

REDESIGNING THE LAVAZZA LOGISTICS NETWORK

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Redesigning the Lavazza logistics network

At the end of the '90s – beginning of 2000's, the logistic department of one of the world's largest coffee producer, Lavazza SpA¹, was acutely aware of the growing burden that demand fluctuations imposed on the company's manufacturing and distribution system. In those years, the logistic network adopted by the company until then was no longer suitable and, consequently, it seemed that it should have been redesigned. At the beginning of the 2000's the company faced the dilemma of making a logistic "make" or "buy" decision. At that time, what was the best decision to be made? How to redesign the logistic network? What were the pros of adopting a collaborative logistic network? The case frames the logistic network redesign decisions made by Lavazza between the end of the 90's and 2012.

The history of the Lavazza Group

Established in 1895, the Turin-based company has been owned by the Lavazza family for four generations. Lavazza is one of the most important roasters in the world, a leader in Italy with a share of about 44% of the retail market by value.

The history of Lavazza began with the "Droghe e Coloniali" shop opened by Luigi Lavazza in 1895 in Turin. It was a small shop specialised in the roasting and sale of coffee. The first innovation that marked the 120-year history of the company was the fact that Luigi Lavazza did not limited himself to roasting coffee but rather created and introduced the concept of "coffee blends". Mixing coffees of different origins, creating a blend based on precise equilibria and proportions, made it possible to produce a beverage distinguished by a unique, original aroma.

Twenty years after its founding, in 1915, thanks to technological innovations introduced in the roasting business, Lavazza was the fifth largest buyer of raw materials in the industry and first among the companies roasting espresso coffee. The first Turin plant at Corso Giulio Cesare was built in those years, and a new material called "pergamini" was introduced into the production cycle, which at that point was operating on a large scale. The innovative "pergamini" packaging made it possible to preserve the aroma and fragrance of freshly roasted coffee without altering it. This allowed the company to expand its market since at that point the packages could be purchased by consumers who did not live in the immediate vicinity of the Lavazza factory.

In 1927 the sons of the founder transformed the family business into a joint-stock company with a capital of 1.5 million lire.

1931 marked a turning point in the distribution system. Abandoning the method of sales on commission, the company decided to change its sales strategy by switching to mobile sales,

¹ SpA (*Società per Azioni*) can be interpreted as "Inc.".

creating a network of agents equipped with company vehicles that delivered freshly toasted coffee directly to retailers.

In 1946 Lavazza was primarily focused on developing the Italian market. With its 20 salesmen the company decided to offer shops toasted coffee in sealed bags bearing the Lavazza brand. In fact, up to that point coffee was sold in bulk, scooped out of glass jars or taken from silos. This innovation made it possible to render the product and its quality recognisable both by the shopkeeper and customers. Thus was born the first coffee distinguished by quality guaranteed by a recognisable brand.

With the opening of the factory in Corso Novara in Turin in 1957 the roasting industry was born. Here an innovative production cycle was adopted, abandoning the traditional horizontal process and replacing it with a vertical gravity method. This system, never used before in Italy, proved to be effective from an operational point of view and was also competitive in terms of costs. Furthermore, advanced automation systems were also used in the Corso Novara factory, allowing for a daily production of 40 tonnes of coffee, packaged in bags or in vacuum-sealed cans. In fact, in the early 1960s Lavazza was the first company in Italy to introduce vacuum packs of ground coffee, a revolutionary innovation. With this method coffee became a product with a long shelf life and could be transported anywhere. The ability to maintain the quality and freshness of the product intact over time allowed the company to win over Italian consumers. Looking to make the most of its large-scale production and the introduction of innovative packaging, the company sought to conquer the mass market. To meet growing demand, in 1965 it opened a new plant in Settimo Torinese, currently one of the most important production plants in the world.

Lavazza continued its innovative ways in the 1970s. In fact, the company was the first to introduce vacuum-packed coffee in aluminium foil. It was an innovative packaging that, besides being cheaper than a can, proved to be an excellent vehicle for communications. In those years, new mixtures were developed including “Qualità Rossa Lavazza”, still popular today with Italian consumers.

In the 1980s the expansion into the European market began and subsidiaries were opened in France, Germany, Austria, England and the United States, followed by Portugal and Spain in the 1990s. The opening of the Lavazza España subsidiary allowed the acquisition of the Spanish coffee shop chain Il caffè di Roma and its more than 70 branded retail outlets.

In 1989 there was another burst of commercial expansion with the acquisition of the brands Sao Caffè, Bourbon and Suerte, and the company began to take an interest in the automatic distribution of Lavazza coffee. To this end the company acquired Unoper, a company that held the patent for the office machine that uses the new single-dose pods to prepare coffee and other beverages.

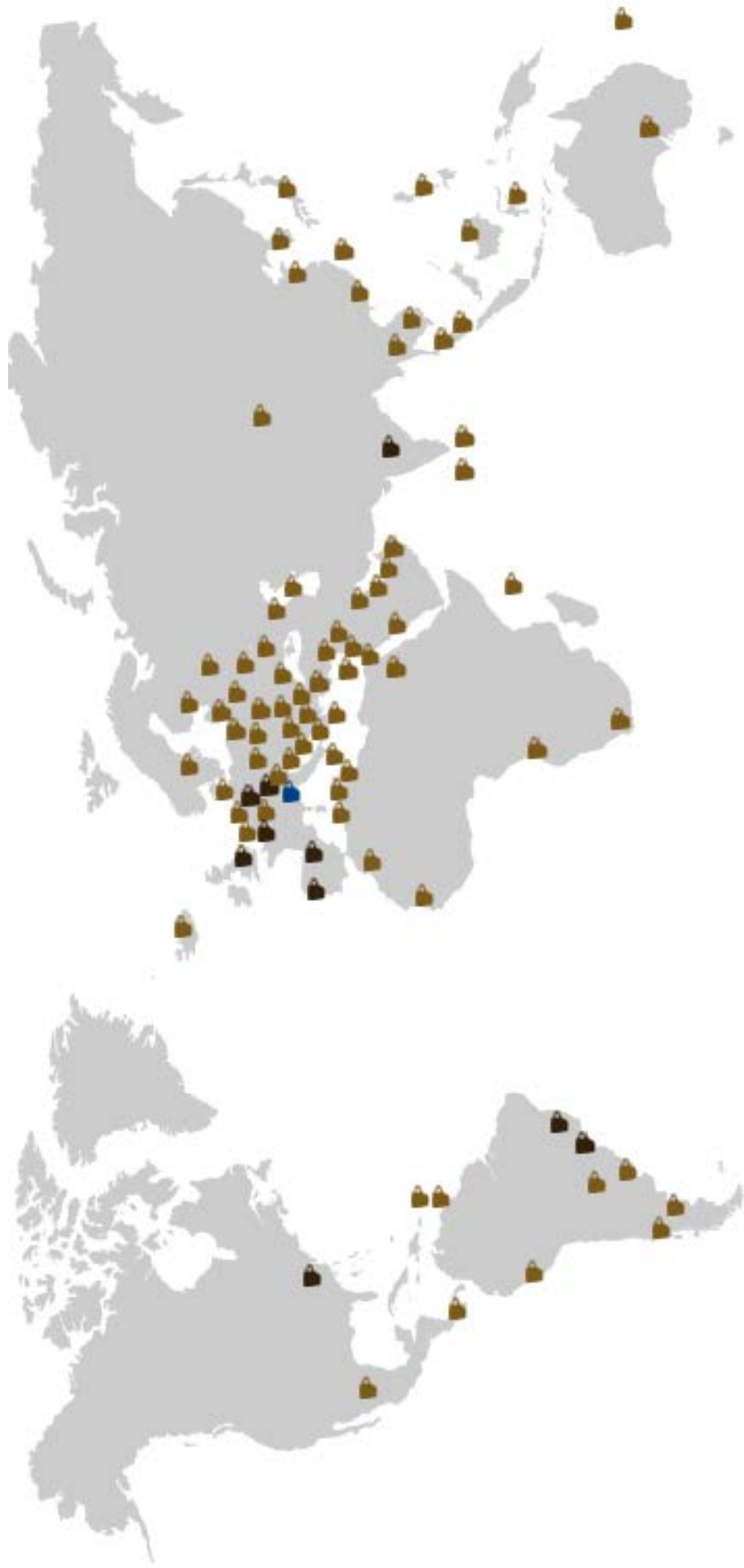
Lavazza then continued its expansion abroad by targeting emerging markets, landing in Brazil in 2005 with a local subsidiary and, in 2007 in India where it acquired Barista Coffee Company Limited and Fresh & Honest Café Limited.

The beginning of 2008 saw another step into Brazil, first with the acquisition of Café Grão Nobre and then with Café Terra Brasil.

In 2010 Lavazza acquired about 7% of the shares of Green Mountain Coffee Roasters (GMCR), the leading coffee pod company in North America. This operation made it possible to stipulate an agreement according to which GMCR and Lavazza would jointly develop new espresso coffee machines with single-portion pods, both produced by Lavazza. These machines would complement the consumer product line with filter coffee pod systems produced by Keurig®, one of GMCR's main divisions. In addition, GMCR would launch the distribution, marketing and sale in the United States and Canada of espresso coffee pods based on Lavazza technology for home use.

In the 2010's Lavazza reached over 90 countries around the world with its network of distributors as shown in Figure 1.

Figure 1 - Lavazza around the world in 2010 (source: www.lavazza.com)



Blu: Lavazza Headquarter
Brown: Lavazza Distributors
Black: Lavazza Subsidiaries

Lavazza business areas

One last important aspect that deserves exploration has to do with the choices of production specialisation based on the company's different business segments. The company has three core businesses, all of which are linked to the different ways coffee is consumed: the Home sector, the Outside the Home channel and the Retail sector.

In 2012, Retail coffee accounted for 50% of the company's turnover, and in Italy Lavazza was the absolute leader with a market share of around 48%.

The Outside the Home business operates through the Ho.Re.Ca. channel (hotels, restaurants and catering) and Automatic Distribution. With regard to the latter channel, from the end of the 2010s, there has been a global boom in coffee machines and pods sold to offices, schools, small communities, etc. In the 1990s Lavazza made a decisive contribution to the spread of new ways of consuming coffee with the launch and distribution of the capsule for the "Espresso Point" system, a pod system for the preparation of coffee outside the home. It was a simple system that brought together the quality of specially selected blends, the technical innovation of pods pre-portioned with the right amount of coffee, and the efficiency and reliability of a dedicated machine. Continuing along this innovative trajectory, in 2004 the company launched Lavazza B.L.U.E. (Best Lavazza Ultimate Espresso). It was a closed system developed by the company's technical management consisting of different types of machines designed for the various markets and by a single, self-protected single-serving pod that made it possible to always enjoy the pleasure of a quality espresso.

In 2012, the Ho.Re.Ca. channel accounted for 28% of turnover. Lavazza competes in this highly fragmented market distinguished by numerous small customers with different players of different sizes. These competitors include companies operating on a national level (like Illy, Segafredo, Kraft Food) and medium-small sized companies that have regional or multi-regional coverage (like Hausbrandt, Essse Caffè, Pellini, Mauro, Casa del Caffè Vergnano, Consorzio Grancaffè, Mokarabia), and with a very high number (about 600) of small local roasters that compete through cost leadership and the production of niche products (roasting and blend linked to local tastes).

Finally, in the Home market (22% of the turnover in 2012) Lavazza has built its leadership (in 2012, in Italy Lavazza controlled 46% of the market) on the variety of a range that is able to meet the needs of different types of consumption. While ensuring a uniform quality standard, Lavazza – especially in the Home sector – is very attentive to the differences found in the tastes of consumers in different countries and for this reason offers a wide range of products. Lavazza's presence in these three different businesses has, of course, an impact on the number of SKUs² that the company stores in its warehouses.

² SKUs: Stock Keeping Units, is a product identification code for an item, often displayed as a machine-readable bar code that helps track the item for inventory.

The coffee recipe

The concept of coffee blend was invented by Luigi Lavazza more than 100 years ago. Blends are secret recipes obtained by assembling different types of coffee in order to create a unique and recognizable aromatic profile. “Raw” coffee is imported from the main producing countries in South and Central America, Africa and Asia. In 2012, it was estimated that every year around 7 million tons of green coffee are produced and sold in the world, from which the roasted coffee is produced. There are two well-known species of coffee: *Coffea Arabica*, the more valuable kind that is grown in South America, in Central America and in some areas of Asia; and *Coffea Robusta*, more resistant, widespread in Africa, South America and Asia. There are five major coffee-exporting countries in the world and together they account for around 60% of global production each year. First is Brazil, supplying 26.6% of exports, followed by Vietnam with 12.8%, Colombia 10.4%, Indonesia 5.6% and Mexico 5%. They produce washed *Coffea Arabica* (36%), natural *Coffea Arabica* (25%) and natural *Coffea Robusta* (38%). Lavazza buys coffee from 25 producing countries, but about 45-50% of the raw material is imported from Brazil. With all the differences in variety and cultivation microclimate, the size of the bean and the degree of selection, in the end Lavazza purchases 50 different qualities of green product (2012) that differ from each other in terms of body, sweetness, fragrance and acidity.

When talking about the basic ingredient for the production of the various beverages the word “raw” has been improperly used. In reality, for each quality of roasted coffee placed on the market the percentage composition of the raw blend is not considered (designated according to the name Arabica and Robusta, according to the country of origin), but rather the aroma and flavour that distinguish the various types of coffee available to the public.

A certain type of finished product with a certain aroma and flavour can be obtained by combining different origins of green coffee in different percentages, and the company's laboratory has done extensive research to define a range of recipes (combinations of different origins) in able to always offer the same final product.

Based on the monthly production programme, an objective function is developed in which the variables are the possible recipes and the coefficients are the costs of raw coffee as quoted by the coffee bank.

The possible recipes are the different formulations that a certain type of coffee can have.

Being a product of the earth, coffee is not always the same at different times of year. This also affects flavour. The company must guarantee final consumers a standard taste. For this reason, the company's research lab has developed many recipes (identical in flavour and aroma) that make it possible to always arrive at the same final result by combining Brazilian, Indian and African coffees.

To overcome the obstacle of variability in coffee flavour and aroma, “n” recipes have been developed whose final result is always identical. When a particular recipe is not suitable, another type of recipe is tried. When defining and choosing the recipe, a linear programming model is used whose objective function is the search for the recipe that is least expensive at the same quality level.

The constraints for the model are the availability on the market of each origin, the production required (logically, as seen above, multiple recipes can be used to produce a single quality of roasted coffee) and the commodity price of coffee at the moment.

The model elaborates the quantities of the various blends to be produced, minimising the objective function (cost) and satisfying the constraints.

The process used is completely analogous to the one used by the petrochemical industry for the production of basic hydrocarbons starting from different types of crude.

Considering the costs of the raw materials and using the linear programming model, sensitivity analyses are performed on the solution obtained to optimise the final result with respect to possible variations of the starting hypothesis (slightly adjusting the production plan if the problem of lack of production is offset by savings on the raw material).

If the price of raw materials undergoes a significant change over the course of the month – usually due to political instability of the countries of origin – it may be appropriate to run the linear programming model again and revise the procurement plan.

Having established the quantities of raw material needed, the purchasing department will make sure that production is supplied in good time, taking into account the various possible delays that can arise when importing the beans through customs. As said, Lavazza invented the concept of “coffee blend”, that is the art of combining different types and geographical origins of coffee, that has led to the creation of hundreds of R&G (Roast & Ground) coffee products.

The production process

Coffee is the seed of a tropical plant belonging to the Rubiaceae family, which includes more than 500 genera and 6000 species, almost all tropical trees and shrubs. The plants are grown at an altitude between 400 and 2000 metres and at a temperature between 20° and 25°C.

Three or four years after planting, the plants produce a fruit called a drupe that reaches maturity when it becomes red and inside there are two seeds covered by a membrane: these are the coffee beans.

After harvesting, which is still done manually to choose only the fruit that is ripe, the pulp is removed from the berries using different procedures, and then the beans are dried and packed in bags.

The purchasing of the raw material is monitored by experts from the operations department who apply strict quality standards for each type of coffee and evaluate its characteristics before buying the batches needed for production. The lab works with purchasing to perform strict checks on the quality of the coffee, and then the quality continues to be monitored as the beans journey from the country of origin to the plant: weight, condition of the containers, humidity, stowage conditions must all be optimal. Today, optic selection processes and the cataloguing of coffee sources takes place directly in the coffee growing countries: each variety is marketed according to specific quality and price criteria. Lavazza experts choose

the coffee they will buy according to the standards applied to Lavazza blends. Raw coffee represents the most significant component of the product cost and therefore it is appropriate to focus a great deal of attention on its procurement in the most favourable market conditions. An analysis of the raw coffee market clearly shows that the price is affected by cyclical trends, with some spikes due to bad weather or political instability in the producing countries.

The Lavazza production cycle starts with the arrival of the green coffee in the plant and then continues with roasting and grinding. The packaging of coffee is then managed according to the final characteristics of the product (ground products in flexible packages or cans, ground products in pods, products in whole beans).

More specifically, the production process consists of the following steps:

- Storage of the raw material;
- Blending;
- Roasting;
- Grinding;
- Packaging.

Upon arrival at the factory, every stage of the process – handling, storage, portioning of the blends and roasting – is controlled by a centralised computer system.

Mixing, roasting and grinding are the core of the production process: these fundamental steps make a coffee unique, and these are the times when Lavazza experts intervene most frequently as they monitor the process. The creation of the coffee blends, fine tuned by the operations department, is controlled by Lavazza experts, the computer system and a panel of tasters who sample each blend in order to guarantee the same final result and flavour for each blend, every year.

Roasting and mixing are critical stages in the production cycle as they make it possible to produce a full, aromatic and balanced blend. In this phase the beans are treated with high quantities of hot air (temperatures above 220°C).

They release moisture, swell and increase in volume while losing weight, becoming more brittle and changing colour from green to brown due to the caramelisation of sugars.

The roasters are all convection machines that make the hot air roasting process more uniform and delicate, thus guaranteeing the proper level of roasting for each blend. A pilot roasting system carries out a short test cycle, roasting a small quantity of coffee before the full-scale production is launched.

The grinding process, which differs depending on the intended use of each blend (espresso, mocha or filter coffee), is also managed automatically by the computer systems and controlled by the operations department.

The ground coffee is then stored in climate-controlled silos to protect against oxidants (light, oxygen, heat and moisture), and is then quickly sent on to the packaging stage. The shapes of the packages and the materials used are essential to guarantee the optimal conservation of the blends, and the operations department is constantly developing more effective solutions.

After roasting, the coffee is packaged with appropriate procedures aimed at the conservation of volatile substances incorporated in the bean to avoid losing its aroma.



www.lavazza.com



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The final stage of the production process is of course extraction, when the product is transformed into a moment of pleasure to be savoured and shared. With the new espresso machines and courses for baristas offered by the Training Centre, Lavazza can now manage this phase as well, thus guaranteeing the quality of its espresso down to the last sip.

The Lavazza production plants

Around the end of the 2012, the Lavazza industrial system was split into five plants: three are based in Italy, and two abroad, in Brazil and India. The products of Italian plants are intended for the international market, while those of the foreign plants for their local markets. Regarding the Italian plants, the plant in Turin is dedicated to the roasting and packaging of roast and ground coffee. Gattinara produces capsules for the Lavazza Espresso Point, Lavazza BLUE and Lavazza A Modo Mio systems. Pozzilli produces all decaffeinated coffee products for home, café and office consumption.

Turin Plant: the first site

Roasting and packaging of roast and ground products (roast & ground). Turin is one of the world's largest, most modern coffee roasting and production plants. Every phase of the process is automated and controlled by a computer system. The warehouse can hold up to 11,200 pallets moved by a computerized system capable of selecting coffee lots to be shipped based on the production date. This guarantees optimal inventory management based on the first-in first-out principle: the oldest package in stock is the first one picked for shipping.



www.lavazza.com

Gattinara Plant: the home of automatic distribution

Production of capsules for the Lavazza espresso Point, Lavazza BLUE and Lavazza A Modo Mio systems. The company recently made a major investment to improve its production operations and modernise the plant's technology, also developing innovative systems for espresso preparation.



www.lavazza.com

Pozzilli Plant: dek for the world, from Italy

Established in 1991, the Pozzilli plant is exclusively dedicated to green coffee decaffeination. The Pozzilli plant carries out the innovative supercritical CO₂ process that has a natural, selective action on the beans, optimising their aroma and flavour. Under special conditions of pressure and temperature (the supercritical state, halfway between liquid and gas), carbon dioxide has an advanced ability to bind selectively to caffeine, extracting it without damaging the coffee's aromatic components. The method is all natural as it uses carbon dioxide, a compound present in the air we breathe and the sparkling water we drink.

Brazil: Tres Rios Plant

In 2008, Lavazza acquired Café Grão Nobre and Café Terra Brasil. Café Grão Nobre owns a roasting plant at Tres Rios, in the state of Rio de Janeiro, which serves the local Ho.Re.Ca. channel.

India: Fresh & Honest Plant in Sri City

In 2011 the cornerstone of the new Lavazza plant in India was laid. The new factory was located in the industrial zone of Sri City, in the Tada region of Andhra Pradesh on the border with Tamil Nadu, approximately 55 km from Chennai. The new industrial complex comprised of five buildings was built on a site of about 40,000 square metres and was equipped with state-of-the-art machinery and systems. The Indian plant in Sri City fulfils the needs of the local vending market and provides coffee for the domestic market.

The Lavazza logistics network in Italy until the 1990s

From the post-war period to the mid-nineties, Lavazza built numerous satellite warehouses throughout the country to better serve the market and strengthen its leadership. Many Italian regions had two or more warehouses. Indeed, the keys to the company's market leadership have always been product quality and the satisfaction of the final consumer. To satisfy its customers and, consequently, final consumers, the company built a network of warehouses located throughout the country and situated in logistically strategic locations near cities. As a matter of fact, in 1996 the Lavazza logistics network consisted in:

- 1 central warehouse;
- 19 satellite distribution warehouses;
- 40 vehicles for the supply of raw materials and first-level distribution;
- 90 second-level distribution vehicles.

Thanks to this network of satellite warehouses where finished product was stored, Lavazza was able to compress the lead time between the order and delivery of the goods.

In short, this logistics system was a powerful strategic advantage that made it possible to minimise stock-outs and quickly dispatch orders. In fact, until the mid-nineties the company prioritised speed over efficiency in its logistics and therefore it designed this network that was extremely widespread.

The logistics network redesign in the late 1990s – beginning of 2000s

In the mid-late 1990s, large-scale retail chains drove the distribution system towards a greater concentration of storage points due to the fact that the points of sale were served by large distribution centres where the suppliers' goods were stored. Because of the high volume of demand, these centres could be served directly from production plants, avoiding having to pass through the satellite warehouses.

In the late 1990s (particularly, 1997) there were two trends that pushed Lavazza's logistics management to opt for a radical renewal of the logistics network. Specifically, there was a reduction in delivery points (in 1990 the delivery points were 60,640, in 1997 28,247, a reduction of 115%) and an increase in the amount of coffee sold (in 1990 53,800 tonnes, in 1997 57,400 tonnes, an increase of 7%). These two trends led Lavazza to face a situation of inefficiency of the distribution system that had to be redesigned.

The guiding criterion for the redesign of the logistic was the customer, with all its commercial and requirements, and not necessarily the distribution optimization of the singular product. In other words, the main driver for the logistic redesign was the customer's need regardless of the mix of products it purchased, which, from a logistic state point, it could have been profoundly different (i.e., coffee packs, capsules, machines, etc.). Considering the number of items to be managed, the complexity of the mix and the multiple distribution channels to be served, the first decision faced by the company was related to the adoption of a "make" or "buy" approach for the logistic system, also considering the advantages deriving from the adoption of some collaborative practices (i.e. MultiDrop and Continuous Replenishment Programme).

The second decision concerned the definition of the responsibility for the management and control of logistical activities that lead, at that time, to the definition of the so called "Lavazza collaborative logistic network".

Linear programming model supporting the logistic network redesign process

In order to verify the effectiveness of the logistics network and to assess whether its configuration is suitable for serving customers, the Lavazza logistic department decides to develop a linear programming (LP) model. Particularly, the LP model may define where a new warehouse should be located and which customers should be served from each warehouse belonging to the logistic network. These scenarios may support Lavazza management in the decision-making process concerning the logistic network redesign. Although the logistic network redesign, as well as the logistics flows management, must take into consideration the company commercial priorities aimed at satisfying its customers, the LP model represents a useful exercise in order to make an analysis of the cost savings that would be achieved by changing from the logistic configuration to a different one.

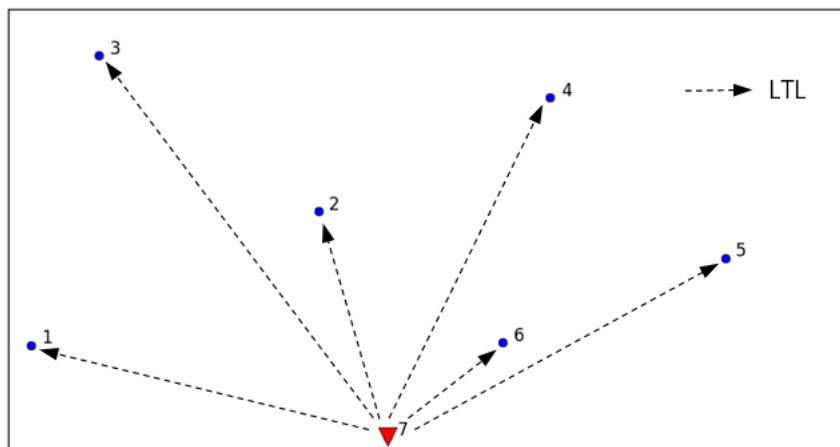
For this reason, the Lavazza logistic Director recruits a Team in charge to develop an LP model³. As a matter of fact, the logistic Director believes it could be possible to reduce the total transportation costs through a (partial) reorganisation of the network.

After several considerations, the Team decides to assess the possibility of activating a new satellite distribution warehouse that could serve a part of the customers, also keeping the current warehouse operational.

The Team assumes that the Lavazza production plant in Turin supplies a nearby distribution warehouse that serves six of its main customers consisting of distribution centres of major normal traders. The team assumes, also, that customers are served through LTL (less-than-truckload) deliveries made by a specialised logistics provider⁴.

The presence of a further warehouse in the area should allow a reduction in transport costs thanks to the possibility of reducing LTL shipping. In fact, it can be assumed that transport to the new warehouse could be done using FTL (full truckload) transport, cheaper than LTL transport by about 40%. With FTL transport, the customer requests a direct point-to-point transport with a dedicated vehicle, usually paying the supplier by kilometre regardless of the volume actually transported. A minimum fixed rate can be charged for short trips (omitted for the discussion of this case). A portion of the customers would be served by shorter (and therefore cheaper) LTL deliveries from the satellite warehouse instead of coming directly from the central warehouse (Figure 4).

Figure 4 - Location of the central warehouse (red triangle) and the main customers (blue dots)



The initial analyses run by the Team raised the possibility of placing the new warehouse near the customers. The Team, however, wants to analyse the cost savings that would be achieved by changing from a single centralised warehouse configuration (marked with the number 7 in Figure 4) to a configuration with two warehouses, one of them coinciding with the current warehouse and the other in a place to be determined.

Pretending you are part of the Team working in the Lavazza logistic department, you are required to develop and solve a LP model that will answer to these two questions: where

³ This part of the case reports an exercise of modelling a two-level distribution network, written in collaboration with Professor R. Pinto, Associate professor at the University of Bergamo (roberto.pinto@unibg.it).

⁴ In LTL transport, also called groupage, the supplier of the vehicle (logistics provider) manages its routes in order to collect multiple shipments from different customers. The customer pays the provider based on distance and quantity transported. This mode is used when the load to be transported does not fill the entire vehicle.

should a new warehouse be located and which customers should be served from each warehouse?

Available Data

Demand: first of all, the Team gathered the expected annual demand per customer, expressed in tonnes of product, that can be most likely represented as following.

Customer	Expected annual demand (tonnes)
1	1,500
2	2,300
3	3,000
4	5,500
5	3,000
6	2,300
Total expected annual demand	17,600

LTL transport costs: average LTL transport costs are available for all source-destination combinations. The Team estimated these costs based on past shipments and with the support of the logistics provider. The logistics provider also estimated that these costs, multiplied by a factor of 0.6, can represent the FTL transport cost between warehouses. Therefore, if, for example, a new warehouse will be opened in location 6, the transport cost per tonne from the central warehouse to the new warehouse would be $215 \times 0.6 = \text{€}129/\text{tonne}$.

LTL transport costs for all possible origin-destination combinations were obtained by multiplying the unit kilometre cost by the distance. Transport from warehouses to customers was always considered as LTL.

	Cost per unit of product (€/tonne)						
	1	2	3	4	5	6	7
1	0	362	594	663	601	391	349
2	362	0	367	301	350	307	463
3	594	367	0	383	663	674	814
4	663	301	383	0	357	500	705
5	601	350	663	357	0	251	460
6	391	307	674	500	251	0	215
7 (central warehouse)	349	463	814	705	460	215	0

Warehouse handling costs: the Team estimated the average unit cost (€/tonne) for warehouse handling. This cost is slightly variable depending on the location. For the sake of simplicity, the Team assumed that the unit handling cost within the warehouses was independent of the quantity managed in the warehouse itself.⁵

⁵ Quite strong assumption is done to keep the model simple.

Average warehouse handling unit costs:

Location	Unit handling cost (€/tonne)
1	20
2	15
3	15
4	20
5	22
6	20
7 (central warehouse)	18

Fixed start-up costs: for the sake of simplicity, the Team assumed that the cost of starting up the new warehouse was the same for all locations. Therefore, the team didn't consider this cost item in the model⁶. In any case, from the results of the model the Logistic department would be able to infer some considerations about the start-up cost.

⁶ This hypothesis also reflects a situation in which it is not possible to have reliable cost estimates for setting up a new warehouse.