.

The third and fourth lines take the information of all the incoming material at 3PL, but only the third line has information since it collects just the information of the STOs, hence the confirmed shipments. So, we can see 259,200 kg incoming in week forty.

The “Stock end week (factory)” is calculated subtracting from the stock of the factory available in the previous period (SF_t) the production requirements of the current period (RF_{t+1}) and adding either the requirements at 3PL of the same period (RW_{t+1}), if the quantity was available in the 3PL’s warehouse, or the stock at 3PL of the previous period otherwise (SW_t).

$$SF_{t+1} = SF_t - RF_{t+1} + \min[RW_{t+1}; SW_t]$$

Following the previous reasoning, the “Stock end week (3PL)” of the period (SW_{t+1}) will be calculated as:

$$SW_{t+1} = \max[0; SW_t - RW_{t+1} + T_{t+1}]$$

Where T_{t+1} stands for the material in inbound at 3PL, showed in the line “Receipt in 3PL (total)”. The “max” function is used to avoid the stock to assume negative values, which might have a misleading impact on the numbers of the following weeks.

The lines referred to the levels of stock in days are calculated comparing the amount of stock available at the end of a week against the requirements of the following weeks looking at how many weeks could be covered with such amount.

In the picture presented, we can see that in week forty the stock in the factory of week thirty-nine will reduce from 241,108 kg by 174,942 kg, which are the requirements in the factory for week forty. But at the same time, the stock will have an increase of 189,000 kg that will be moved from 3PL to the factory, producing a positive net difference in the stock in the factory of 14,058 kg, thus leaving the final stock level at 255,166 kg.

Because of the outbound movement of 189,000 kg and the receipt of 259,200 kg, the stock at 3PL will change from 286,400 kg to 356,600 kg at the end of week forty.

If we take another example, we can analyse what happens when the stock is not enough to meet the demand at 3PL.

Material	Material description	Measure	Actuals	2018.38	2018.39	2018.40
43418324	Coffee Green Class 7.1 Sustainable 4C	Requirements (Factory)		53.292	101.616	89.357
43418324	Coffee Green Class 7.1 Sustainable 4C	Requirements (3PL)		85.800	221.600	42.000
43418324	Coffee Green Class 7.1 Sustainable 4C	Receipts in 3PL (shipments)		-	-	-
43418324	Coffee Green Class 7.1 Sustainable 4C	Receipts in 3PL (Shopping Basket)		-	-	-
43418324	Coffee Green Class 7.1 Sustainable 4C	Manual Adjustment (in 3PL)		-	-	-
43418324	Coffee Green Class 7.1 Sustainable 4C	Receipts in 3PL (total)		-	-	-
43418324	Coffee Green Class 7.1 Sustainable 4C	Receipt In Transit		-	-	-
43418324	Coffee Green Class 7.1 Sustainable 4C	Stock end week (factory)	132.053	164.561	187.435	98.078
43418324	Coffee Green Class 7.1 Sustainable 4C	Stock end week (3PL)	210.290	124.490	-	-
43418324	Coffee Green Class 7.1 Sustainable 4C	Stock end week (In-Transit)	108.000	108.000	108.000	108.000
43418324	Coffee Green Class 7.1 Sustainable 4C	Total Stock end week	450.343	397.051	295.435	206.078
43418324	Coffee Green Class 7.1 Sustainable 4C	Stock Cover days (Total)	39	32	25	18
43418324	Coffee Green Class 7.1 Sustainable 4C	Stock Cover days (Factory)	12	12	17	10
43418324	Coffee Green Class 7.1 Sustainable 4C	Stock Cover days (3PL)	18	9	-	-
43418324	Coffee Green Class 7.1 Sustainable 4C	Stock Cover days (In-Transit)	11	8	9	11

For the material 43418324 we spot the stock end week at 3PL in week thirty-eight is not enough to satisfy the requirements of week thirty-nine since we only have

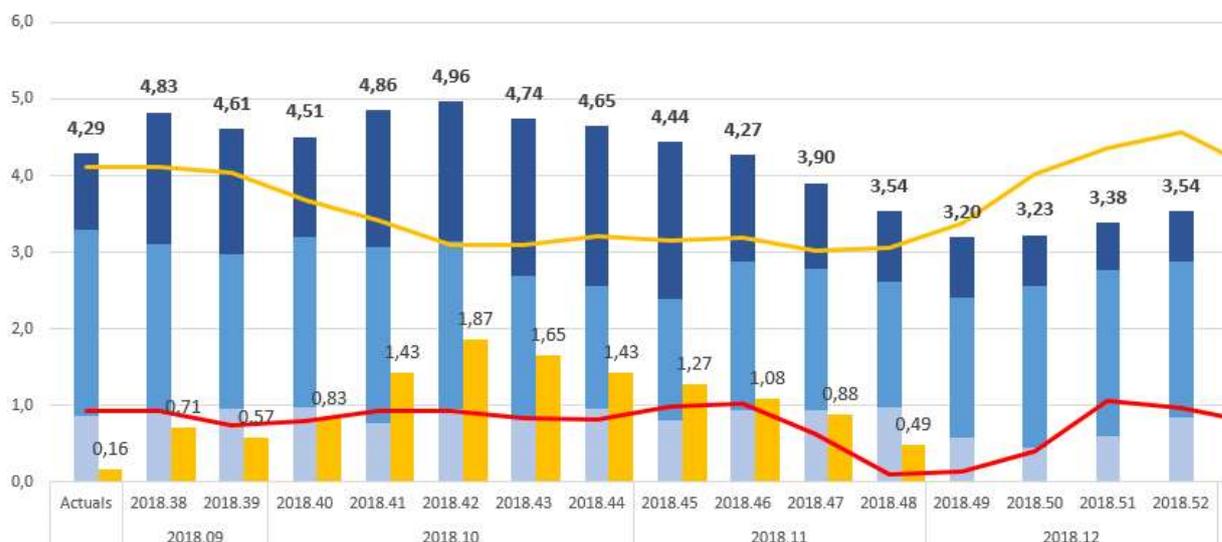
124,490 kg against the needed 221,600 kg. So, only the 124,490 kg will be moved to the factory leaving the stock at 3PL to zero.

However, this does not mean the production will be stopped since the factory sill has material available for the following weeks. Nevertheless, the logistics planner should take note of this situation and ensure that new material is expected to arrive as soon as possible at 3PL to replenish at least the safety stock levels required. Later, the planner will have to investigate why this lack of stock happened, whether because of a change in the production plan, a delay in the shipping line or a poor material scheduling.

Beside the described change, I thought it would be appropriate to have an improvement in the summary graphs in the Stock cover file to ease the planning work of the logistics team. With this purpose and following the idea of the “demand variation” analysis, I introduced two lines in the graph to make it easy to identify the target of 70 days and the minimum level of stock to be reached, corresponding to the safety stock quantity. Clearly, the upper limit corresponding to the target of 70 days was expressed in quantity as a function of the factory requirements. So, the quantity to be held in the warehouse would change and follow dynamically the demand to achieve the target as a calculation of the following 70 days of consumption.

With the same logic, the safety stock time and quantities would be calculated as a function of the demand, indicating the minimum quantity to be stowed to guarantee the planned service level to the factory.

To make it even more visual and straightforward, I added a column series in the graph showing either the overstock quantity (in orange) or the quantity lacked to reach the safety level (in red). This would immediately indicate the quantity to be moved inbound or outbound the warehouse in a specific week to adjust the stock levels to the desired targets.



The picture above presents a part of the new graph just described. Here we can see the yellow line representing the 70 days target expressed in quantity and the red line for the safety stock. As in the previous format of the graphs where the cover in days was depicted, the different grades of blue indicate the stock held in the three different storage locations (factory, 3PL and in-transit) but this time in MT. The orange columns highlight by how much the total stock is deviating in excess from the target. If the columns were to be in red, it would have meant by how much the stock on hand (factory + 3PL) should be increased to meet the safety stock levels.

6 Other tasks and responsibilities

Beside the duties linked to the MRP and logistic scheduling expounded until this point, I was assigned with other tasks linked to the management and performance side of the logistics team in Barcelona.

Among these contouring tasks, I am going to focus on four of them: flow chart definition and improvement, KPIs management and building of the shipment allocation report.

6.1 Flow chart: processes definition and improvement

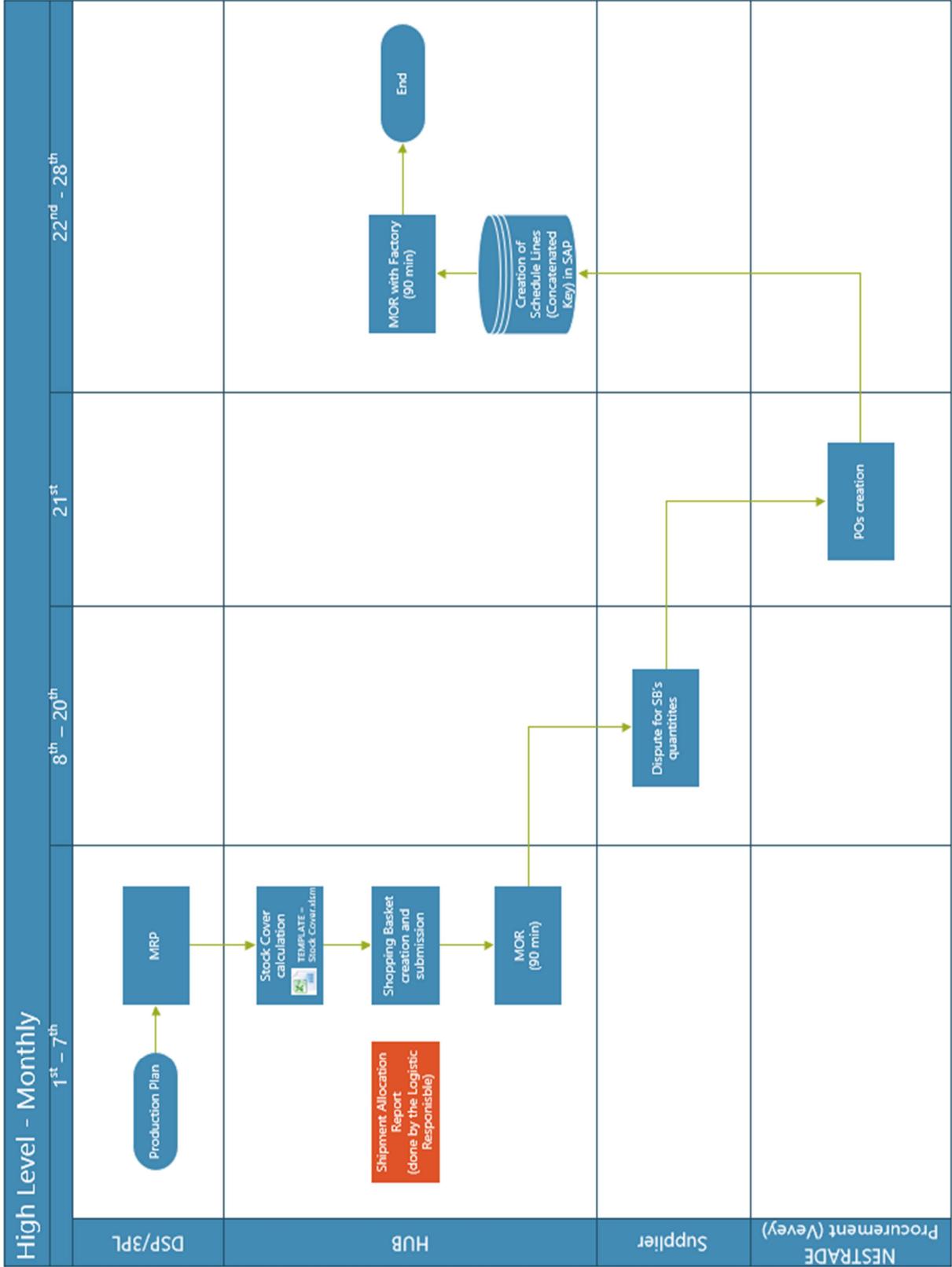
One of the very first activities that I was appointed was the definition of all the processes and activities carried out by the logistics team in Barcelona with two main purposes: for me to better understand the working environment I was introduced to and for the team to see where processes standardization and improvement could take place.

First, I booked some time with each member of the team to gather data, make questions and observe their major activities during the day. In this way I could learn how the process worked while taking notes on timings and procedures.

Half way the work, after the first week of meetings with the team members, I could already draw a general picture of the key processes of the Barcelona HUB with a monthly and weekly time framing.

In order to have a clear and effective view, I was suggested to use the software Visio, a Microsoft software for the creation and design of charts and diagrams.

So, after a quick self-learning online of the software mechanics, I started drawing the flow chart on Visio with a tabular view. Horizontally we will have a distinction of actors with the activities of their responsibility while vertically there will be a time range distinction either in days or weeks.



We see the cycle of activities starts on the first week of the month when the demand supply planner of the factory (DSP) generates the MRP demand at 3PL and factory and submit it in SAP. In the late part of the week, the logistics HUB starts the calculation of the Stock Cover file for controlling and material planning purposes, hence will allow the subsequent calculation and submission of the Shopping Basket in SAP as Purchase Requisitions to indicate the quantities to be purchased to the buyers.

After the stock projections are finalized, the Monthly Operational Review (MOR) can take place and the material cover forecasts, along with all the others KPIs of the previous month, can be screened and analysed by the managers.

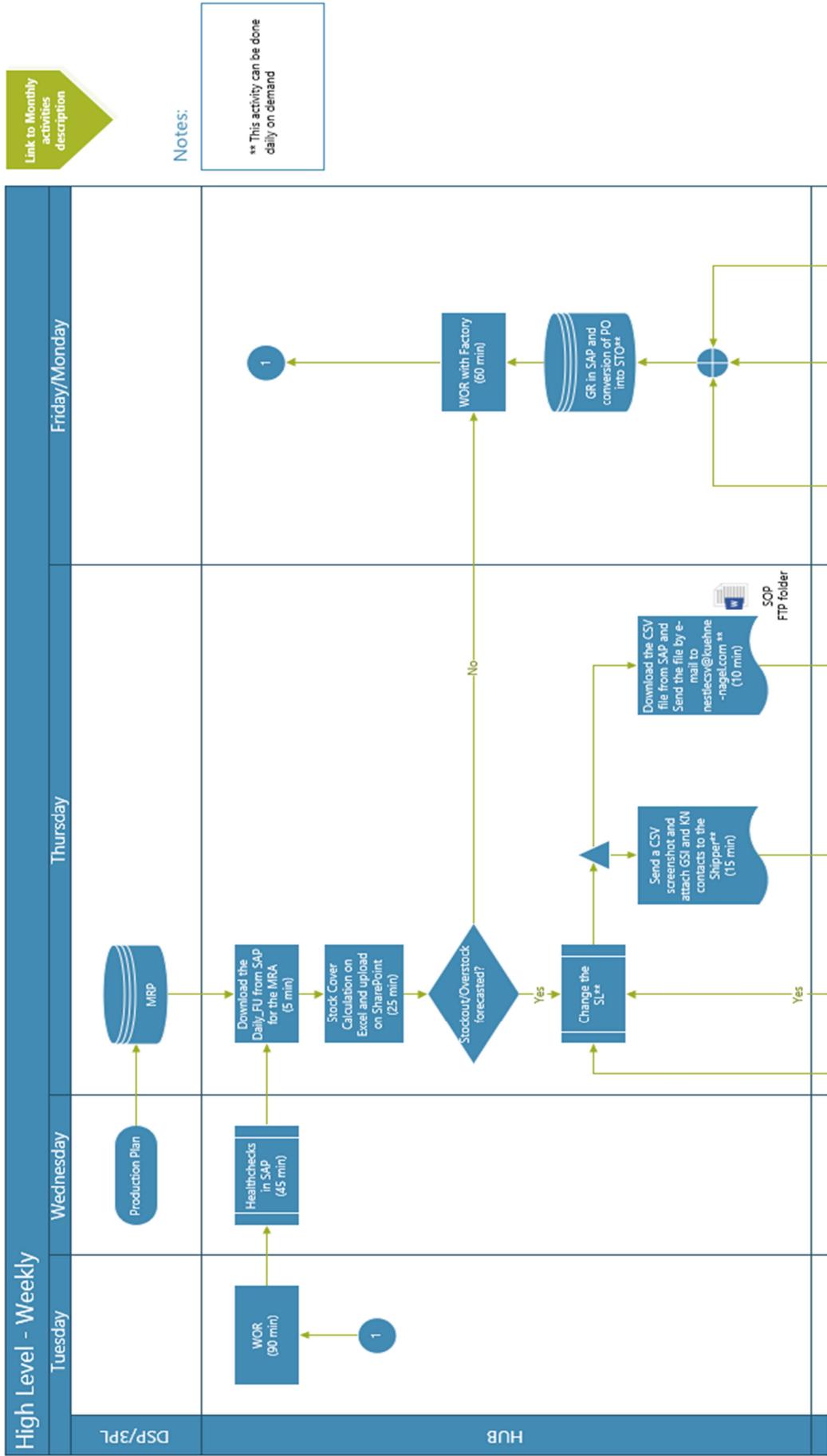
During the first week we can find an activity in a red box. This is an extra activity I had to introduce after I created the Shipment Allocation report for the Global Transportation Team since this report was required at the beginning of every month for container allocation purposes on a global scale. The fact it is in red indicates that will be carried by one specific person responsible, which was the logistics expert of the team.

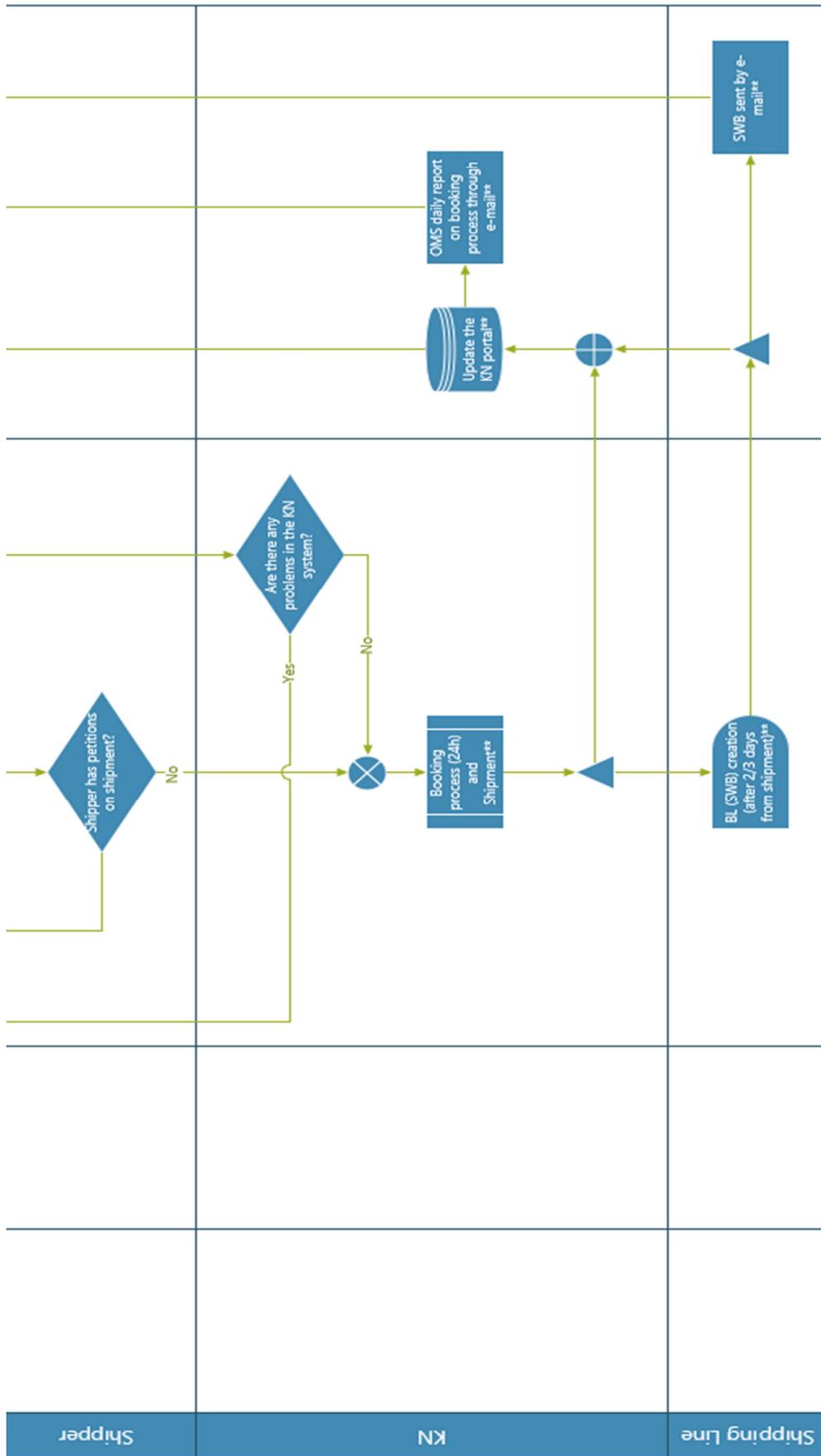
Between the 8th and the 20th of the month communication between buyers, suppliers and the logistics team happens where disputes of the Shopping Basket can take place to adjust the scheduling of the material accordingly to the availability and convenience of the international coffee market.

Once the quantities are fixed, the procurement division in Vevey can create contracts with the suppliers and generate the POs in the system.

The last part of the process consists of scheduling the created POs with a best fit to the factory's needs of material. These schedules, called "Schedule Lines", are agreed with the suppliers and the communicated to the factory in the MOR with the factory where the factory's KPIs and projections are revised.

While the monthly horizon of activities has a linear flow, this is not the case when we observe the weekly frame of activities.





Starting from Tuesday, we find the Weekly Operational Review (WOR) within the logistics team in Barcelona to give an overview on the stock levels of the EMENA zone and discuss the action plan for the week ahead.

The following day is dedicated to performing a control activity (Healthcheck) in SAP to confirm all the information has been processed correctly and there are no schedule lines pending, typing mistakes in the numbers of the system or other details that might contribute to have a misleading view on the projections. Then, on Thursday the MRP is downloaded from SAP and the Stock Cover file is built and uploaded on the SharePoint for each factory. The activity of building the Stock Cover file is the most crucial one within the week since from it depend all the scheduling of materials and emergency detections that have been described in the chapters linked to the Stock Cover file.

Then, if any issue is detected for any material, the first solution should be looked at in a change in the schedule lines with the suppliers through direct communication or through the communication with K&N.

This was a particular node where I stressed out margin for improvement since there were multiple channels of communication for doing the same thing.

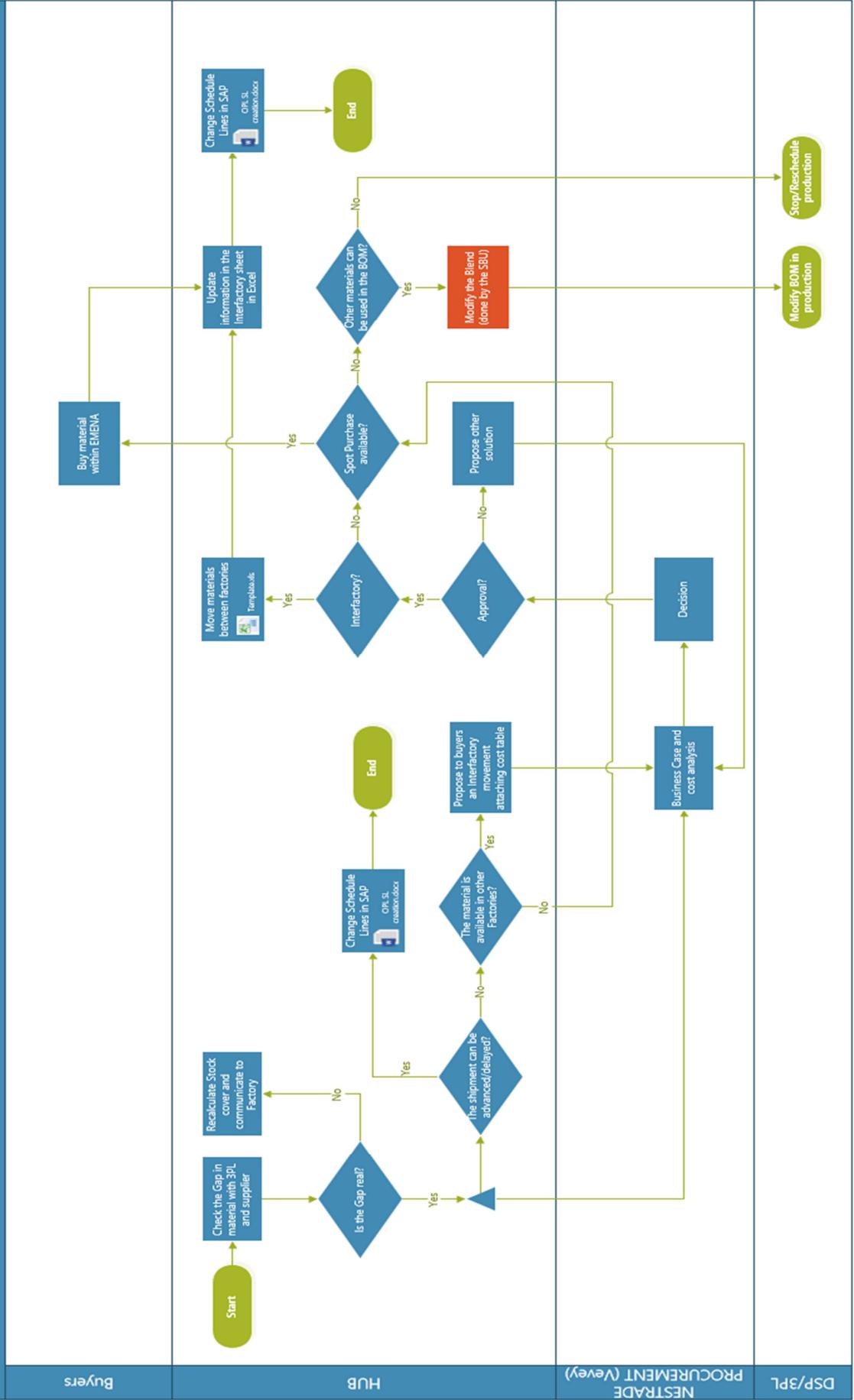
After observing timing and procedures of the alternatives, I concluded the best practice to communicate changes in the schedule lines should be using a CSV file with the updated dates of container scheduling and updating this file in a folder shared with K&N. Then, K&N itself would update the information with the suppliers and the shipping lines for the bookings. This automatic process developed under the supervision and testing of two logistics team members and the IT team of K&N required on month before it could be extended to the whole team, but it allowed, with a simple upload of a file in a folder, to speed up operations and reducing the time from some hours to less than 15 minutes.

On the last part of the week, the team was generally dedicated on solving specific issues and communicating the stock levels projections with the factories in the WORs.

The following chart presents the logic behind any material scheduling change that comes after the definition of the Shopping Basket quantities.

As can be noticed, some activities have a Word or Excel icon inside their boxes. This is because the whole work in Visio was intended to be interconnected with any document that could help the understanding of the process, such as templates, standard routines descriptions and guides. In the end, the flow chart in Visio was uploaded in the SharePoint to make it accessible to the team and to future members of the team with training purposes.

Detailed Level – Change the SL, Objective: Guarantee Service to the Factory



6.2 KPIs management

As anticipated in the previous chapters, I was responsible for the management and creation of all the Key Performance Indicators linked with the Logistics HUB in Barcelona and, partially, for the Procurement division.

Aligned with the operations' time frame and to facilitate the dialogue during operational reviews, I built two sets of KPIs before in Excel and then in PowerBI. For simplicity, I will present only the final versions on PowerBI.

Since PowerBI is a dynamic business intelligence tool able to import data from external sources, I backed all the information on user-friendly Excels where the logistics team could insert the data which would have then be extracted by a query built in PowerBI. Of course, to guarantee the access to all the Excels, these where to be uploaded in SharePoint under codified names retrievable from the business intelligence tool.

The first dashboard of KPIs built was the WOR dashboard, for the homonymous meeting happening every Tuesday. This dashboard contains the Stock Cover levels in quantity and days for all the factories and other KPIs linked to the emergency movements, Spot and Interfactory purchases,

Since there where eleven factories with as many Stock Cover Excels, I decided to build a universal query including as variables "Factory name", "Market" and "Folder address". This way, combining the universal query function with a table including the above variables for all the factories, I could import and manipulate the data all at one time. Below the beforementioned query:

let

```
Source =  
SharePoint.Files("https://nestle.sharepoint.com/teams/TRADINGHUBBARCELONA",  
[ApiVersion = 15]),  
#"Filtered Rows" = Table.SelectRows(Source, each ([Name] = ""&Factory&"")),  
#"SC WOR" = #"Filtered Rows" {[Name=""&Factory&"";#"Folder  
Path"="https://nestle.sharepoint.com/teams/TRADINGHUBBARCELONA/BUSINESS  
ES/"&Market&"/"&Folder&"/"]}[Content],  
#"Imported Excel" = Excel.Workbook(#"SC WOR"),  
#"Stock Cover calculation_Sheet" = #"Imported Excel" {[Item="Stock Cover  
calculation",Kind="Sheet"]}[Data],  
#"Removed Blank Rows" = Table.SelectRows(#"Stock Cover calculation_Sheet",  
each not List.IsEmpty(List.RemoveMatchingItems(Record.FieldValues(_), {"", null}))),  
#"Removed Top Rows" = Table.Skip(#"Removed Blank Rows",2),  
#"Transposed Table" = Table.Transpose(#"Removed Top Rows"),  
#"Removed Bottom Rows1" = Table.RemoveLastN(#"Transposed Table",15),
```

```

#"Transposed Table1" = Table.Transpose("#Removed Bottom Rows1"),
#"Promoted Headers" = Table.PromoteHeaders("#Transposed Table1",
[PromoteAllScalars=true]),
#"Unpivoted Other Columns" = Table.UnpivotOtherColumns("#Promoted
Headers", {"Actuals", "Measure", "Material description", "Material", "Max Stock
Cover", "Min Stock Cover", "Transport time (weeks)", "Storage Location", "CONCAT
+ Measure", "Plant Description", "Plant", "CONCAT MAT", "CONCAT PLANT",
"Grouping"}, "Attribute", "Value"),
#"Renamed Columns" = Table.RenameColumns("#Unpivoted Other
Columns",{"Attribute", "Year.Week"}),
#"Reordered Columns" = Table.ReorderColumns("#Renamed
Columns",{"Grouping", "CONCAT MAT", "Plant", "Plant Description", "Material",
"Material description", "Year.Week", "Actuals", "Measure", "Value"}),
#"Removed Columns2" = Table.RemoveColumns("#Reordered
Columns",{"Actuals"}),
#"Pivoted Column" = Table.Pivot("#Removed Columns2", List.Distinct("#Removed
Columns2"[Measure]), "Measure", "Value", List.Sum),
#"Changed Type" = Table.TransformColumnTypes("#Pivoted
Column",{"Requirements (Factory)", type number}, {"Requirements (3PL)", type
number}, {"Receipts in 3PL (shipments)", type number}, {"Receipts in 3PL (Shopping
Basket)", type number}, {"Manual Adjustment (in 3PL)", type number}, {"Receipts in
3PL (total)", type number}, {"Receipt In Transit", type number}, {"Stock end week
(factory)", type number}, {"Stock end week (3PL)", type number}, {"Stock end week
(In-Transit)", type number}, {"Total Stock end week", type number}, {"Stock Cover
days (Total)", type number}, {"Stock Cover days (Factory)", type number}, {"Stock
Cover days (3PL)", type number}, {"Stock Cover days (In-Transit)", type number}),
#"Removed Columns" = Table.RemoveColumns("#Changed Type",{"Grouping",
"CONCAT PLANT", "CONCAT MAT", "Plant Description", "CONCAT + Measure",
"Storage Location", "Transport time (weeks)", "Min Stock Cover", "Max Stock
Cover"})
in
#"Removed Columns"

```

So, once crossed with the following table, the files could be merged in one database later applying another query to set the data ready to be presented in graphs.

	Factory	Market	Folder
1	SC WOR Orbe.XLSM	ORBE	1. Follow up stock cover Orbe
2	SC WOR Dieppe.xlsm	DIEPPE	1. Follow stock cover Dieppe/KPI stock cover + transit
3	SC WOR Girona.xlsm	GIRONA	1. Follow stock cover Girona
4	SC WOR Inofyta.xlsm	GREECE	1.Follow stock cover Inofyta

Query:

let

Source =

```
Table.FromRows(Json.Document(Binary.Decompress(Binary.FromText("dY/RboMg
GEZfhXC7xmWPMC1TslYlaLql8al61pl5Mlhzzft1KBsm7RUJOefk//Z7yBOWlwwQU4v
oZcO3cAUJi9HleYjAk25bPYKhA73VzQdo9JcwjoXV6s9dS9F1lvpu+8+Ltsal0qUfyhN
8/0zx4vsOWHNQvbRhOJVGq4MPp5iR/PFmeIJDHSv9frb/PkMomQ67os9w6Gei7aU
61toctSNDG47zmLB0cQd3ocSF+CjehAo7VBurfYESVpBJDi3HhBITQ+8dhkrulKvDf8
nQ5M1pFEYqb/Mk2yGG83D54uCZDxvFYOvBnH2iKlu4ZK83N884rKof",
BinaryEncoding.Base64), Compression.Deflate)), let _t = ((type text) meta
[Serialized.Text = true]) in type table [Factory = _t, Market = _t, Folder = _t],
#"Changed Type" = Table.TransformColumnTypes(Source,{{"Factory", type text},
{"Market", type text}, {"Folder", type text}}),
#"Invoked Custom Function" = Table.AddColumn(#"Changed Type", "SC WOR",
each #"SC WOR"([Factory], [Market], [Folder])),
#"Expanded SC WOR" = Table.ExpandTableColumn(#"Invoked Custom Function",
"SC WOR", {"Plant", "Material", "Material description", "Year.Week", "Requirements
(Factory)", "Requirements (3PL)", "Receipts in 3PL (shipments)", "Receipts in 3PL
(Shopping Basket)", "Manual Adjustment (in 3PL)", "Receipts in 3PL (total)", "Receipt
In Transit", "Stock end week (factory)", "Stock end week (3PL)", "Stock end week (In-
Transit)", "Total Stock end week", "Stock Cover days (Total)", "Stock Cover days
(Factory)", "Stock Cover days (3PL)", "Stock Cover days (In-Transit)"}, {"SC
WOR.Plant", "SC WOR.Material", "SC WOR.Material description", "SC
WOR.Year.Week", "SC WOR.Requirements (Factory)", "SC WOR.Requirements
(3PL)", "SC WOR.Receipts in 3PL (shipments)", "SC WOR.Receipts in 3PL
(Shopping Basket)", "SC WOR.Manual Adjustment (in 3PL)", "SC WOR.Receipts in
3PL (total)", "SC WOR.Receipt In Transit", "SC WOR.Stock end week (factory)", "SC
WOR.Stock end week (3PL)", "SC WOR.Stock end week (In-Transit)", "SC
WOR.Total Stock end week", "SC WOR.Stock Cover days (Total)", "SC WOR.Stock
Cover days (Factory)", "SC WOR.Stock Cover days (3PL)", "SC WOR.Stock Cover
days (In-Transit)"}),
```

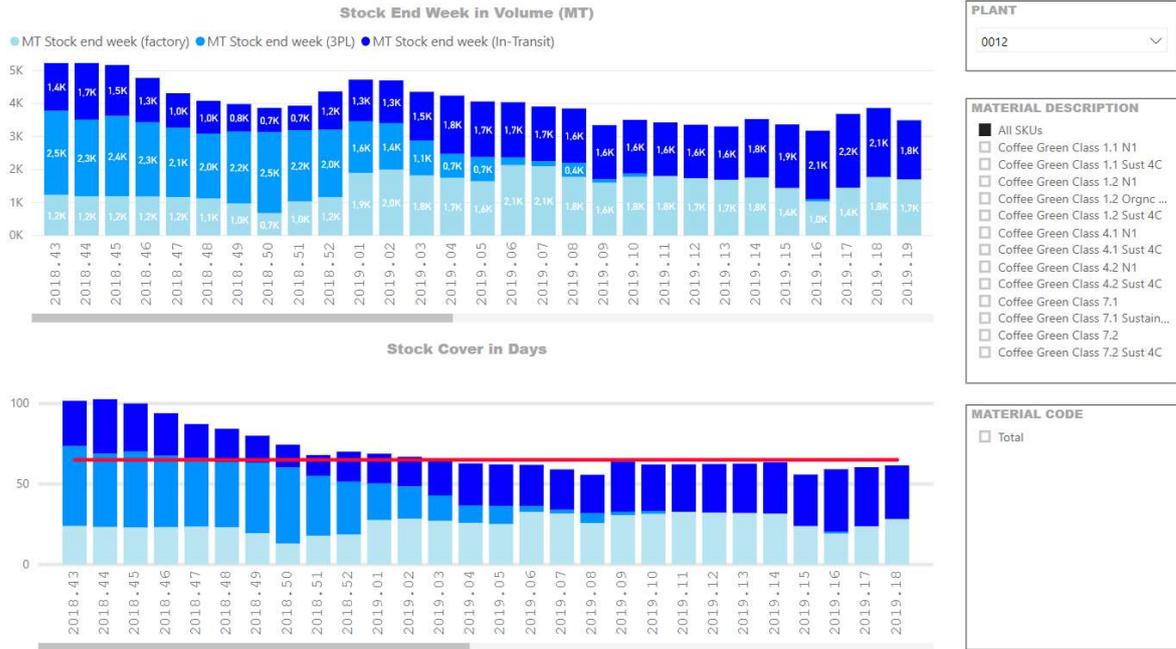
```

#"Removed Columns" = Table.RemoveColumns("#Expanded SC
WOR",{ "Factory", "Market", "Folder"}),
#"Changed Type1" = Table.TransformColumnTypes("#Removed Columns",{{"SC
WOR.Stock Cover days (In-Transit)", type number}, {"SC WOR.Stock Cover days
(3PL)", type number}, {"SC WOR.Stock Cover days (Factory)", type number}, {"SC
WOR.Stock Cover days (Total)", type number}, {"SC WOR.Total Stock end week",
type number}, {"SC WOR.Stock end week (In-Transit)", type number}, {"SC
WOR.Stock end week (3PL)", type number}, {"SC WOR.Stock end week (factory)",
type number}, {"SC WOR.Receipt In Transit", type number}, {"SC WOR.Receipts in
3PL (total)", type number}, {"SC WOR.Manual Adjustment (in 3PL)", type number},
{"SC WOR.Receipts in 3PL (Shopping Basket)", type number}, {"SC WOR.Receipts
in 3PL (shipments)", type number}, {"SC WOR.Requirements (3PL)", type number},
{"SC WOR.Requirements (Factory)", type number}})
in
#"Changed Type1"

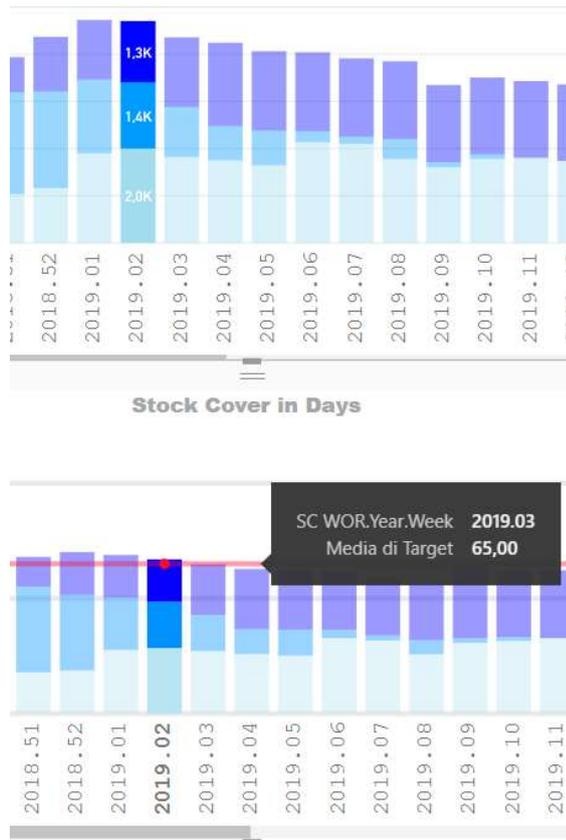
```

The final result in the dashboard presents two column bar charts that recall the colours of the charts in the Stock Cover files with the distinctions between factory, 3PL and in-transit. On the horizontal axis we find the time framed in weeks and years while the vertical axis indicates the quantity of raw material in tons in the first graph and the number of days in the second graph.

On the right it is possible to interact with the filters selecting the plant code (in this case Orbe 0012) and either the material description or the material code to analyse the references individually or aggregated as it is the case in the picture below. The red line in the second graph identify the target level in days for the factory.



The advantage of PowerBI is the possibility to interact with the charts presented. For example, we could move the cursor on any element in the dashboard to have an insight on the data or it is possible to select one series of data to focus the analysis on a specific data set, like for example to focus the discussion on week number 02 and analyse the partition of the stock quantities between factory (2,000 tons), 3PL (1,400 tons) and in-transit (1,300 tons).



The second section of the dashboard presents on the top left hand-side a set of filters to change the data view while on the right there is a table showing details on the filtered data.

Seller

- Dieppe
- Girona
- Helsinborg
- Inofyta
- Orbe
- Porto
- Reus
- Schwerin
- Tutbury

Buyer

- Dieppe
- Girona
- Helsinborg
- Inofyta
- Orbe
- Porto
- Reus
- Schwerin
- Tutbury

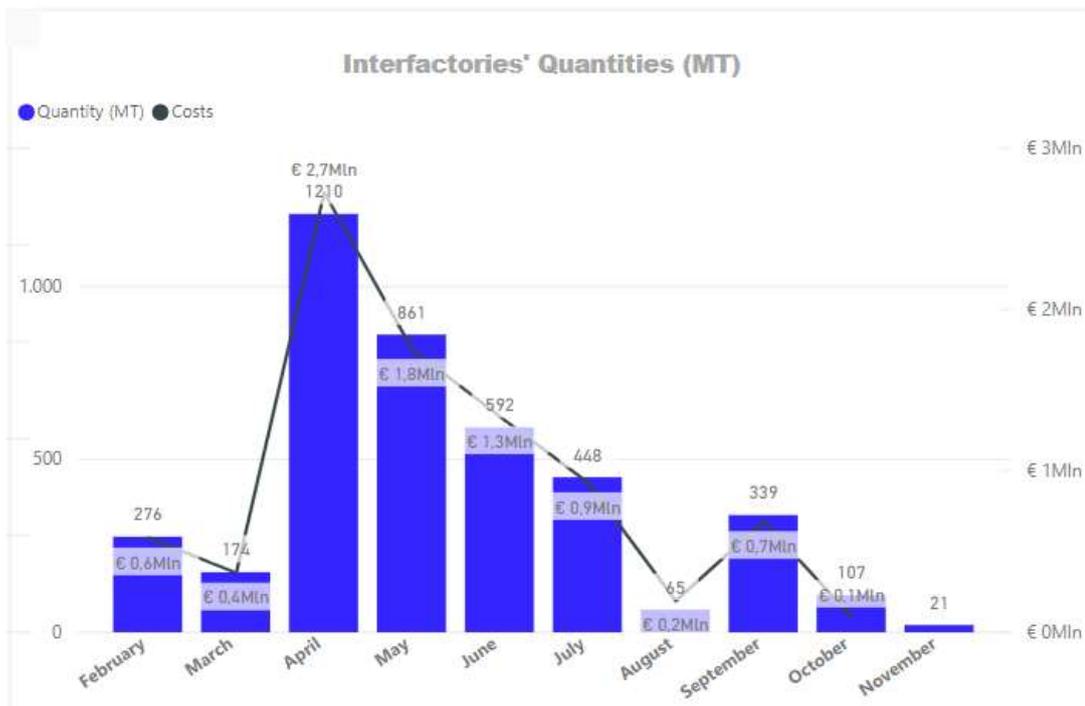
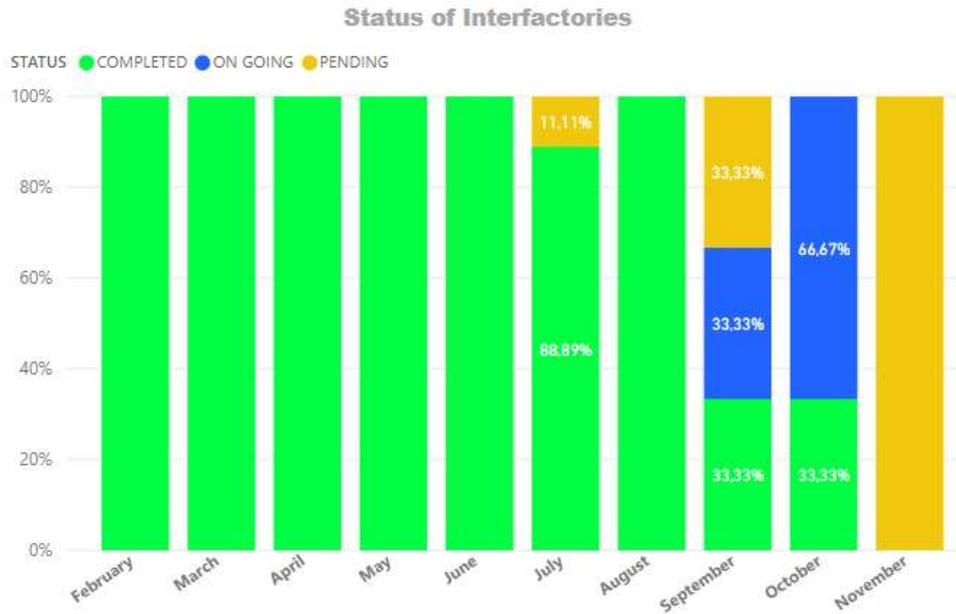
STATUS

- CANCELLED
- COMPLETED
- ON GOING
- PENDING

Buyer	Seller	STATUS	SKU Description	Quantity (MT)
Girona	Tutbury	COMPLETED	Coffee Green Class 7.2 Sust 4C	561,00
Tutbury	Orbe	COMPLETED	Coffee Green Class 7.2 Sust 4C	530,00
Girona	Dieppe	COMPLETED	Coffee Green Class 1.2 N1	315,00
Tutbury	Girona	ON GOING	Coffee Green Class 7.2 VN	245,08
Orbe	Tutbury	COMPLETED	Coffee Green Class 7.2 Sust 4C	237,00
Girona	Porto	COMPLETED	Coffee Green Class 7.2 UG Scr18	201,00
Schwerin	Tutbury	COMPLETED	Coffee Green Class 4.1 BR LM-S/S Sust 4C	194,40
Orbe	Tutbury	COMPLETED	Coffee Green Class 4.1 Sust 4C	172,80

This information is referred mainly to the Interfactory movements to foster communication of overstock/understock situations and potentially boost the bureaucracy behind the transactions to close the on-going movements.

Below this section, we find two graphs giving a visual impact on the status of the Interfactory movements (on the left) and on volumes and costs associated to these (on the right). These graphs were important to understand the trend of these practices and identify any potential issue with material scheduling, supplying or forecasting.

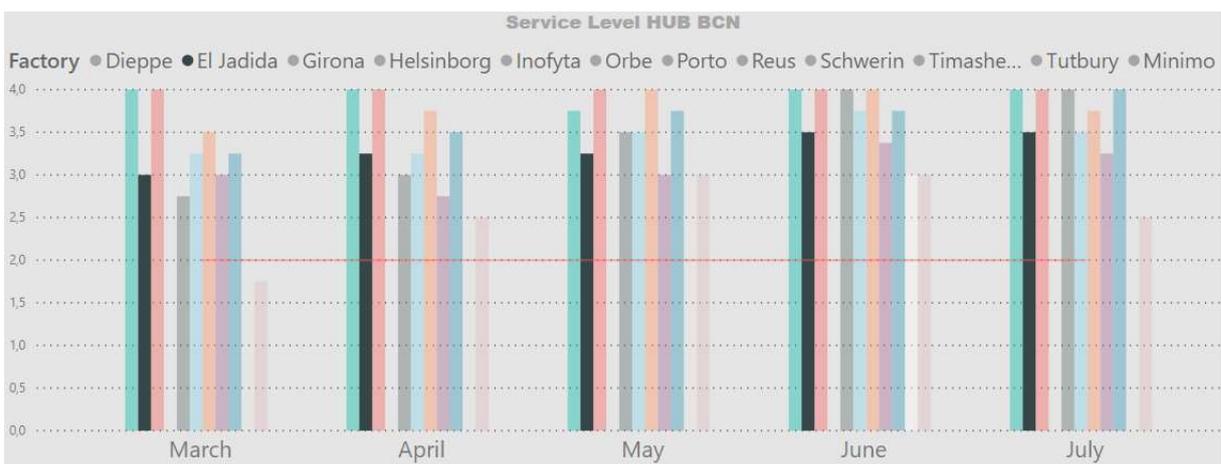
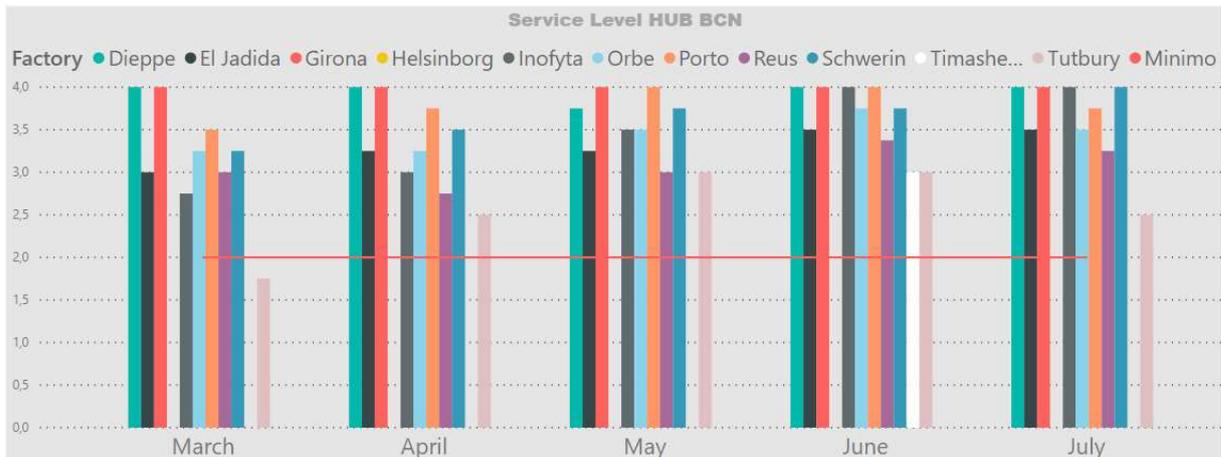


The biggest dashboard, however, is represented by the MOR dashboard where all the KPIs are presented to the Head of Operations of Nestrade.

This dashboard is composed by multiple queries that extract the data from several Excels in the SharePoint. Each one of these Excels has been built and organized to ease the data import in PowerBI and to allow a live update of the information at any time.

The first page of the dashboard presents the Service Level, a rating provided by the factories as a feedback on the service provided by the logistics team. This rating is the

combination of a set of factors on a scale of 4 grades. The minimum to achieve is grade 2 to have a satisfactory service level represented by the red line in the chart. The service grade is presented in columns of different colours for each factory, so it can be analysed the general trend of the HUB or a single factory performance.



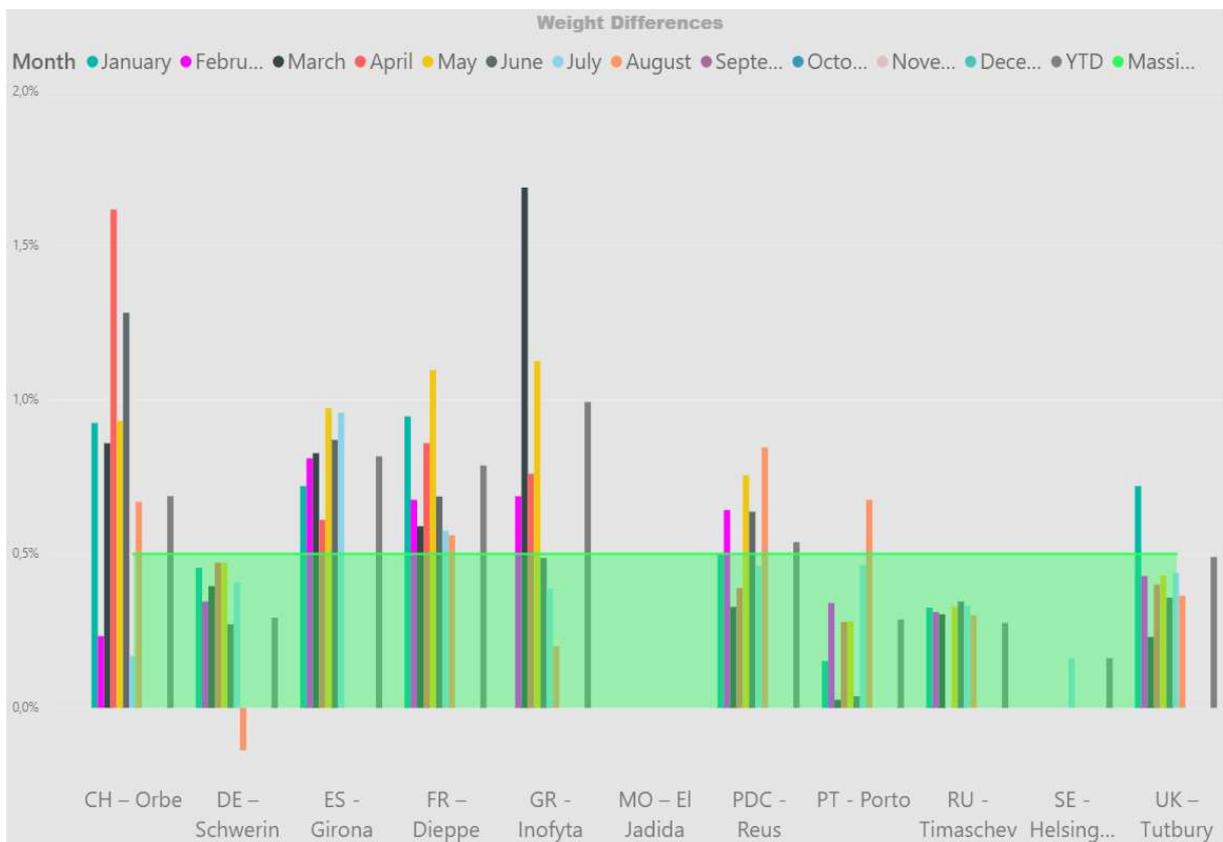
The second page, instead, is dedicated to a controvert KPI: Weight Differences. This KPI has been the centre of many discussions between Procurement, Suppliers, factories and the HUB because the factories' responsible in charge of calculating this indicator were not performing the calculation properly.

The KPI should be below the 0,5%, indicating that the difference in weight between the quantity in the Bill of Lading and the actual quantity received within a month should not exceed this value. For all the differences above this value, the European Coffee Contracts (ECC) obliges the supplier to pay an amendment to compensate the client.

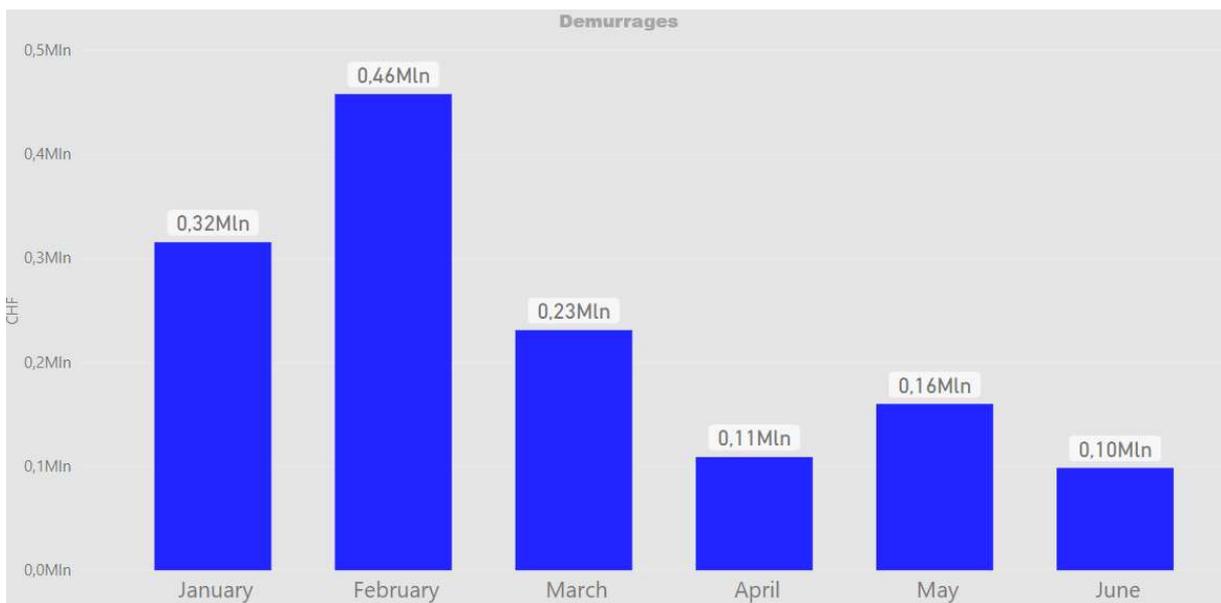
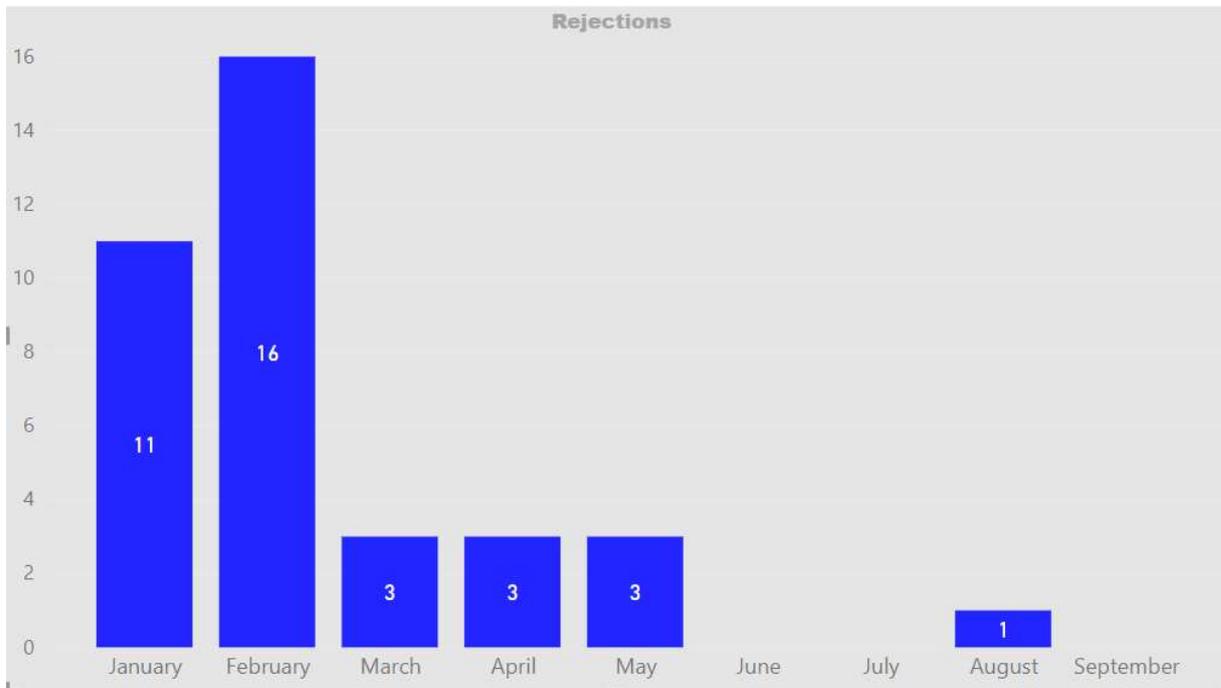
The cause of this difference could be either natural losses of material during transportation or reduction in humidity in the coffee beans with consequent reduction in weight of the water component or it could be caused by the intentional input of dust and foreign materials among the coffee beans. This dust, once the container is opened and weighted, could easily fly away and cause weight reduction.

The problem with the KPI was that some factories were weighting the load after a process of cleaning the coffee where the beans were passed through a filter to block all these foreign materials before being sorted in big bags. The fact of weighting the coffee after the cleaning was generating important differences and numerous unjustified claims against suppliers since the ECC does not include any cleaning process between the two weights.

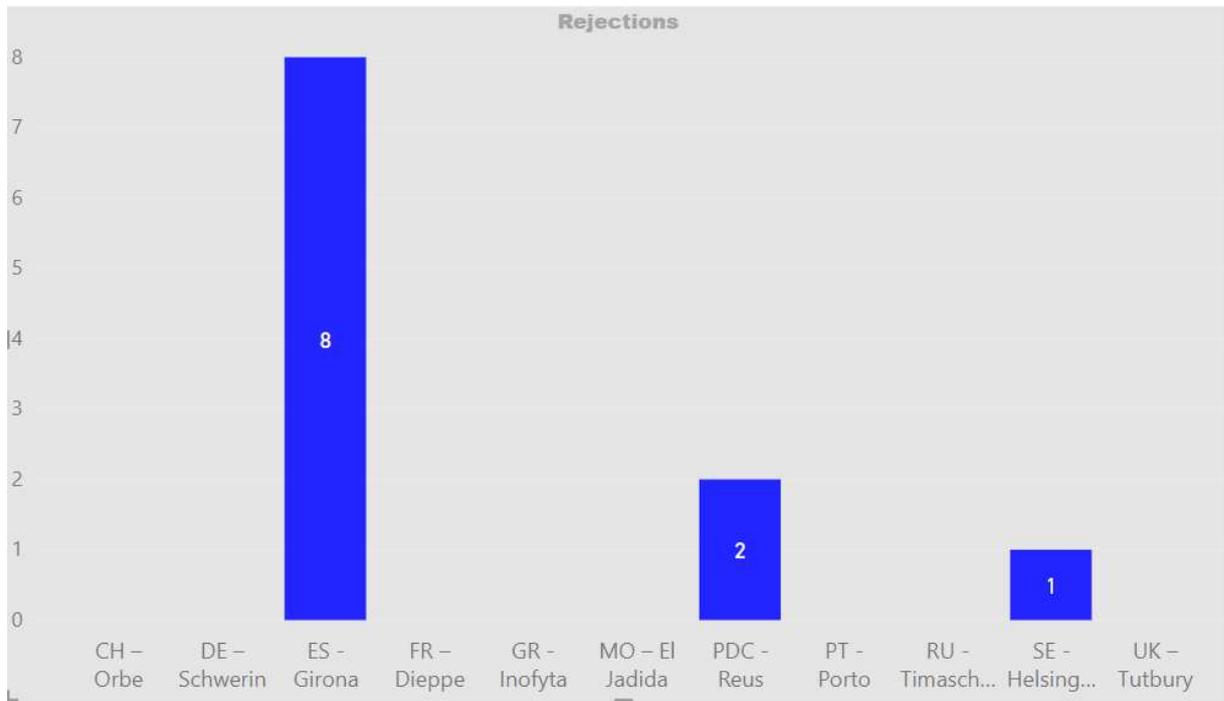
This indicator is then presented in a columns chart where each column represents a weight difference of a month and where horizontally we find the factories and vertically the weight difference level expressed in percentage. Everything below the green area is within the acceptable 0,5% tolerance.



Following in the dashboard, pages number three and four present Rejections of containers and Demurrages paid. The formers are generally linked to quality issues while the latter are due to delays in recollecting the goods from rented locations in the port.

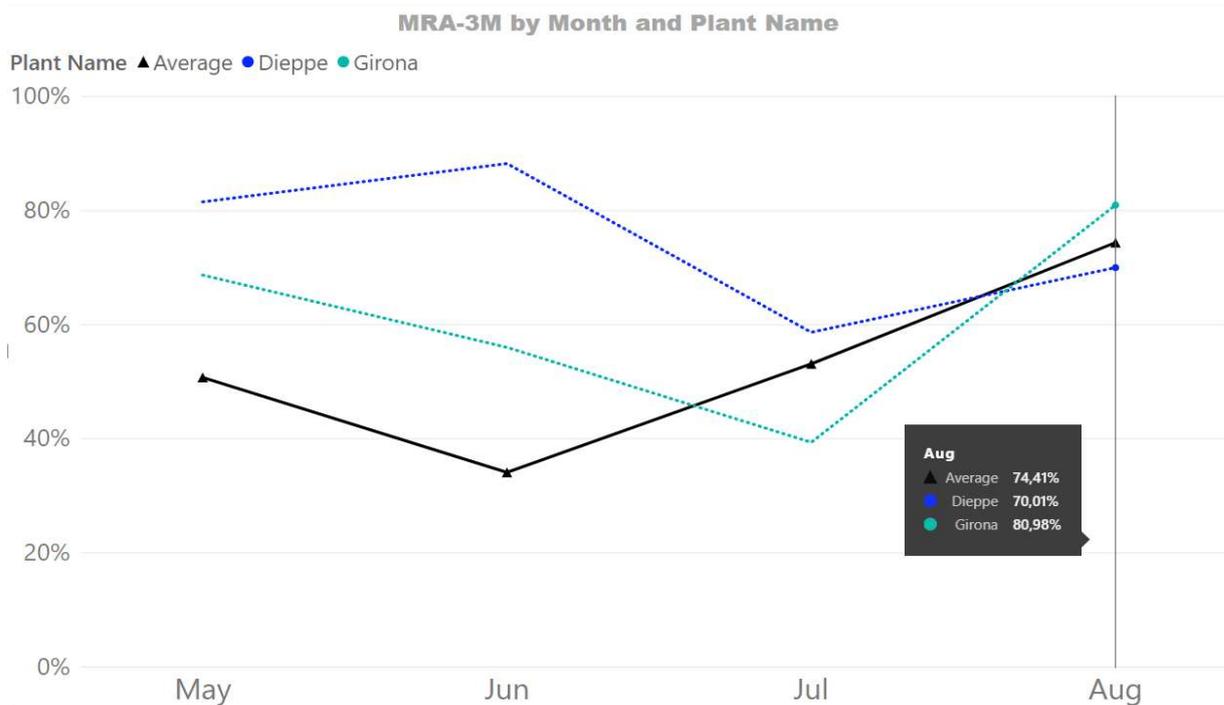


Once again, it is possible to interact with the graphs by clicking, for example, on the month of January to see how these eleven rejections were split among the different factories.



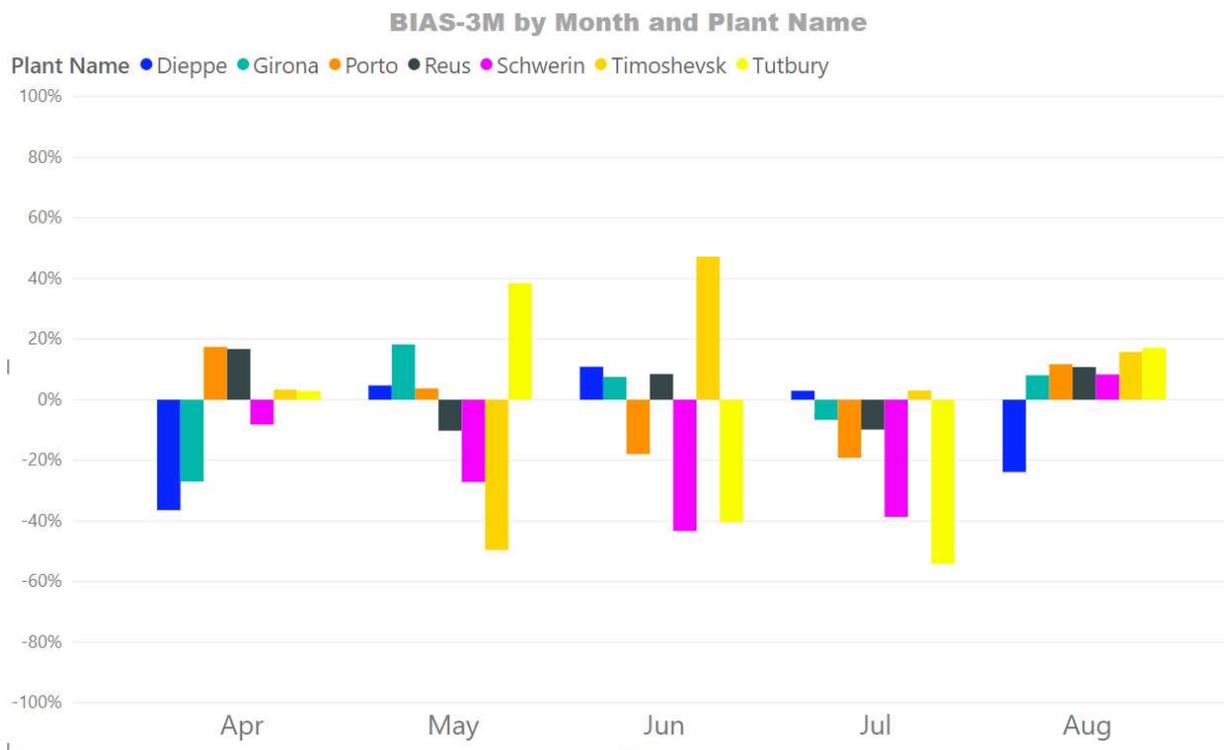
It is important to underline that Girona was the factory impacting the most on the Rejections KPI since there is a very strict law in the Spanish market about imported coffee humidity which must not overcome the value of 13% to avoid the presence of fungus and bacteria.

Following in the dashboard we find the MRA and Bias where the average of the zone was discussed, and factories were put in comparison to improve their performances and discuss changes in the market demand.



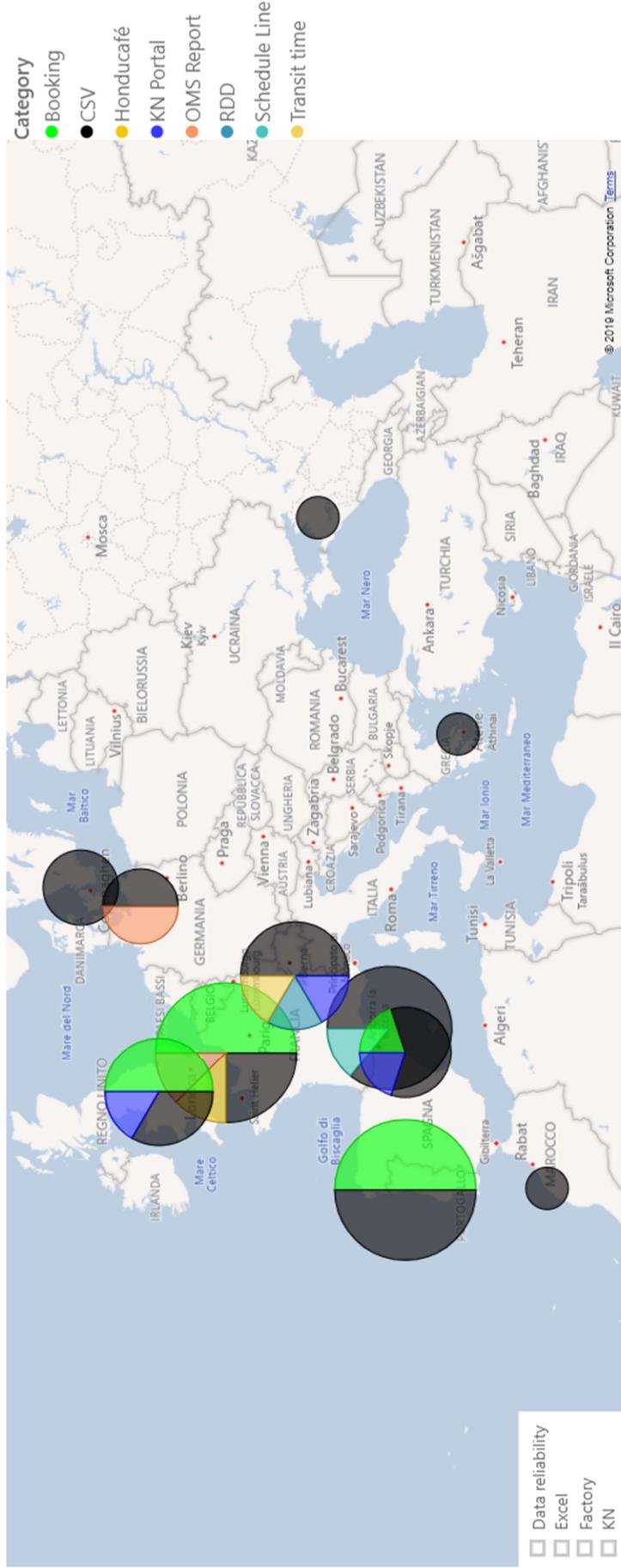
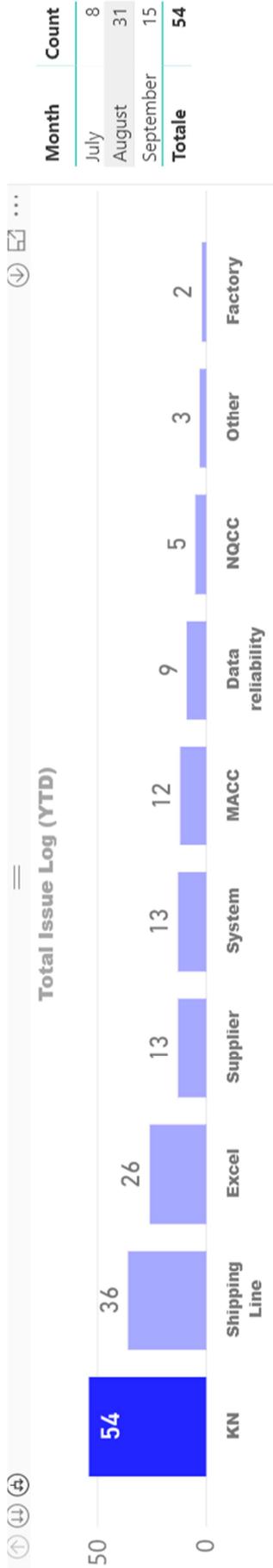
In this example, we see Dieppe was performing well until the month of June but then decreased its accuracy below the average while Girona managed to pass its negative trend and achieve an 80% MRA in August. Overall, we observe a positive trend in the MRA starting from June, meaning the factories acquired awareness on the impact of MRP changes along the supply chain.

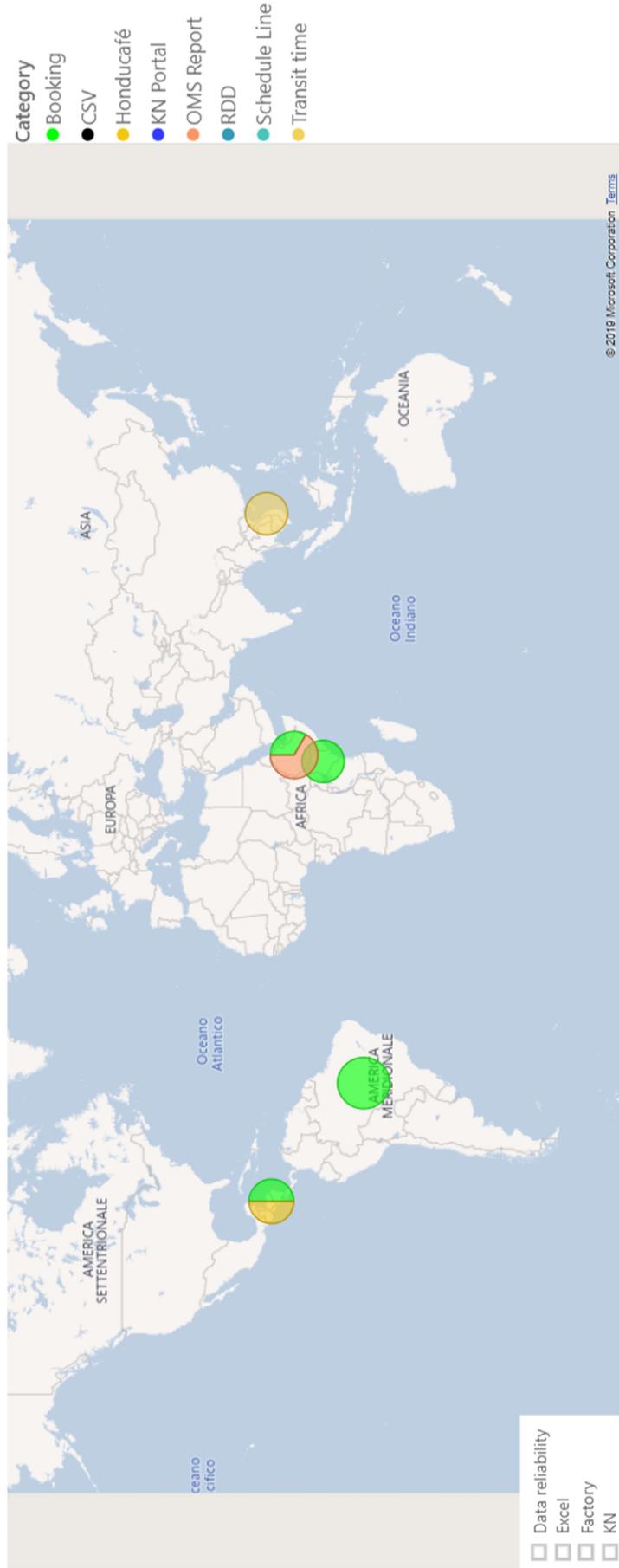
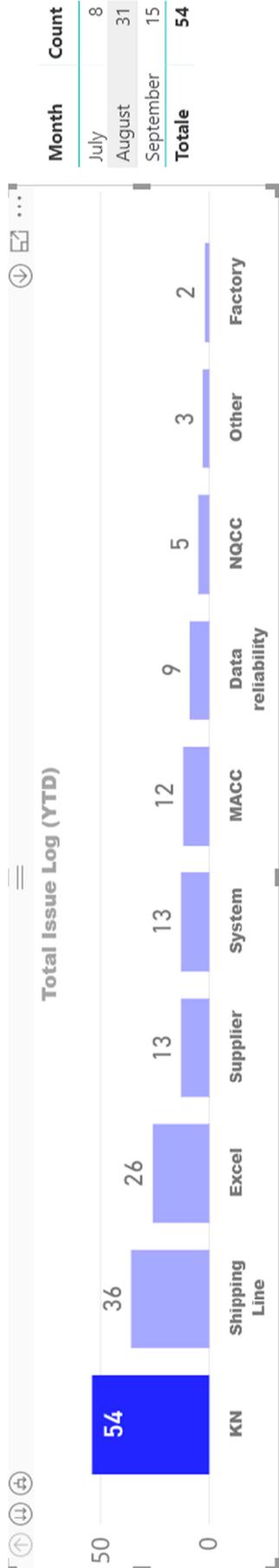
The Bias below is a good indicator of the discrepancies between forecast and consumption. It was useful to identify trends of the factory to forecast less or more than what was needed and then adjust the purchase.



The last part of the dashboard was dedicated to analysing internal problems such as issues encountered during the month or timeliness in submitting the Shopping Basket to be purchased by the buyers.

The Issue Log was an effective tool that gathered data during the Daily Operational Reviews (DOR) and then describing the problem by root cause, origin and destination country, time and potential solution. Clearly the information had to be put by the coordinator of the DOR in the Excel but then the layout in PowerBI allowed a good understanding of how to prevent issues and how to build knowledge on the past problems faced by the team. The view presented below is just a focus on the issues linked to K&N seen by destination country and then origin country and the size of the pie charts is proportional to the number of issues registered.





This analysis surely helped the team to find a seasonality in the problems related to the bookings in Brazil that were happening recursively between July and August every year.

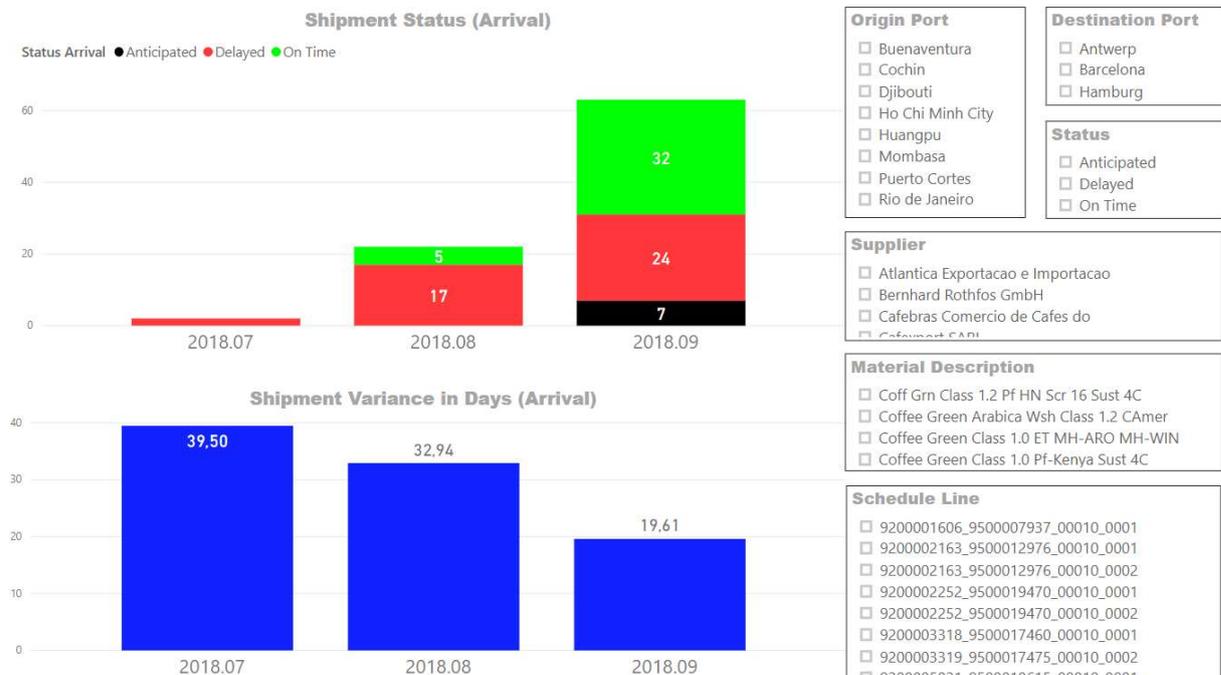
As said before, this part of the dashboard also included the issues with the submission of the Shopping Baskets (SB) and the creation of the Purchase Orders (PO). The picture shows the root causes for delays in SB submission on a year to date basis. Different colours indicate different causes while the inner rectangles show in which markets it happened and with which frequency.

The bottom part of the page, instead, is dedicated to measure the performance of the PO creation. In this particular case, the filter is set to the month of August for all the factories and the graph shows that 69 PO were created on time over a total of 139 (49,64%).



Concluding the MOR dashboard we find two pages dedicated to a KPI that was under construction: the shipment report. This KPI was built on the very last weeks of my experience in Nestlé with the purpose of creating a live tool to track delays in departure and arrival for all the shipments headed to EMENA.

However, in order to fill the information, it was needed to compile a field in SAP to provide the information of the required date of delivery and compare it against the expected date of delivery, an information that was not registered in the past and I had to code in an SAP column. So, since the information was not available for past shipments, the report appears still under construction and therefore it was not yet part of the discussion in the MOR.



The right-hand side of the page shows the filters applicable to the report. It is also possible to set a filter on the Schedule Line to observe a single or multiple shipment with the related information of origin, destination, supplier, etc.

The left-hand side, instead, is divided in two. The top part is dedicated to give information on the number of shipments anticipated, delayed or on time by month while the bottom part reports the average variance expressed in number of days compared to the required date of arrival.

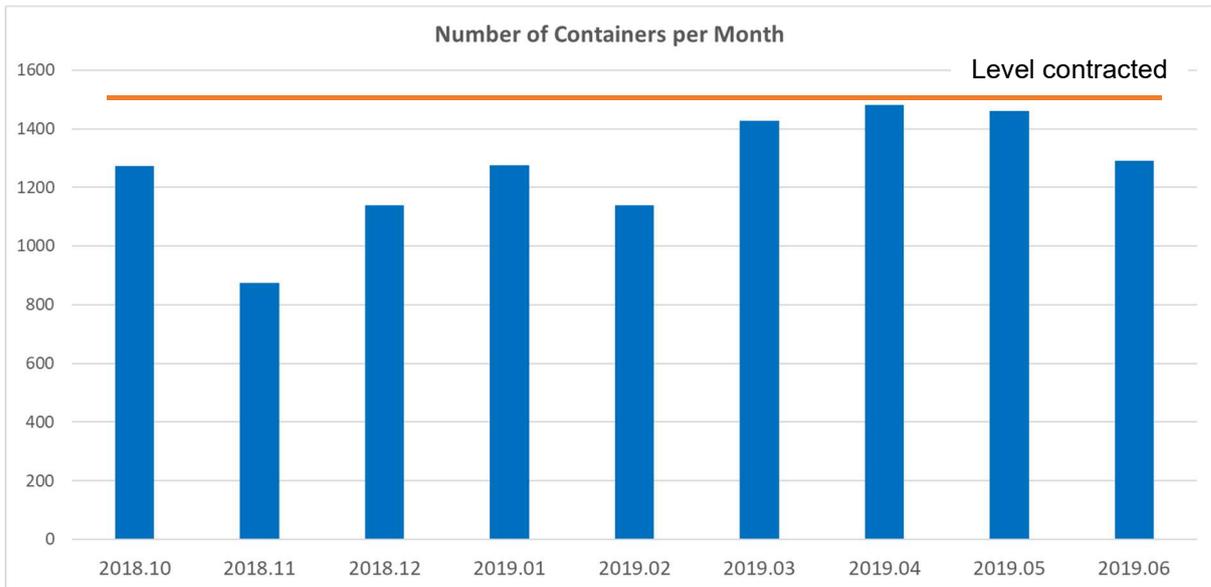
6.3 The Shipment Allocation Report (Supporting the Global Transportation Team)

The Shipment Allocation Report was created after the need of the Global Transportation Team (GTT) of Nestlé, based in Vevey, to have visibility on material movements from origin countries to have a dynamically updated set of data to negotiate containers allocation on the shipping lines working with Nestlé.

Up to that moment, the GTT was working just looking at one aggregated projection of containers movements for the upcoming year and then contracting allocations on

vessels to guarantee space to put Nestlé containers. However, the forecasted with twelve-months horizon provided a fixed aggregated value, not always that accurate, that was then divided by twelve to split equally the allocations between the months.

It is easy to think that this way of working was forcing the Nestlé group to contract far more the spaces actually needed with the shipping lines because the monthly allocation should have been large enough to cover all the twelve months no matter seasonality or peaks in the demand.



So, I had to build a report that would take all the Purchase Requisitions and Purchase Orders confirmed for all the EMENA factories and, for each material, identify a potential shipping route or a set of routes for the destination country. To do so, I had to firstly specify and origin port for the material code and then, adding the information about the destination port, identify a route. Later, I could cross this information with a report of the GTT to associate an average transportation time to the route.

Therefore, knowing the Purchase Requisition date, which would be the desired arrival date, and knowing approximately custom clearance times and the transportation time associated with the route, I could calculate back the date of departure of the material.

All the quantities in this report are expressed in containers (rounded to 21 MT) with a monthly and weekly time frame to allow the GTT to contract respectively in general terms and in specific terms the shipping lines.

Moreover, this report was updated once a month with the most accurate forecasts available. And this would let the GTT to adjust the initial yearly allocations contracted by comparing the initial values with the most recent ones that, for a three months horizon, should have less than 80% discrepancies with the true movements of containers.

In the following pictures we can observe the number of containers with a weekly time frame and, following, with a monthly one.

Containers per Week					Year:Week							
Origin Port	Destination Port	Material Description	Plant	Plant Name	2018.40	2018.41	2018.42	2018.43	2018.44	2018.45	2018.46	2018.47
Abidjan	Barcelona	Coffee Green Class 7.3 CI	0289	Girona	5	1	0	0	0	0	0	0
Abidjan	Barcelona	Coffee Green Class 7.2 CI	0289	Girona		4	0	0	0	0	0	0
Abidjan	Total Barcelona				5	5	0	0	0	0	0	0
Total Abidjan					5	5	0	0	0	0	0	0
Buenaventura	Barcelona	Coffee Green Class 1.1 CO Scr18	0289	Girona								
Buenaventura	Barcelona	Coffee Green Class 1.1 CO Scr18	0298	Reus	0				1			
Buenaventura	Barcelona	Coffee Green WsA Pf-Colombia Huila	0289	Girona	0	0	11		0	0	8	14
Buenaventura	Barcelona	Coffee Green Class 1.1 CO	0289	Girona				4	4			
Buenaventura	Barcelona	Coffee Green Class 1.1 CO	0298	Reus	0				3			0
Buenaventura	Barcelona	Coffee Green Class 1.1 CO M-WIN	0289	Girona								6
Buenaventura	Barcelona	Coffee Green Class 1.1 CO Sust4C	0289	Girona	2	13	0	0	0			
Buenaventura	Barcelona	Coffee Green Class 1.1 CO M-WIN Sust4C	0289	Girona	10	0	0	1	0	0	0	0
Buenaventura	Total Barcelona				12	13	11	5	8	0	8	20
Buenaventura	Hamburg	Coffee Green Class 1.1 CO M-WIN	7016	Schwerin		3			0	10	0	0
Buenaventura	Hamburg	Coffee Green Class 1.1 CO M-WIN Sust4C	7016	Schwerin	11	0	0	0	0	0	0	0
Buenaventura	Total Hamburg				11	3	0	0	0	10	0	0

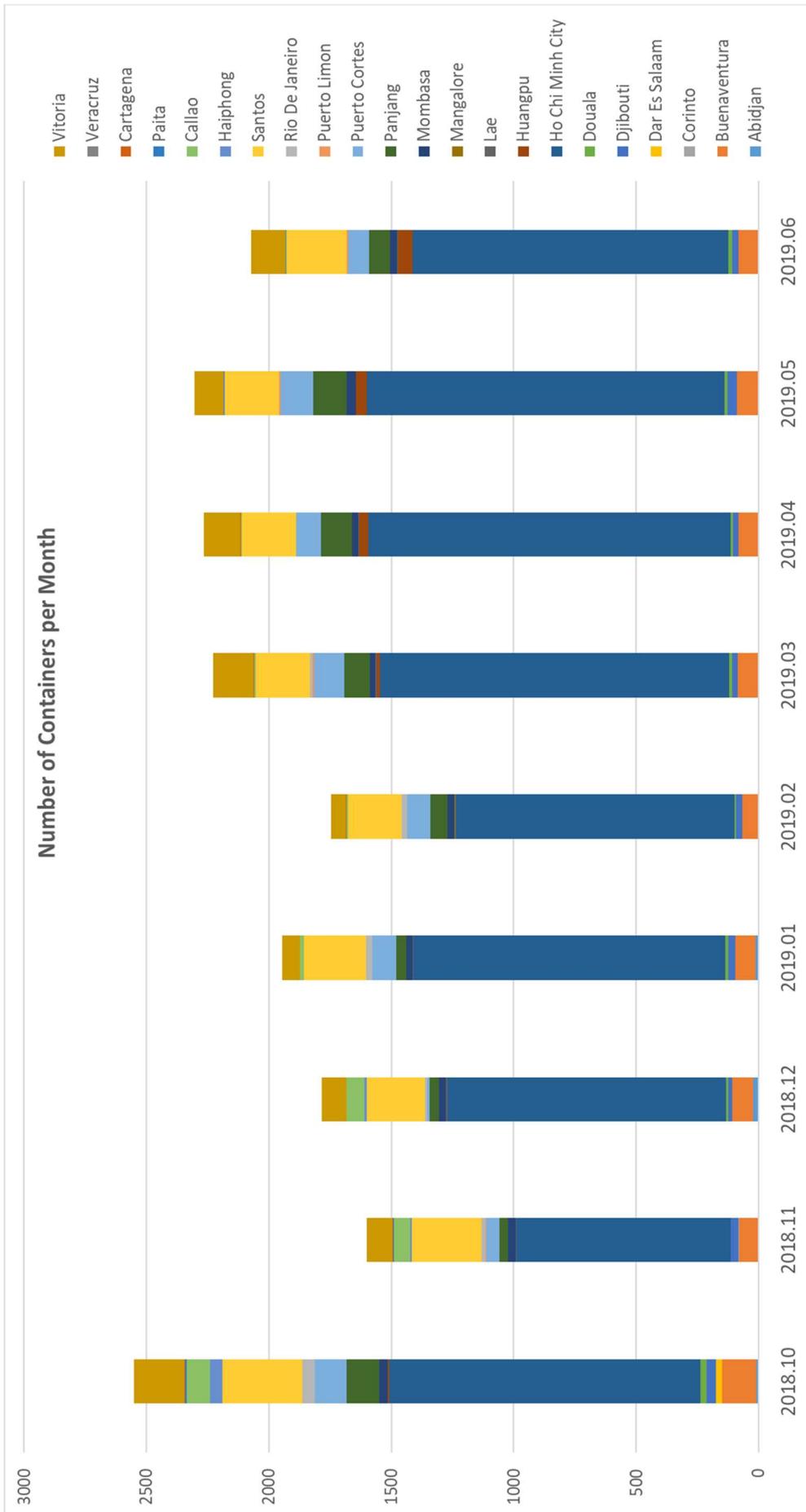
Suma de Containers	Origin	Abidjan	Buenaventura	Corinto	Dar Es Salaam	Djibouti	Douala	Ho Chi Minh City	Huangpu	Lae
2018.10		10	138	1	24	39	24	1272	6	2
2018.11		0	78	5	0	32	0	873	0	3
2018.12		21	88	0	0	16	7	1140	0	5
2019.01		12	84	0	0	28	12	1275	0	2
2019.02		0	65	0	0	27	7	1138	0	2
2019.03		0	84	0	0	24	12	1426	14	4
2019.04		0	82	0	0	24	7	1482	38	2
2019.05		0	89	0	0	37	12	1461	44	2
2019.06		0	82	0	0	27	15	1290	59	2
Total general		43	790	6	24	254	96	11357	161	24

In the first picture, each line shows the number of containers for each material code with its destination factory and port. Then, the total value for the route is contained in the grey lines while the blue lines show the total number of containers to be shipped from a specified origin port.

The second picture, instead, only shows the aggregated number of containers that will be shipped from an origin port on a monthly basis.

Another helpful view was provided by the graph attached in the following page. It shows, with a more user-friendly sight, the containers that will be shipped each month sorted by origin port.

This graph helped the GTT mainly to understand the monthly total volumes and which were the major players in terms of origin countries for coffee to understand which shipping lines suits best to Nestlé needs.



Another interesting point in the construction of the Shipment Allocation Report is that the report includes a percentage of switch between different origin countries for those materials that might have more than one origin during the year.

These materials, called “basket” materials, are common goods produced in different parts of the world because it easy to cultivate the crop or because of similar environmental conditions. An example of these materials could be the 7.2 class green coffee that is a very resistant and cheap crop which can be cultivated and bought either from Vietnam or Brazil between August and December. The rest of the year it is bought only from Vietnam.

When a material can have different origin in the same month, a percentage split will be introduced in the Excel formula to determine the origin port of the material.

All the information about material origin and splits were given to me by the Global Category Leader for coffee who had access to the strategic plan of purchase for the year. So, I integrated the following table in the report.

Seasonal Information for Shipment														
Material number	Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Expected volume split
40607711	1.1 Basket	Peru								Honduras				50% split
		/Honduras	Honduras	/Peru	Peru	Peru								
40607712	1.2 Basket	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	China	China	Brazil	Brazil	Brazil	50% split
					/China	/China	/China	China	/Brazil	/Brazil	Brazil	/Vietnam	/Vietnam	
40607741	4.1 Basket	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	
40607742	4.2 Basket	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	
40607771	7.1 Basket	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	
40607772	7.2 Basket	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Vietnam	Brazil	Brazil	Brazil	Brazil	Brazil	90% Vietnam / 10% Brazil

The introduction of this information in the report was possible using a randomly generated number and a logic function that would pick a different origin country depending on the month of shipment, which should well approximate the month of purchase. However, there were some exceptions in origin ports or countries for some factories for example for Tutbury (1092) which only bought the material 1.2 class (40607712) from Brazil all year, differently from what the origin table above shows.

To reconcile all the exceptions I was informed or aware of I had to introduce some logic structures in the Excel formula to determine the origin port resulting in this expression:

=SE(E(O(A16470="0178";A16470="0190");B16470="40607772");"Ho Chi Minh City";SE(E(A16470="1092";O(B16470="40607712";B16470="40607741";B16470="40607742"));"Santos";SE(E(A16470="1092";B16470="40607772");"Ho Chi Minh City";SE(O(B16470='Master Data'!\$W\$28;B16470='Master Data'!\$W\$29;B16470='Master Data'!\$W\$30;B16470='Master

Alberto Porcelli

```
Data!$W$31;B16470='Master Data!$W$32;B16470='Master
Data!$W$33);SE(O(E(CASUALE())<=0,1;B16470='Master
Data!$W$33);E(CASUALE())<=0,5;O(B16470='Master Data!$W$28;B16470='Master
Data!$W$29));INDICE('Master
Data!$W$35:$AJ$41;CONFRONTA(Daily_FU!B16470;'Master
Data!$W$35:$W$41;0);CONFRONTA(MESE(Daily_FU!D16470);'Master
Data!$W$35:$AJ$35;0));INDICE('Master
Data!$W$27:$AJ$33;CONFRONTA(Daily_FU!B16470;'Master
Data!$W$27:$W$33;0);CONFRONTA(MESE(Daily_FU!D16470);'Master
Data!$W$27:$AJ$27;0));INDICE('Master Data!'O:O;CONFRONTA(C16470;'Master
Data!'N:N;0))))))
```

So, from the original information provided by SAP:

Plant	Material	Material Description	Days	BUn	Receipts
1092	40607771	Coffee Green Class 7.1	20/12/2019	KG	64.800
1092	40607771	Coffee Green Class 7.1	22/12/2019	KG	0
1092	40607771	Coffee Green Class 7.1	24/12/2019	KG	151.200
1092	40607771	Coffee Green Class 7.1	31/12/2019	KG	21.600

It was possible to associate the following data with the Excel calculations:

Plant Name	Destination Port	Origin Port	Supplier	Month of arrival	Year
Tutbury	Liverpool	Ho Chi Minh City	Coex Coffee	November	2019
Tutbury	Liverpool	Ho Chi Minh City	Coex Coffee	November	2019
Tutbury	Liverpool	Ho Chi Minh City	Coex Coffee	November	2019
Tutbury	Liverpool	Ho Chi Minh City	Coex Coffee	November	2019

Containers	Custom Clearance	Transit Time	Route Key	Shipment	Year.Week	Year.Month
3	7	31	Ho Chi Minh CityLiverpool	12/11/2019	2019.46	2019.11
0	7	31	Ho Chi Minh CityLiverpool	14/11/2019	2019.46	2019.11
7	7	31	Ho Chi Minh CityLiverpool	16/11/2019	2019.46	2019.11
1	7	31	Ho Chi Minh CityLiverpool	23/11/2019	2019.47	2019.11

The number of containers was calculated approximating the receipts quantity a standard container load, that could be either 21,000 or 21,600 kg. The Route Key, instead, was the key reference to look up the transit time of the route in the GTT report.

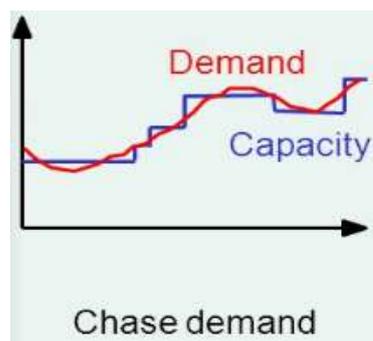
So, while the report was initially developed to serve the allocations towards the EMENA zone, it was so appreciated and useful for the GTT that it was presented in the executive board for commodities and adopted, with some adjustments, also by Dairy division (chocolate) and for infantry products.

Later, I extended the report with a global scope also to the zones of AOA (Asia, Oceania and Africa) and AMS (Americas) under the request of the GTT's managers.

Despite the report was already set up, it was not easy to include the rest of Nestlé's factories spread around the world because nobody in the Barcelona HUB had experience with the factories beyond the European borders and also because we did not have permissions in SAP to access data regarding those factories. To overcome this barrier, I had to open a request, along with the supervision of my manager, in the Nestlé internal information system to give roles and access to the required information to all the logistics team members. Once the roles had been extended at a global level, I could aggregate the information of all coffee factories providing a report with global scope to the GTT.

Plant	Plant Name	Destination Port	Zone
0012	Orbe	Antwerp	EMENA
0289	Girona	Barcelona	EMENA
0298	Reus	Barcelona	EMENA
0303	Porto	Porto	EMENA
0444	Inofyta	Piraeus	EMENA
0698	Helsingborg	Helsingborg	EMENA
0814	Dieppe	Le Havre	EMENA
0895	Timashevsk	Novorossiysk	EMENA
1092	Tutbury	Liverpool	EMENA
7016	Schwerin	Hamburg	EMENA
0310	El Jadida	Casablanca	AOA
3444	Mexico	Lazaro Cardenas	AMS
3312	Mexico	Veracruz	AMS
CHILE	San Antonio	San Antonio	AMS
USA	Nestle USA	New Jersey	AMS
1135	Malaysia	Port Klang	AOA
3411	KR CP Subcontracting	Busan	AOA
3657	KR PL Cheongju	Busan	AOA
4911	Japan	Kobe	AOA
0178	South Africa	Durban	AOA
0525	Thailand	Lat Krabang	AOA
1927	Australia	Brisbane	AOA
0190	Philippines	Cagayan de Oro	AOA

We can affirm then that the report was used to change a levelled planning of the container allocation to a more flexible "chase demand" planning technique.



7 Conclusions

Nestlé logistics is a complex machine developed all around the globe focused on a continuous flow of materials from origin countries to manufacturing regions and, so far, the process is managed by the central HUB of Barcelona in a standardized way for all materials.

However, it is legit to think that twin HUBs will grow in AMS and AOA zones to control closely the processes in FOB terms also for the manufacturing activities in those two other regions. It is also intuitive that margins for improvement are still there to be discovered and tested for the green coffee supply chain.

From my side, I would like to focus on a potential improvement in the materials management disrupting the standardized control of all materials in favour of a more efficient stock management policy.

7.1 Future improvements

The purpose of implementing a more efficient stock management policy is to save time in planning and procurement activities and to be able to play with stock out costs for some materials whilst guaranteeing availability for others.

My intention is to implement a dual stock management policy following the theory of “Material A” and “Material C” stock management.

The former will be a look ahead stock management policy which will focus on forecasts and uncertainty to plan supplying orders. The latter, instead, is intended as a look back stock policy where future refilling orders for the warehouse are calculated on the historical consumption to fix the reorder level at which the level of stock will be restored.

Nestlé is performing a “Material A” policy for all raw materials, risking at low levels of stock also for those materials that are crucial for the production and consuming a lot of energies in observing and calculating a variable quantity to be reordered for each material code.

The first step for implementing a different technique of stock management would be to perform an ABC analysis on the raw materials for each factory to identify a Pareto relationship (80:20) among materials and economic impact on the business.

For an experimental purpose, I took the example of Orbe factory to perform the ABC analysis.

The total number of materials for the Swiss factory is thirteen, not the largest factory but large enough to serve the purpose of the analysis.

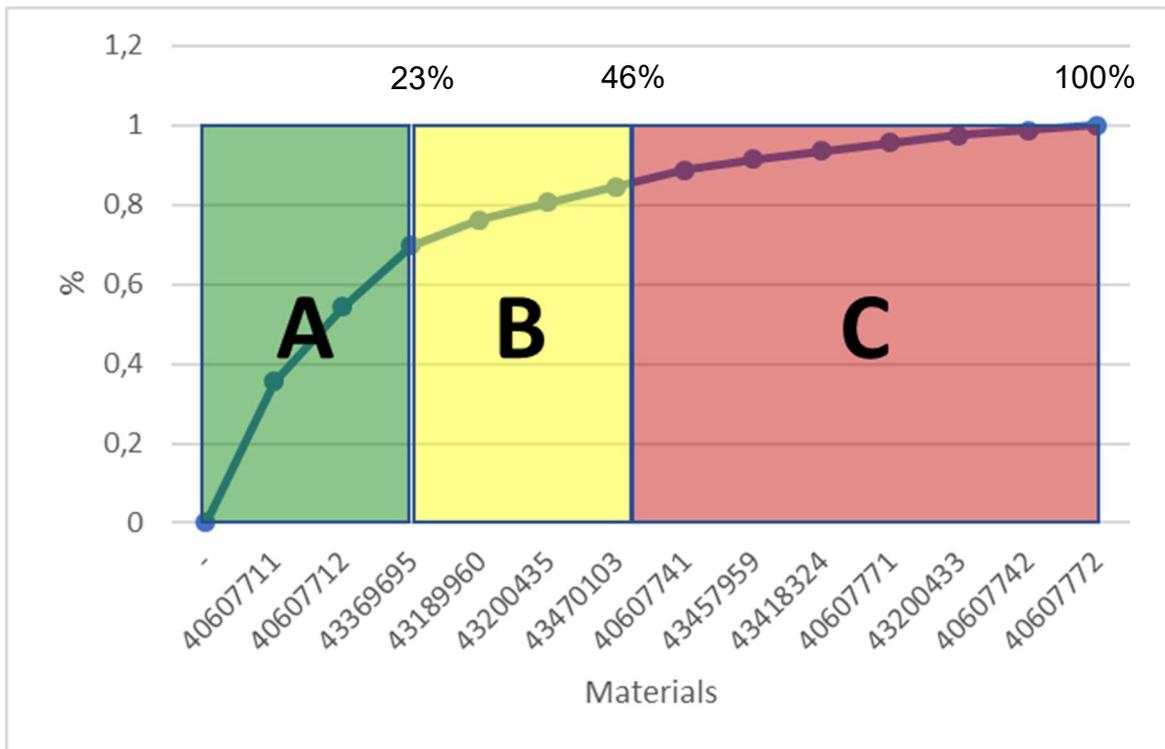
7.1.1 ABC analysis

To calculate the economic impact of these materials, we can observe an SAP report for the stock situation including the value of the stock held in the different storage locations. Then, we can obtain the unit cost of 1 kg of raw material and multiply this value for the average monthly demand to estimate the impact of the investment for a specific material on the business.

Material code	Stock Quantity [kg]	Stock Value [€]	Unit cost [€/kg]	Demand	Impact on business [€]	Relative weight
43189960	747583	2660882	3,6	277185	986587	6,43%
43200433	348989	568540	1,6	183750	299348	1,95%
43200435	571675	1682273	2,9	231000	679766	4,43%
43369695	1013530	3619510	3,6	665086	2375152	15,48%
43418324	756542	1083368	1,4	231300	331221	2,16%
43457959	696249	1986295	2,9	147000	419369	2,73%
43470103	2511	10986	4,4	142800	624807	4,07%
40607711	231183	5208844	22,5	241500	5441295	35,47%
40607712	299033	4523499	15,1	190750	2885487	18,81%
40607741	864711	3017424	3,5	178500	622878	4,06%
40607742	2754162	3078647	1,1	166250	185837	1,21%
40607771	1520295	1753508	1,2	264250	304786	1,99%
40607772	5067651	2184921	0,4	430500	185610	1,21%
					15342145	100,00%

If we sort the materials by their relative weight on investment, we come up with the following table:

Material	% of investment	Cumulative %	Stock policy	% of materials
40607711	35,47%	35,47%	EOQ	8%
40607712	18,81%	54,27%	EOQ	15%
43369695	15,48%	69,76%	EOQ	23%
43189960	6,43%	76,19%	EOQ	31%
43200435	4,43%	80,62%	RL	38%
43470103	4,07%	84,69%	RL	46%
40607741	4,06%	88,75%	RL	54%
43457959	2,73%	91,48%	RL	62%
43418324	2,16%	93,64%	RL	69%
40607771	1,99%	95,63%	RL	77%
43200433	1,95%	97,58%	RL	85%
40607742	1,21%	98,79%	RL	92%
40607772	1,21%	100,00%	RL	100%



Despite the relationship 80:20 is not perfectly matched, we can see that around 23% of the materials account for 70% of the business investment. Therefore, we could assume that these materials can be considered as material 'A' category. On the right-hand side of the graph we can observe about 54% of the materials involving less than 12% of the total investment for the company. Such materials will be treated as 'C' category materials.

The remaining materials, materials of class 'B', will fall in one of the other two categories and will be managed accordingly. In particular, we can consider material 43189960 as class 'A', since it still has a fairly significant impact on business investment, and the other materials as class 'C'.

After sorting the class 'B' materials, we can assign a stock policy to each material as showed in the table presented previously and for this, we will calculate the Economic Order Quantity (EOQ) for class 'A' materials and the Reorder Level (RL) for the others.

7.1.2 EOQ or JIT?

The Economic Order Quantity is the number of units that a company should add to inventory with each order to minimize the total costs of inventory such as holding costs, order costs, and shortage costs. The EOQ is used as part of a continuous review inventory system in which the level of inventory is monitored at all times and a fixed quantity is ordered each time the inventory level reaches a specific reorder point.

The EOQ model assumes that demand is constant, and that inventory is depleted at a fixed rate until it reaches zero. At that point, a specific number of items arrive to return the inventory to its beginning level. Since the model assumes instantaneous replenishment, there are no inventory shortages or associated costs. Therefore, the cost of inventory under the EOQ model involves a trade-off between inventory holding costs and order costs (any fees associated with placing orders, such as delivery charges). Ordering a large amount at one time will increase holding costs, while making more frequent orders of fewer items will reduce holding costs but increase order costs. The EOQ model finds the quantity that minimizes the sum of the total cost (C_{tot}) expressed as:

$$C_{tot} = C_f + C_o + C_{sh} + C_p$$

where:

- C_f indicates the cost of fixed assets in the warehouse;
- C_o stands for the cost of placing an order to the supplier;
- C_{sh} is the cost of shortage, the potential loss due to an out of stock situation and a missed sale;
- C_p represents the total cost of the product demand.

Since the basic concept of EOQ is to find a balance between holding costs and ordering costs, it might seem a contradiction to stress the reduction of the batch order to the unit, as the JIT philosophy. However, if we can reduce the order cost, then the EOQ reduces along with the total cost. So, depending on the agreements with the suppliers, it might be much more attractive to order a smaller lot size and a continuous refilling of the warehouse.

On the other side, we need to consider the green coffee beans are generally coming from the other coast of the ocean, so it would be extremely cost inefficient to purchase any quantity lower than a shipment transport unit, a container load. Moreover, we need to take into account the reception of the material in the warehouse, which can be parcelled up to an efficient point where the workforce operates for limited hours focusing the workload. It would not make sense to have a constant unloading of coffee bags or boxes while it could be much more convenient to directly unload the full container in a filter grid which ends in a hopper that sorts the coffee in big bags of 1 MT for an efficient stowing of the material.

So, we can affirm that despite the efficiency of the one-piece-flow process, we will need to consider a 21 MT container as our minimal batch size.

Further considerations need to be done on the evaluation of C_o , C_{sh} and C_p . The C_o cost of order includes not only the transportations costs described above, but also any costs associated with the creation of a contract and a negotiation between the buyer and the supplier. This cost, however, can be negligible since the only cost we could associate with this activity would be the definition of the differential considering that the creation of the contracts carries no extra costs associated. So, again, we are constrained to the container as minimal batch. The C_{sh} is extremely complex to calculate as well as the C_p since the product price fluctuates depending on the market price of either New York or London trading markets.

This uncertainty in cost evaluation would make the determination of the Reorder Point (**RP**) quite difficult as it should be the value that minimize the equation:

$$C_{tot} = \left(RP - C_{\mu} + \frac{Lot}{2} \right) \cdot pi + \frac{Q_0}{Lot} a + p_s \frac{Q_0}{Lot} T_s c_s + p Q_0$$

Another trouble comes from the procurement process as it is designed now. The process, in fact, expects the calculation of material purchase quantities to happen during the first week of each month to allow an efficient negotiation and communication in the second week of the month to the buyers. Such negotiation can obviously be more efficient if all the volumes to be purchased are contracted at the same time with the supplier. So, it would be a meaningful choice to keep the negotiation of all materials at the same moment, both for class 'A' and class 'C' materials. Thereby, knowing class 'C' materials will be purchased on a monthly basis (or a multiple of it), why not fixing the **RP** to the first week of each month and build a semi-kanban monthly system?

Considering we have the information of the demand coming from the MRP and we should try to minimize the stock level at most to meet the target of 70 days of total stock, the planner could plan accurately the quantity to be purchased by comparing the actual level of stock and the forecasted consumption in the following three months. To do so, the monthly forecasted demand should be aggregated and set as new

purchasing volume as a test in the Stock Cover Excel. Then, the stock cover in days should be compared week by week by the planner to ensure both the target of 70 days is not overtaken and the safety stock and times are respected during the frozen period.

If one of these two constraints is not respected, then the planner will have to adjust, either in positive or negative, the quantity to be submitted to the buyers for the purchase. This is why it should be a semi-kanban system, since not all the quantity requested for the consumption would be actually replaced. While the pure Kanban system requires every unit of material to be associated to a card that will eventually be transformed into a replenishment need when the material will be consumed, the new system should rather have a comparison of material consumed with material already available and future demand that might have an impact on the stock cover target, since lower requirements will require lower stock quantity to achieve the same target in days (look at the calculation of stock cover days in the Stock Cover File paragraph).

This way of working should allow a narrow and effective planning for those materials that impact the most on business investments, thus reducing the working capital of the company overall.

Although the process may seem easy to implement, it presents two limits or inefficiencies. The first of the two is the time. This planning process would be extremely time consuming because at least twelve weeks for each material will need a scrupulous analysis to avoid discrepancies from the targets and adjust, rounding to the container unit, the quantity to be purchased at their best value. The second issue would be the variability associated with the forecasted demand. As described in the previous chapters, the variance associated with the MRP represents a serious issue to be tackled along with the variability of the shipping times. These uncertainties could easily wear away the safety stocks of the warehouse and expose the factory to a stock out risk. Nevertheless, the stock out event is a risk that the company will have to assume and plan in the definition of the safety stocks themselves, accordingly to the service level that needs to be achieved. So, the variability should be still reduced but is a factor that is part of the game and risk for class 'A' materials.

Undoubtedly a solver system of equations could be applied to the described system to guarantee the planning process is done automatically, without human errors and in a more efficient and quicker way. But we need to consider that the Excel solver tool has limited number of variables and constraints, so it might be required an external more powerful solving software.

7.1.3 Reorder levels

The reorder level is the level of quantity at which the stock will be ideally restored once the supplier will deliver the planned order. This stock policy will avoid the majority of the risks associated with the stock out events and the variability of the demand since the reorder level is calculated to be sufficient for the 99,73% of the possible demand

levels and the 95% of the possible lead times. The discrepancy between the two percentages is due to the fact that the demand distribution could be approximated to a two-tales normal distribution whilst the lead time should be considered as a one-tale normal distribution since we are only interested in covering those times that are larger than the average delivery time and we are not worried about any “early” delivery.

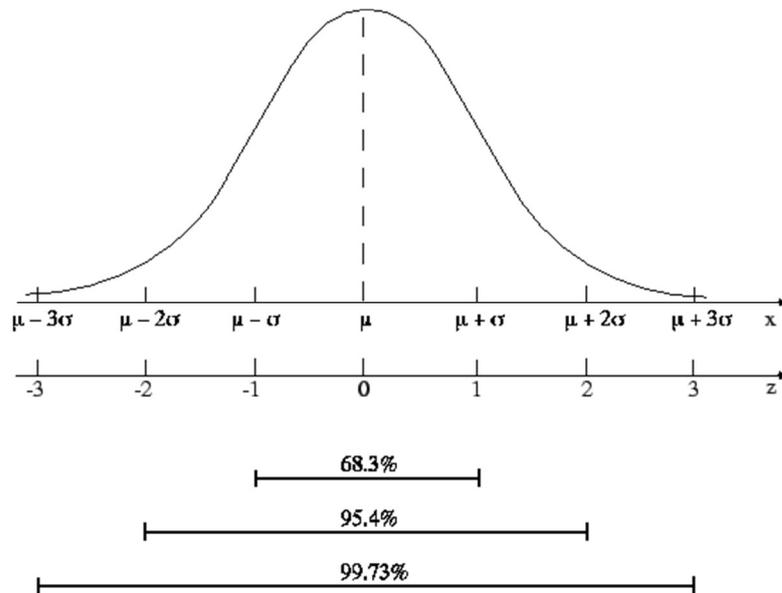
The lead time information has been extracted from a K&N report, who is in charge to monitor all the shipments for Nestlé EMENA. From the data available in the report we can calculate the average time and the standard deviation associated for the delivery.

The ΔT represents a time interval expressed in months as an integer multiple of the average lead time (\overline{LT}) including three standard deviations (σ_{LT}).

$$\Delta T = Integer[\overline{LT} + 3\sigma_{LT}]$$

The other factor that influences the Reorder Level is the consumption. The information about the average monthly consumption (\overline{C}) and its standard deviation (σ_C) can be easily calculated from the data available in the reports extracted from SAP and used for the MRA analysis. An interesting fact is the high value for the standard deviation for some materials. As discussed above, the variability associated with the demand is a crucial problem for Nestlé logistics, and this problem is naturally reflected in all its operations.

If we calculate the reorder level only on the average monthly consumption we would have the probability that in 50% of the cases the demand will be covered by the reserves. However, the stock policy associated with class ‘C’ materials is to avoid stock outs because it is not worth for the business to juggle with stock levels for these materials from a cost perspective. Therefore, if we sum a factor of $z \cdot \sigma_C$ we will increase our probability of satisfying the demand, assuming the demand will follow a normal distribution.



In fact, the larger the z factor the larger will be our chances to satisfy the demand. We can then fix the z to 3 to reach the 99,73% probability of having enough material stowed to face the monthly demand.

The **Max** value, so representing the maximum consumption that the company could face within a month in 99,73% of the cases, is calculated as:

$$Max = \bar{C} + z \cdot \sigma_c$$

Where \bar{C} indicates the average monthly consumption and the z value is fixed to 3.

Material code	Lead Time			Consumption			RL
	Average	Sigma	ΔT	Average	Sigma	Max	
43200435	0,70	0,10	1,00	231000	100669	533007	693000
43470103	1,17	0,13	2,00	142800	75207	368421	882000
40607741	0,70	0,07	1,00	178500	26005	256514	315000
43457959	0,70	0,08	1,00	147000	75126	372377	462000
43418324	0,93	0,13	2,00	231300	119037	588410	1407000
40607771	0,93	0,13	2,00	241500	28879	328138	798000
43200433	0,70	0,10	1,00	183750	83207	433370	567000
40607742	0,67	0,09	1,00	166250	43324	296221	378000
40607772	0,93	0,13	2,00	430500	175146	955938	2289000

Finally, the Reorder Level (**RL**) is calculated with the following formula:

$$RL = Max \cdot (\Delta T + z \cdot \sigma_T)$$

The value is then rounded to the closest standard unit of load which is one container (21,000 kg) for an operational and practical purpose.

Now that we know the Reorder Level, the logistics planner will have to compare the current stock situation at 3PL and calculate the order quantity (Q) to be shipped as:

$$Q = AC + FC$$

where:

- FC stands for forecasted consumption, the quantity we foresee to consume from the order point to the supplier's delivery.
- AC stands for actual consumption, expressed as the difference:

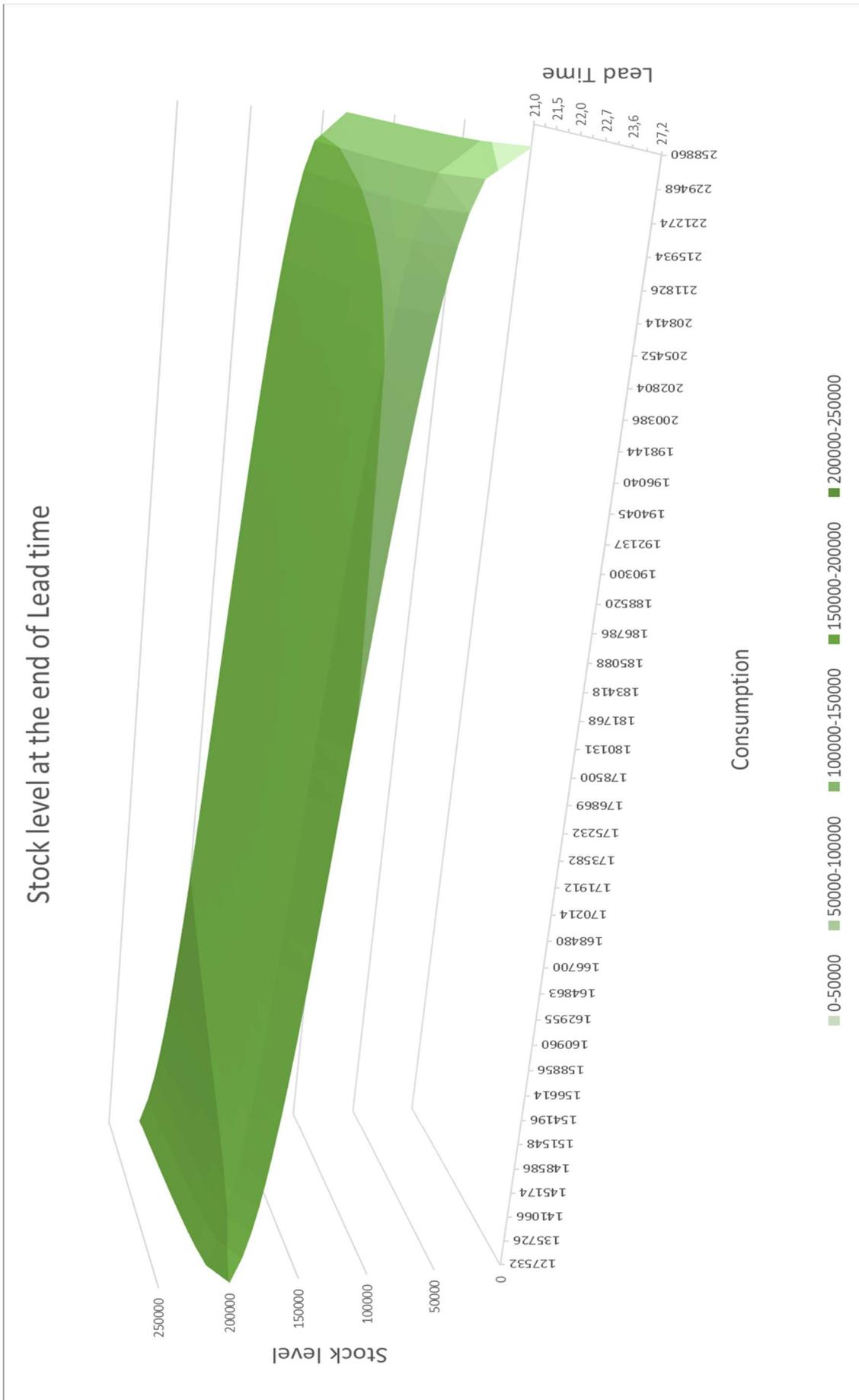
$$AC = RL - CurrentStock$$

For example, for the material code 40607741, the planner will have to place an order every month ($\Delta T = 1$) to reach the ideal level of 315,000 kg. So, if we assume the stock is at 260,000 kg at the moment of placing the order with the supplier and we forecast to consume 126,000 kg, then we will have:

$$AC = 315,000 \text{ kg} - 260,000 \text{ kg} = 55,000 \text{ kg}$$

$$FC = 126,000 \text{ kg}$$

$$Q = 55,000 \text{ kg} + 126,000 \text{ kg} = 181,000 \text{ kg}$$



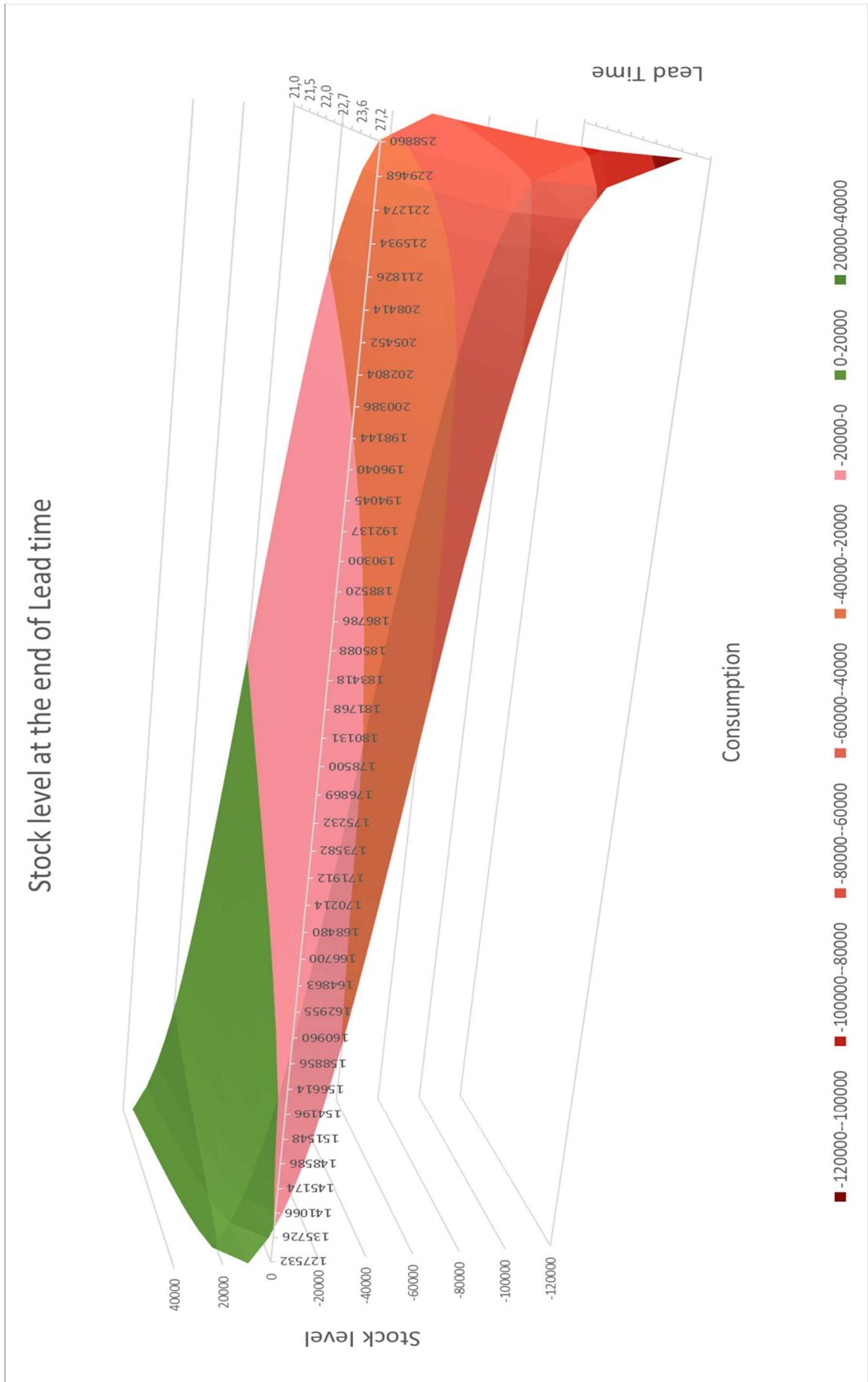
The previous graph presents the potential scenarios we would incur for the combination of variable consumption levels and delivery times, accordingly to their average and standard deviations. The surface in the graph shows the level of stock at the time of supplier's delivery. The green area shows that there is still material available in the warehouse to satisfy the production requirements. A red colour, instead, would indicate a negative stock, hence an out of stock situation.

However, it is interesting to point out that if we reach the critical stock level of 124,950 kg at the moment of reordering for this material, the stock could be just enough to cover a demand of 178,500 kg (Prob=50%) with a delivery time of 21 d (Prob=50%).

This combination of consumption and delivery time is an event most likely to happen since it is generated by the average values of consumption and lead time. If this happens, the planner should start the emergency process of Spot purchase or Interfactory movement to dab the gap in the stock levels in case either consumption or delivery time exceed their average value.

The situation described in the previous paragraph could happen in the event of having had, during the previous month, a consumption greater or equal to 234,932 kg (Prob=0,015%) and a total lead time of at least of 24,3 d (Prob=0,05%), a rare event that has low chances to happen.

The picture below shows the potential scenarios we will have having the current stock level at 124,950 kg when placing a new order.



It is clear that the red area shows a lack of stock in the warehouse due to an unfavourable combination of lead time and consumption. The '0' line that separates a positive stock situation from a negative one starts from a situation of average consumption (178,500 kg) and lead time (21 d) and delimitates a green surface front for increasing values in the lead time, which means that for rising delays in the delivery, the stowed material will be enough for lower consumption quantities.

The use of a class 'C' stock management would not only guarantee healthy levels of stock for Nestlé but it would also ease the work and analysis of the planners in the Logistics HUB in Barcelona that will now have the Reorder Level as a reference point and will rather be able to focus on a more accurate planning of class 'A' materials, generating potential savings for the company in terms of stock holding costs and working capital.

8 References

Shortage cost

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